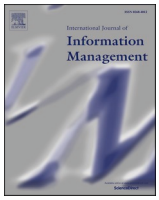
International Journal of Information Management 69 (2023) 102597

Contents lists available at ScienceDirect

International Journal of Information Management

journal homepage: www.elsevier.com/locate/ijinfomgt



A conceptual model of feedback mechanisms in adjusted affordances – Insights from usage of a mental mobile health application

Christian Meske [a,*], Ireti Amojo [b], Devinder Thapa [c,d]

[a] Institute of Work Science, Faculties of Mechanical Engineering and Computer Science, Ruhr-Universität Bochum, Universitätsstr. 150, 44801 Bochum, Germany
[b] Department of Information Systems, Freie Universität Berlin, Garystr. 21, 14195 Berlin, Germany
[c] Department of Business, Marketing and Law, University of South-Eastern Norway, Bredalsveien 14, 3511 Honefoss, Norway
[d] Department of Information Systems, University of Agder, Universitetsveien 25, 4630 Kristiansand, Norway

ARTICLE INFO

Keywords:
Affordances
Perception
Actualization
Feedback Mechanisms
Mental Models

ABSTRACT

Affordance theory provides one of the most prominent lenses through which the socio-technical aspects of a system's use can be investigated and understood. In this context, the literature has proposed that perceived and actualized affordances may be adjusted over time. Yet, how the adjustment of affordances occurs has not been explained in detail. Thus, in this article, we develop a conceptual model of feedback mechanisms that includes a more explicit description of how affordances are perceived by users, whether actualized and adjusted. With the model, we introduce the central concept of a *generative base*, out of which affordance perceptions emerge and which can be updated through affordance actualizations. With this base, we integrate mental model (MM) theory to explain better the differing perceptions before and after actor–artifact interactions. Our conceptual model is illustrated and specified using an empirical case of the mental mobile health (mHealth) app "Between The Lines" in Germany. In this study, we conducted 40 interviews in two rounds with 20 teenage app users. Our results show that the users' perceptions of mHealth affordances become adjusted and hence change over time due to experiencing the actualization process, which may lead to an update of the generative base, including the user's MM.

1. Introduction

Affordances represent an established theoretical lens through which the social and technical aspects of artifact use can be assessed (e.g., Thapa & Sein, 2017; Mettler & Wulf, 2019; Faik et al., 2020; Sun et al., 2020; Fu et al., 2020; Osmundsen et al., 2022; Xu et al., 2022). Affordances provide human users opportunities for action, which can emerge from the relationship among goal-oriented actors, material aspects of a technology, and situations (Abhari et al., 2022; Meske & Amojo, 2020; Osmundsen et al., 2022). In research, technology artifacts are understood as objects in the environment that have some material presence (e.g., features) and that incorporate social elements or contexts of, e.g., feature use (Faraj & Azad, 2012).

However, the affordance concept also specifies that technology affordances must be perceived before users can actualize them (i.e., make use of technology affordances), and they will remain mere possibilities for action, independent of users' perceptions (Du et al., 2019; Osmundsen et al., 2022). Research has likewise emphasized that affordances can be misperceived (cf. Shaw et al., 1982), which in turn has a moderating effect on the actualization of affordances (Bernhard et al., 2013). Scholars argue that affordance perceptions may require some form of internal processing (i.e., cognition) to make sense of technology materiality and what it affords users in specific situations (Greeno, 1994; Sun et al., 2021). Furthermore, such perceptions of affordances may vary dynamically over time, leading to actualization adjustments (e.g., Leidner et al., 2018). Understanding how perceptions of affordances are generated is hence a prerequisite for understanding adjusted affordances and thus whether and how users apply technology over time, as we argue.

In this regard, much of the existing literature investigates affordances from a rather static perspective. This important work has addressed the ontological and epistemological groundwork for research on technological affordances, but it does not account for changes in perception and actualization. Only a few articles have incorporated a dynamic perspective, focusing on how affordance actualization leads to recursive processes of adjusted action (e.g., Dremel et al., 2018). Yet, while the latter work is highly relevant and provides first concepts to explain the emergence of *adjusted affordances*, the explanations remain on an

* Corresponding author.
E-mail addresses: christian.meske@rub.de (C. Meske), ireti.amojo@fu-berlin.de (I. Amojo), devinder.thapa@usn.no (D. Thapa).

https://doi.org/10.1016/j.ijinfomgt.2022.102597
Received 24 February 2022; Received in revised form 8 November 2022; Accepted 15 November 2022
Available online 20 November 2022

abstract level. For instance, it is stated that affordances are perceived and adjusted when users and artifacts are set into a relation within a specific context (Tim et al., 2017). It remains unclear how the characteristics of an individual, as part of the user–artifact relation, might influence corresponding perceptions and adjustments. More specifically, the relevance of a user's understanding of the world and thus, for example, of what 'things' can be used for has not been discussed.

In summary, the existing literature provides us with a rather abstract understanding of the interplay between actors and artifacts that leads to the perception and actualization of affordances, while details on this (recursive) interplay and the role of a user's understanding of their surroundings are rarely discussed. Against this backdrop, our research article addresses the following research question: How can the emergence of affordance perceptions, actualizations, and outcomes be made more explicit to extend the current understanding of adjusted technological affordances?

To address this gap, in our article, we develop a conceptual model of feedback mechanisms in adjusted affordances. To do so, we conduct a literature review that, according to Leidner (2018), could be classified as a specific theorizing review, by completing "(…) a separate analysis of the reviewed literature with a specific focus on extracting insights relevant to filling the gap" (p. 556) and "(…) introducing new or previously unconnected constructs" (p. 561). Within the model, we discuss the role of mental models (MMs), which may influence perceptions of the uses of artifacts and which can be updated based on the experience of actualization, leading to adjusted affordances.

Our introduced model is illustrated by an empirical case in the mobile mental health care context. Mobile health (mHealth) applications provide a simple and remote addition to established health care services, as they are less costly and time-intensive than existing health care services (Liu et al., 2019; Nisar et al., 2019; Samhan, 2017; Zhao et al., 2018). The recent COVID-19 pandemic severely impacted the need for mental mHealth services, especially among younger age groups. For instance, international organizations, such as the Organization for Economic Co-operation and Development (OECD), recently published reports about the significant increases in mental illnesses among young adults between the ages of 15 and 24 (Scarpetta et al., 2021). Based on these developments, additional research is necessary to understand better the perceptions of mobile applications for such sensitive purposes as mental health. At the same time, designing IT artifacts for such a domain is difficult, since heterogenous user backgrounds and understandings of the world need to be considered, while today's world itself changes more and more rapidly, which again is partially a result of users interacting with new IT artifacts. Hence, so we argue, it is important to understand how affordances of an artifact may differ after actualization in a specific context, not only to help actors to perceive available and changing action potentials but also to provide a user experience that aligns with their expectations. Furthermore, this perspective allows practitioners to address the complexity of permanent (e.g., self-efficacy, previous experience) and temporary (e.g., goals) components, which are required for the emergence and adjustment of affordances. In this context, we investigate the perceptions and use of "Between the Lines" (BTL), an app that educates teenagers about mental health and helps build their self-help capacities. More specifically, we analyze the material properties of BTL and the changing perception as well as actualization of possibilities for action it affords teenage users. To do so, we conducted 40 interviews in two rounds with 20 teenage app users in Germany between the ages 12 and 20 years.

Our contributions are twofold. First, we contribute to the unboxing of feedback mechanisms in (adjusted) affordance research. This also helps practitioners to design technology that better accounts for differing and flexible user MMs, as well as the overriding feedback mechanism. This is necessary, as the increasingly complex world in which we live, including extraordinary events and times, such as the current pandemic, may lead to increasingly dynamic actor–artifact interactions in thus far less-explored contexts. Designers can therefore minimize the chances of situations in which users cannot make sense of or use an available technology. Second, by making the actual feedback mechanisms more explicit and explaining how they lead to changes in the actualization process in the BTL case, we contribute to a better understanding and design of actor–artifact relations in the context of mental mHealth applications.

The paper is structured as follows. In the next chapter, a detailed review of the status quo on affordance research and relevant models is presented. The focus is on affordance perceptions, actualizations, and feedback loops to highlight the research gap. Thereafter, our conceptual model of the feedback mechanisms in adjusted affordances is derived to address the existing research gaps. The following chapters then present the empirical BTL context and method used to illustrate the model, as well as the results. The article continues with a detailed discussion of the results before the conclusion is presented in the last chapter.

2. Theoretical background and related concepts

For our literature search, we used SCOPUS as the main data base and the term "affordance* " in combination with either "perception", "actualization", "adjust* ", "feedback" or "recursive". We then selected most prevalent models from IS literature that were mainly focused on perception, actualization and adjusted affordances (feedback). With the results, we show that there is a lack of more detailed information regarding how the adjustment of affordances in actor-artifact relations occurs. Consequently, to fill this gap, in Section 3, we establish a more nuanced conceptual model of feedback mechanisms in adjusted affordances.

2.1. Affordance theory

The term '*affordances*' was introduced by ecological psychologist James J. Gibson (1979) in his study of animals' perceptions of their surroundings. In more detail, he assumed that animals directly perceive what their environment will enable them to do: "The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill." (Gibson, 1979, p. 127). Transferred to the *actor-artifact relation*, affordance theory suggests that the *artifact*, from Latin *arte* (by or using art, or skill) and *factum* (something made), in relation to the human (the *actor*) holds affordances, that is, what is offered, provided, or furnished to someone by an object (Leidner et al., 2018; Strong et al., 2014). Affordances can therefore be summarized as "possibilities for *goal*-oriented action afforded to specified user groups by technical objects" (Markus & Silver, 2008, p. 622), while *goals* in that context refer to what the user wants to do, for example to complete a certain task. In an actor-artifact relation, humans need to *perceive* the affordance in order to actualize them (Tim et al., 2017). *Perception* can be described as the users' awareness and means of executing an action in a certain environment (Bernhard et al., 2013; Pozzi et al., 2014). If the user executes the corresponding action, the perceived affordance has been *actualized* (Leidner et al., 2018).

Technological affordances can hence be understood as opportunities for action in the relation between a goal-directed actor and an information technology (IT) artifact (Abhari et al., 2022; Leidner et al., 2018; Strong et al., 2014). Thus, affordances are not viewed as properties of the actor or IT artifact alone, but as possible actions that arise in a unique actor–artifact relation (Chemero, 2003; Majchrzak & Markus, 2014; Osmundsen et al., 2022). In more detail, the affordance perspective enables researchers to study how technology and social beings interact. Accordingly, researchers have applied the affordance lens to investigate, for example, IT design (e.g., Maier & Fadel, 2009; Bardram & Houben, 2018; Benbunan-Fich, 2019; Osmundsen et al., 2022); IT implementation, adoption, and diffusion (e.g., Du et al., 2019; Porter & van den Hooff, 2020); IT-related organizational change (e.g., Strong et al., 2014; Tim et al., 2020); consumer behavior (Huotari & Hamari, 2017; Sun et al., 2019); and interaction and knowledge sharing via

social media (Karahanna et al., 2018; Mansour et al., 2020; Pandey et al., 2021; Sun & Zhou, 2019).

The most common view of potential technological affordances (Lanamäki et al., 2015; Osmundsen et al., 2022) sees affordance perception as the process through which human individuals interpret and recognize the action possibilities offered to them in relation to and by an IT artifact. More specifically, affordances must be perceived first to be actualized (Bernhard et al., 2013). In this context, perception is understood as emerging in relation to the actor, as well as the artifact, thus relying on the features or properties of the artifact and the capabilities and goals of the actor (Osmundsen et al., 2022; Pozzi et al., 2014). However, while most of the affordance literature relies on this assumption, the emergence of affordance perception has not been sufficiently investigated thus far.

In the following, we further elaborate on this knowledge gap. For this purpose, we present existing non-recursive, as well as recursive theoretical models of affordance perception and actualization. In Section 3, we integrate the existing knowledge and add to it, resulting in our proposed conceptual model of feedback mechanisms in adjusted affordances.

2.2. Non-recursive models of affordance perception

In the research, perception itself is rarely discussed in much detail and is only mentioned as a condition for users to actualize an artifact in pursuit of a goal (Bernhard et al., 2013; Effah et al., 2021). Bernhard et al. (2013) understood affordance perception as users' awareness and means of executing an action, which can be influenced by signals (i.e., information about affordances) from the artifact itself or by external signals. They establish that perception illuminates the artifact's properties, while user capabilities, goals, and the existence of affordances only emerge from the relationship between the two (Bernhard et al., 2013). This constitutes a perspective of perceived affordances as a subset of existing affordances (Bernhard et al., 2013), which is based on the idea that users can miss existing affordances if there is no information (hidden affordances) or can misinterpret given information (false affordance; Gaver, 1991). Altogether, the distinguishment of perception from affordance actualization marks an important contribution to the affordance research. While scientists suggest actor capacity and understanding affordances may require a degree of effort, they do not specify the elements involved in perception.

Against this backdrop, Pozzi et al. (2014) contribute to affordance perceptions by delineating cognition, recognition, and behavior in temporal-causal relationships among object, actors, and relational affordances. Based on Greeno (1994), who argues, "Perception of symbols is a process of recognition, rather than a process of direct perception" (p. 341), the authors further specify that affordance existence (relationships between material properties of an artifact and goal-oriented actors) is a process of cognition, and affordance perception is a process of recognizing existing affordances (Pozzi et al., 2014). Table 1 summarizes the mentioned authors and developed frameworks and highlights key contributions to the theoretical discussions on affordance perceptions.

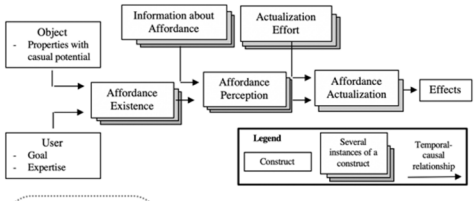
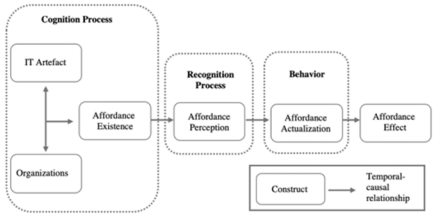
Pozzi et al. (2014), based on Greeno (1994), contribute a delineated perspective of perception as a process of recognition, cognition, and affordance perception. Namely, the current understanding of affordance perception in technological contexts does not explain the emergence of the perception of digital objects, including necessary 'ingredients' in situations where information is not directly perceivable. The question remains as to what constitutes the perception of digital objects in research contexts. More specifically, the affordance definition describes that user perceptions may be influenced by knowledge derived from prior experiences (McGrenere & Ho, 2000). Further, as pointed out by Markus and Silver (2008), any affordance must be perceived by goal-oriented actors before it can be actualized, which requires users' capabilities to perceive (correctly) action potentials (cf. Parchoma, 2014).

However, while capabilities (cf. Chemero, 2003) or goals (Abhari et al., 2022) are explored in affordance contexts, until now, the role of prior experience and other information in users' perceptions of what an artifact affords them has not yet been conceptualized. Without a better understanding of what influences the perception of affordances, it remains difficult to investigate how this perception may be adjusted over time. This may be why few papers have focused on adjusted affordances thus far, as will be demonstrated in the following section.

2.3. Feedback in models of affordance perception and actualization

Affordance actualizations are defined as actions taken based on multiple technology affordances in pursuit of immediate concrete outcomes (Strong et al., 2014). The scholars Strong et al. (2014) discuss various levels of affordances and contribute to the conceptual understanding of actualizations and outcomes of affordances at the organizational level. More specifically, they show how individual actualization processes combined can lead to organizational-level outcomes (Strong et al., 2014). Thus, Strong et al. (2014) first contribute to scholarly discussions on the diverse levels of affordances by presenting empirical evidence from their case study. Namely, that individual-level affordances from different employees at a company (i.e., health practitioners) accumulate to become actualizations at the organizational level, in line with organizational goals (Strong et al., 2014). Further, the authors acknowledge the temporal sequences of actualization processes, but do

Table 1
Non-recursive Models of Affordance Perception and Actualization.

Authors	Models	Key Contributions
Bernhard et al. (2013)		Affordance Perception (research-in-progress): • affordance perception constitutes object properties, user goals, and capabilities, as well as affordance existence (i.e., the relationship between both) • perception is influenced by signals from the object itself or external signals • perception determines affordance actualization
Pozzi et al. (2014)		Affordance Perception: • affordance existence describes a cognitive process as a relational interaction between IT artifacts and organizations • recognition processes describe affordances that are perceived or recognized by the organization • Actualizations are behaviors organizations enact based on perceived opportunities for action, which produce effects

not reveal in much detail how immediate concrete outcomes give feedback for adjusted actions related to the actualized affordances.

Bygstad et al. (2016) use affordances as an analytical construct and argue that a better understanding of affordance actualization processes can be derived from a close assessment of techno-organizational contexts, giving rise to enabling or restricting conditions for affordances. The authors argue that in all their complexity, socio-technical relationships will always entail a variety of affordances "at any level of granularity, from a new instance of a data element or a completed transaction to a new artifact" (Bygstad et al., 2016, p. 5). In their assessment of the levels of granularity involved in affordance actualization processes, they identify higher-level mechanisms at the structural level of the organization as stimulating or releasing conditions of lower-level mechanisms, which in turn provide an interesting contribution to the discussion of recursive enactments of social structures (Orlikowski, 2000). However, Bygstad et al. (2016) do not specify further on actualization processes.

Building on Strong et al. (2014), Tim et al. (2017) similarly focus their attention on affordance actualization processes, specifically by addressing user action, intended and unintended consequences, and adjusted actions (outcomes). In their assessment of a community-driven social media-enabled environmental sustainability movement, the authors identify three affordances (i.e., information democratization, network-informed associating, and emergent organizing) that the community perceived and used in pursuit of their self-organization goals. However, they also identify unintended consequences, that is, information cluttering, exclusion, and disorganization, as a result of the affordances, and they discuss how unintended consequences lead to action adjustments, which lead to new outcomes (Tim et al., 2017). More specifically, the authors propose that unintended consequences function as feedback effects that influence (adjust) the actions of actors (i.e., delivery of better-quality information, setting up offline movements, cultivating strong awareness). This finding provides an interesting contribution to IS discourses on the process of affordance actualization, and it especially provides new insight into the forms of feedback that result from affordance actualizations. However, a few gaps remain. Bygstad et al. (2016) identify unintended consequences from the perspective of the grassroots movement, but they do not explain further how or where feedback translates into collectively adjusted action or how members know to counteract unintended consequences. Further, it is not mentioned whether the unintended consequences and adjusted actions lead to new affordances at any level of granularity (Bygstad et al., 2016).

Dremel et al. (2018) focus their research on big data analytics in socio-technical systems. They identify four affordance actualization mechanisms (enhancing, constructing, coordinating, and integrating) on three distinct levels (structure, actor, and technology). They further present their research model as an extension of Strong et al. (2014) and Tim et al. (2017) by introducing a multidimensional and more dynamic perspective of how specific action adjustments lead to new realizations (perception) and consequent actualizations. This is done by complementing affordance theory and socio-technical-systems (STS) theory, which, according to the authors, allow a more detailed assessment of exactly which "modifications of the STS affect the realization of affordances" (Dremel et al., 2018, p. 3). Based on STS theory, the authors distinguish between social system entities (e.g., actor capabilities, organizational structures) and technical system entities (e.g., tasks for the delivery of work processes, technological platforms), which recursively influence each other in socio-technical relationships (Dremel et al., 2018). In their case study, it is described how action adjustments entail incremental changes to at least one of the social or technical system entities (Dremel et al., 2018). For instance, the use of big data analytics technologies enables incremental learning and capability improvements at the employee level to enhance the development of structural entities at the organizational level (Dremel et al., 2018). Accordingly, Dremel et al. (2018) make an important contribution to the understanding of actualization processes, explaining further the interdependencies between individual and collective or organizational affordances by introducing an STS perspective. Their approach focuses on recursive enactments between socio-technical entities; however, questions remain regarding the influence that recursive enactments of affordances can have at the individual actor level during sustained technology use.

In the following, Table 2 summarizes the mentioned authors and developed models and highlights key contributions to the theoretical discussions of affordance actualizations and outcomes.

The affordance actualization research has acknowledged the existence of a sort of affordance sequence in the form of unintended consequences from actualizations during continued artifact use (Tim et al., 2017). Moreover, Dremel et al. (2018) provide empirical evidence and a nuanced explanation of affordance actualizations at the individual level, leading to adjustments at the organizational level. At the same time, Dremel et al. (2018) mention affordance perception as part of the process of adjusted affordance actualizations, without providing a more detailed explanation.

The models in Table 2 all have in common that they present affordance actualizations and feedback as some form of dynamic process. While feedback concerning affordance actualizations can also influence future perceptions during continued artifact use, to this day, there is no nuanced understanding of how feedback from affordance actualizations influences adjusted perceptions.

3. Proposing a conceptual model

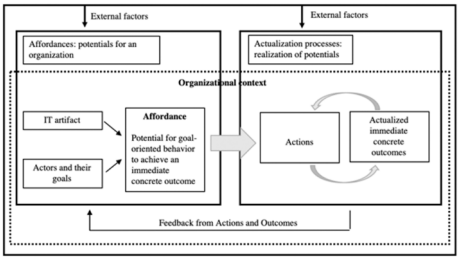
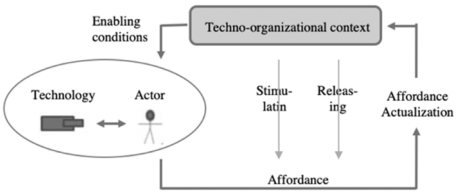
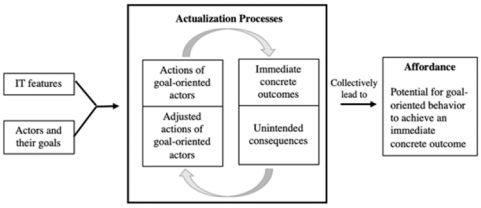
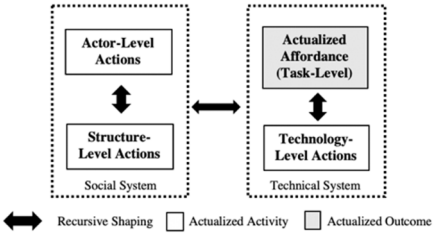
In this section, grounded in the existing literature on technological affordances, a conceptual model of feedback mechanisms in adjusted affordances is derived. Piece by piece, we first establish the *generative base*, focusing on the users and what they bring to actor–artifact relations. Second, we outline the feedback mechanism from the generative base overriding the perceived as well as actualized affordances and experienced outcome, which eventually updates the generative base.

3.1. Generative base for the perception of affordances

Traditionally, affordances are potentials for action in specific contexts that emerge from user–artifact interactions (Volkoff & Strong, 2013). Affordances emerge from the triadic relationship of user–artifact interaction in specific contexts, forming a generative base and requiring certain in-situ conditions to enable the emergence of affordances. The generative base, as we argue, consists of the permanent knowledge components (previous experience with similar artifacts, information from others, capabilities) and temporary components of a situation where the user is confronted with an artifact (goals for artifact use, specific contexts of use, the artifact characteristics). The combination of permanent and temporary knowledge components forms what we call the in-situ *user–artifact relation*.

User characteristics are only partially addressed in existing affordance discourses. For instance, Markus and Silver (2008) and Adhari et al. (2022) point out that affordances are possibilities for goal-oriented action. While goals have received scientific scrutiny in the past and depend on, e.g., the tasks a user wishes to complete, scholars also point to the capabilities required to perceive an artifact's action potential (Parchoma, 2014). Knowledge is the basis of capabilities, especially concerning digital objects, where capabilities refer to a user's mental and physical "capacity for activity" to engage with a digital object (Bernhard et al., 2013, p. 5). However, this article argues that users need not only the mental and physical capacity for an activity, but also a sense of self-efficacy to actualize perceived potentials. More specifically, self-efficacy constitutes the combination of mental, physical, and behavioral skills into an "integrated course of action" and describes users' judgements of how well they can carry out perceived action potentials (Bandura, 1982, p. 122).

Table 2
Feedback in Models of Affordance Perception and Actualization.

Authors	Models	Key Contributions
Strong et al. (2014)		Affordance Effect: • actualizations are goal-oriented and iterative processes in support of organizational goals • affordances are actualized using technology • actualizations lead to (immediate concrete) outcomes, which provide feedback to adjust action • individual actualizations can contribute to organizational actualizations (goals) and outcomes
Bygstad et al. (2016)		Affordance Actualization (generative mechanisms): • techno-org. contexts (i.e., structures) consist of networks of human, social, and technical objects • structure enables action, action reproduces structure • the results of action communicate back to the structures as (immediate concrete) outcomes • outcomes entail any level of granularity (e.g., new instances of data/completed transactions, new structures, new artifacts)
Tim et al. (2017)		Affordance Actualization (adjusted actions): • model adapted fromStrong et al. (2014) • focuses on actualization processes and collective outcomes • outcomes also entail unintended affordances, which contribute feedback effects (i.e., adjusted actions) • adjustments further influence the actions of actors
Dremel et al. (2018)		Affordance Actualization (recursive enactment): • affordances are action potentials at the (STS) task level • affordance actualizations entail the recursive enactment of socio-technical entities (actors, structures, tasks technologies) • recursive enactment describes organizational modifications at the structure-, actor-, and technology levels • All three levels of actions can lead to affordance actualizations at the task level

Because self-efficacy and goals have already been identified in the affordance research as user-related characteristics, despite insufficiently explaining the initial or adjusted perceptions of such, in the following, we hence rather focus on a new aspect that we introduce to fill this gap: MMs. The current affordance perception discourses are focused on providing explanations for how users will perceive the functionalities of an artifact if user–artifact interactions occur in a situation where familiarity with the context and goal orientation exist (in-situ *components*, as we name them). Until today, research has generally accepted this explanation without providing a more nuanced understanding of other factors influencing affordance perception, especially whether the artifact functionalities of digital objects are directly perceivable. Given the complexity of user backgrounds and digital object design, this article suggests the introduction of MMs as a central aspect of a more nuanced understanding of perception in affordance contexts.

In research, MMs constitute the (internal) representations of relationships, objects as well as systems, and can be used to better understand how humans perceive systems in their environment (García García et al., 2021; Yang & Park, 2019). Here, IT artifacts are the representations of reality for which MMs are used to explore, process, and understand artifacts (Yang & Park, 2019; Yang et al., 2003). Accordingly, the better the system matches user expectations, "the more easily and quickly user learning takes place" (Gerlach & Kuo, 1991, p. 531). These processes are well explained in a study by Ltifi et al. (2019), who show that knowledge representations in systems must be contextualized in users own MMs based on their experience first, before knowledge representations can be used to make sense of the system. This is also explained by Klein and Herskovitz (2007), who argue that systems or MMs of users must be revised or adjusted when users' MMs cannot validate the systems. Moreover, systems can support the maintenance of existing MMs or challenge assumptions and support the development of new MMs (Vandenbosch & Higgins, 1996), which can also improve the accuracy of MMs with increasing use experience (Yang & Park, 2019).

Davern et al. (2012) explain that representation can be internal (mental) or external (how information is presented to the user of an information system). García García et al. (2021) present the interconnectedness between internal and external representations in their study on the influence of individuals' cognitive bias on the MMs of how systems work. The authors show that external representations, such as, e.g., animations in the UI about a specific system, can bias user perceptions of system functionalities, which, if they contradict previously held (internal) MMs of how the systems works, may negatively impact user perceptions of system performance.

Based on the existing literature, MMs, as we argue, comprise tested and untested assumptions about how the world and existing artifacts 'work' (e.g., based on education, training, or experience), including tested/untested assumptions about how to interact with the artifact to achieve a certain outcome. These tested/untested assumptions are built through the user's own perceptions or their experiences interacting with the artifact, but they can also be based on information/instructions from others. Through testing initial MMs, they are verified (reinforced) or falsified (corrected/adjusted).

The following Fig. 1 shows the generative base, and specifies it by focusing on the analytical unit 'user' with his/her goals, mental models and self-efficacy. In sum, it displays the ontological connection between artifact, user and context, which represents the in-situ conditions of an

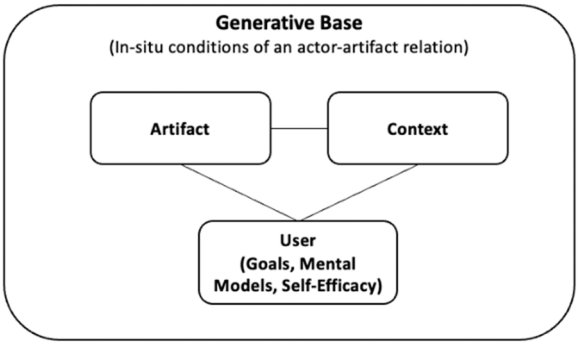


Fig. 1. Mental Models for a Nuanced Understanding of Affordance Perception.

actor-artifact relation.

3.2. Feedback mechanisms in adjusted affordances

In Section 3.1, we specified the generative base, which consists of the user–artifact–context triad and out of which the perception of affordances emerges. Now, we focus on the general processes of perception and actualization.

For this purpose, the introduced MMs to help us address how feedback from affordance actualizations influence adjusted perceptions and future actualizations during continued artifact use. Namely, users learn and change their MMs based on feedback from the outcome of affordances, which can lead to updates of the generative base and corresponding new or adjusted affordance perceptions and actualizations during continued artifact use. MMs are formed based on external information and instructions, as well as on personal past experiences or learning from artifact interaction. External information about how a system works can positively or negatively influence user perceptions and (internal) MMs about the artifact's action potential (García García et al., 2021). Therefore, it is important that user MMs are in alignment with how a system works to enable the learning and updating of MMs during continued system use (Kayande et al., 2009). At the same time, initial MMs of a given system can be revised or adjusted if users cannot validate the system and provide use potentials (Klein & Herskovitz, 2007). An improvement in MMs, e.g., through feedback from continued system use, can support and improve users' generative base (e.g., self-efficacy in Klein & Meininger, 2004), which consequently also leads to adjusted affordances.

Depending on their goal orientation, users actualize perceived or expected artifact action potentials that lead to affordance outcomes (Parchoma, 2014). Based on the experienced affordance actualization and outcomes, the generative base can be updated (i.e., goals, MMs, self-efficacy). The update of the generative base describes the feedback mechanisms central to any continued affordance perception, actualization, and outcome cycle (see e.g., Strong et al., 2014; Tim et al., 2017).

The following, conceptual model in Fig. 2 further stipulates that users may want to use the artifact again at some point in time after the first user–artifact interaction cycle. Based on the update of the generative base during the first user–artifact interaction cycle, the initial perception or expectation of action potentials is reinforced (extended) or adjusted (corrected) (e.g., Tim et al., 2017). Accordingly, the user actualizes perceived or expected action potentials, which are new or the same as before (Strong et al., 2014; Tim et al., 2017). In Fig. 2, it is also argued that depending on future affordance perceptions, actualizations, and outcome cycles, the generative bases continue to be updated.

In the following, a case study is used to address both research aspects under scrutiny in this article: affordance perceptions and adjustments based on feedback mechanisms. The case is used to learn how goals, self-efficacy, and MMs influence affordance perceptions. Furthermore, the case explicates how feedback from affordance actualizations can influence adjusted perceptions. From the results, we derive a more detailed version of our conceptual model (Fig. 5 in Section 5.3).

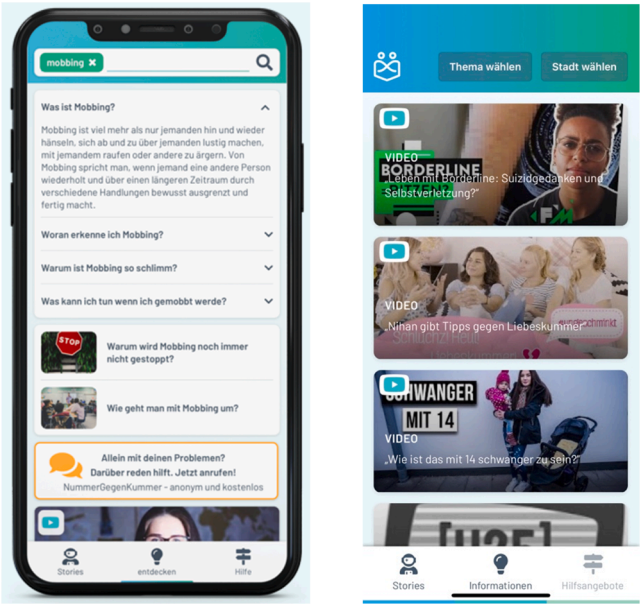


Fig. 3. The BTL App Interface, Provided Information, and Navigation.

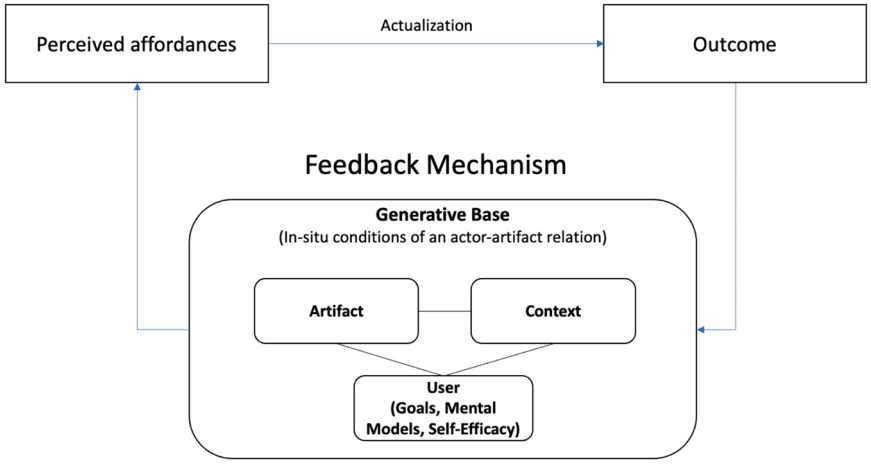


Fig. 2. (General) Conceptual Model of Feedback Mechanisms in Adjusted Affordances.

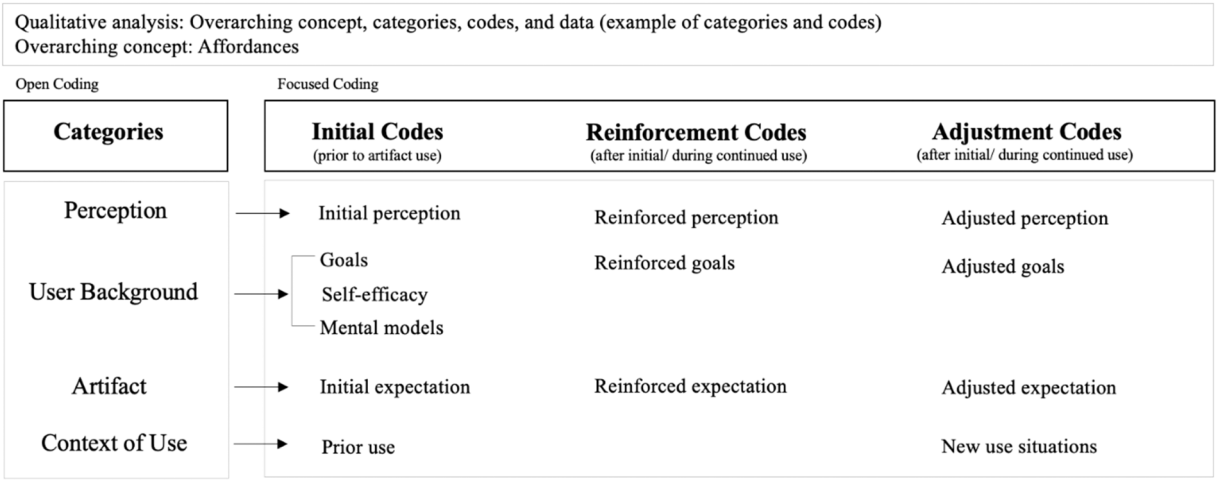


Fig. 4. Affordance Concept-Based Open Coding and Focused Coding Cycles.

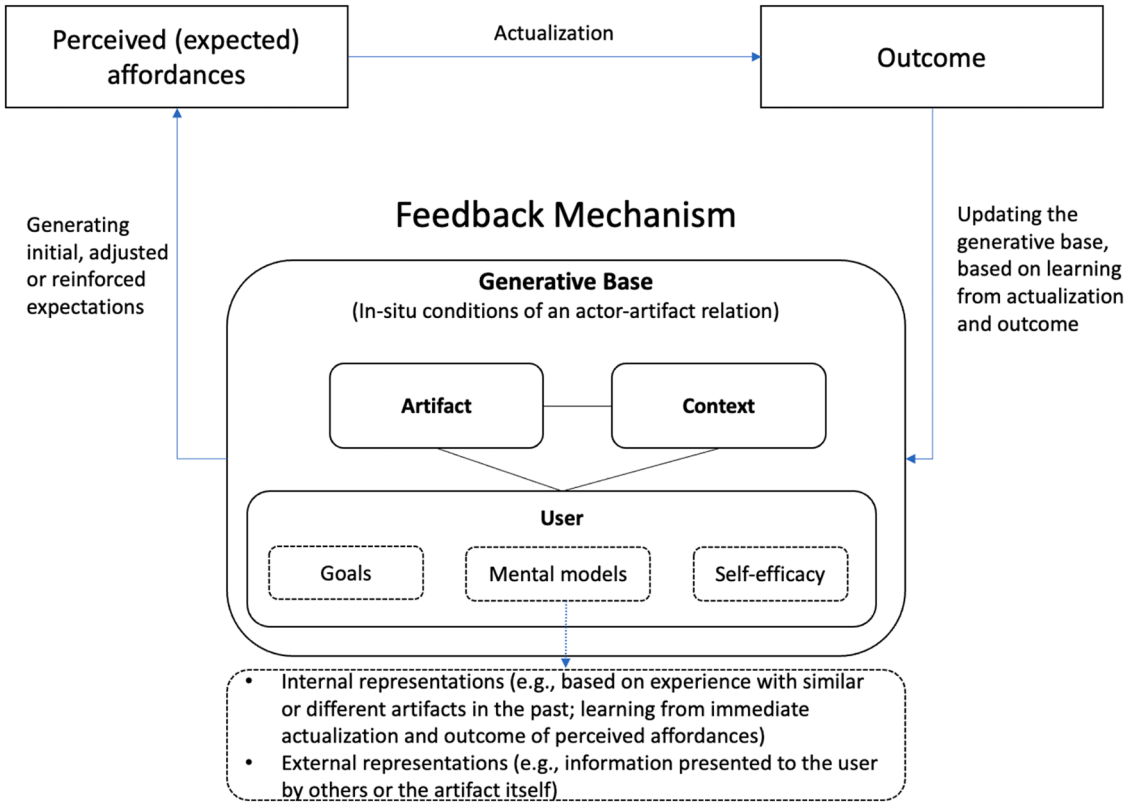


Fig. 5. (Specified) Conceptual Model of Feedback Mechanisms in Adjusted Affordances.

4. Empirical illustration of the conceptual model

We conducted a qualitative interpretive case study (Walsham, 2006), which is appropriate to determine the interplay among goals, self-efficacy, MMs, and perceptions of object affordances. The research object observed in this article is the "Between The Lines" (BTL) app, and the context was mobile mental health for teenagers. The following section describe the BTL case, data collection, and our data analysis approach.

4.1. Between the Lines: a mobile mental health app for teenagers

The research object observed in the context of this article is BTL, an mHealth application developed by the non-profit organization Between The Lines, which aims to empower teenagers and encourage them to use self-help services by providing information on how to help others. A close collaboration with the BTL founders for the purpose of joint research projects allowed a detailed look into the inner workings of the non-profit, as well as familiarization with the app. The BTL app targets teenage users between the ages of 12 and 20 years, and it is available free of charge for Android users via the Google Play store and iOS users via the App Store (currently only in German). As stated in the app description, the overall goal of BTL is to "build users' self-help capacities" at the societal, organizational, and personal levels. At the personal level, the app provides problem identification and information about topics as a method of capacity building. At the organizational level, BTL

provides contact information for helpful resources to the help system. Finally, BTL aims to build user capacity at the societal level by increasing user awareness and de-stigmatizing mental health issues. Exemplary screenshots of the BTL app interface and provided information can be seen in the following Fig. 3. The screenshot on the left shows what information is provided to users, if they search for the term "mobbing", including a description of the term and what affected persons can do about it. In addition, a button is provided to anonymously get in touch with someone in order to get help or exchange experiences. The screenshot on the right shows general topics that users can chose from in order to receive additional information (e.g., borderline syndrome, lovesickness and or teen pregnancy).

The BTL app can be used by teenagers who struggle with mental health-related issues themselves or teenagers whose friends are affected. The app presents an ideal research subject for the purpose of this study, as it targets all teenagers, regardless of their current mental health status. Namely, BTL follows the idea that any teenager can become affected by a mental illness at any point in life or may develop a need for the app if close friends or relatives become affected. Accordingly, BTL offers interesting data for assessing teenagers' perceptions of the BTL action possibilities, depending on (1) their individual characteristics in relation to, e.g., mental states or prior experiences with mental illness; (2) their goals for artifact use (building self-help capacities, helping others); and, lastly, (3) their ability and capability to operate and use the app. At the same time, BTL offers data that allow the assessment of how feedback from affordance actualizations can update or inform existing knowledge representations, goals, or capabilities and consequently lead to adjusted perceptions and actualizations during continued artifact use. For instance, it is suggested that teenagers can learn about mental illnesses on the BTL app, which may lead to a process of self-reflection about their own or others' situations and which may influence the way BTL is perceived and consequently actualized.

Three predominant BTL features provide a variety of affordances to users. The Discovery feature provides a keyword search and an information platform where users can access relevant and verified information about mental health-related problems. Here, users can find a frequently asked questions section and explanatory videos concerning the identified problem. The Discovery feature also provides access to the other BTL features. The Stories feature presents success stories or coping strategies of other teenagers struggling with mental health-related problems. Finally, the Help feature provides contact information of professional youth aid institutions within users' proximity. Table 3 on the next page provides an overview of the BTL features.

4.2. Data collection

This empirical study, used to explore user perceptions and actualizations of BTL affordances, was conducted through two rounds of qualitative interviews with 20 teenage app users in Germany between the ages 12 and 20 years. Altogether, 40 interviews were conducted. The first round of 20 interviews averaged about 40 min each, the second round of 20 interviews averaged about 15 min each. Table 4 on the next page presents the demographics and participant characteristics. The respondents were either recruited via a German municipal youth center or using snowballing. The mental health status of the respondents was not the determining characteristic for their participation, because the BTL app targets all teenagers, regardless of mental health problems, as they could potentially develop problems in the future or have friends who are affected. Some respondents had previous knowledge of BTL. However, the majority did not use the app regularly prior to the interviews. Regular use was defined and inquired as mobile app use for at least two consecutive weeks. After the first round of interviews, respondents were asked to become more familiar with and use the app at least twice weekly until the second round of interviews, about four weeks later.

Table 3
'Between The Lines' Features.

App Features	Intended Usage According to Website Information
Discovery	• inform users about mental health • build self-help capacities, help others
Stories	• de-stigmatize mental health problems • build self-help capacities
Help	• show proximity of youth aid institutions • make contact information for youth aid institutions easily accessible

Table 4
Demographics and Participant Characteristics.

ID	Age	Gender	Prior App Use	Prior App Knowledge	Interview Dates I	Interview Dates II
R1	16	female	✓	✓	04/08/21	05/11/21
R2	16	female	–	✓	04/09/21	05/12/21
R3	20	female	–	✓	04/13/21	06/04/21
R4	17	female	–	–	04/17/21	06/05/21
R5	20	male	–	✓	04/18/21	05/16/21
R6	19	female	–	–	04/20/21	06/10/21
R7	13	male	–	–	04/23/21	05/27/21
R8	19	female	–	✓	05/07/21	05/31/21
R9	13	male	–	–	05/08/21	06/12/21
R10	14	male	–	–	05/08/21	06/06/21
R11	18	female	–	✓	05/11/21	06/07/21
R12	15	female	–	✓	05/11/21	06/10/21
R13	18	female	–	✓	05/12/21	06/15/21
R14	15	male	–	–	05/13/21	06/17/21
R15	18	female	–	–	05/17/21	06/17/21
R16	16	male	–	–	05/17/21	06/17/21
R17	19	male	–	✓	05/20/21	06/23/21
R18	15	male	–	–	05/22/21	06/21/21
R19	13	female	–	–	05/22/21	06/26/21
R20	17	female	–	–	05/26/21	06/15/21

The interviews were semi-structured, and the interview guide was aligned with the presented conceptual model. Accordingly, the interview guide was structured in four different parts to capture (1) user characteristics and MMs stemming from prior experiences with similar apps or the youth aid system; (2) consequent initial user expectations, which could additionally be influenced by prior information about the mobile app; (3) perceived BTL action potentials from interacting with the app; and (4) reinforced or adjusted expectations and perceptions from (continued) BTL use. Interview parts (1), (2), and (3) were the subject of the first interview, and part (4) was the subject of the second interview. One respondent who had actively used the app for at least two weeks prior to the interview was asked to answer the questions retrospectively. All respondents were asked to read the app description in the App Store or Google Play store and familiarize themselves with the app as part of the first interview. Only one interview was inconclusive due to insufficient app use leading up to interview round two.

The interviews were conducted from April until June 2021. The time between interview rounds one and two was roughly four weeks. However, a minimum of three weeks had to pass until interview round two was conducted. Of the 20 interview respondents, 12 identified as female and eight as male. In line with the BTL target group, the interview respondents were aged between 13 and 20 years (13 = 3, 14 = 1, 15 = 3, 16 = 3, 17 = 2, 18 = 3, 19 = 3, 20 = 2). Only one respondent reported having used BTL for more than two consecutive weeks prior to the interview. Because about half of the respondents were recruited through the snowball effect, nine of the respondents had prior knowledge of the app through word of mouth from their friends.

4.3. Data analysis

We applied thematic analysis to our collected data (Broun & Clarke, 2006), following the six phases: familiarizing ourselves with the data, generating initial codes, searching for themes, reviewing themes,

naming themes, and, finally, building the construct. Our analysis was driven by our conceptual model and research objective, and we chose the theoretical approach to thematic analysis (Braun & Clarke, 2006).

Following the six phases, all the recorded data were transcribed for familiarization. The transcripts were distributed between the two groups according to the first and second rounds of interviews to allow a distinguished approach in the coding process, as well as to draw inferences between both interview rounds. Thereafter, to generate initial codes and themes, we used open and focused coding techniques. During the first coding cycle, we used the open coding technique to break the data down and identify affordance concepts, given that the interviews were used as narratives to bring the affordance concepts to life (Berend & Deken, 2021). The affordance concept-based structure of the interview guide helped identify relevant coding categories, such as user perception, user characteristics, artifacts, and contexts of use. In the next step, multiple focused coding cycles were used to distinguish the data further and to explore and compare the categories across the selected sample (Saldana, 2009). Focused coding allows data comparisons to improve researchers' understanding of individual experiences (Charmaz, 2006). In the next phase of reviewing and naming, we conducted cross-reading and comparisons among the transcripts in interview round I, as well as cross-reading and comparisons between interview rounds I and II. After the initial focused coding cycle, two additional focused coding cycles were administered to identify possible changes in perceptions, expectations, or experiences during and after the respondents' continued app use. The identified focused codes included, for instance, respondents' forms of perceiving the app features, individual goals for using the app, expectations of the app, as well as use patterns. In the final phase, as shown in Fig. 4 below, we derived categories and their corresponding codes. The data were coded in MAXQDA and translated to English in a separate Excel spreadsheet.

Altogether, the open and focused coding cycles produced 906 codes. Some codes overlapped due to their similarities because of, for instance, new use situations and new experience codes. Each coding cycle presents an iterative process of critical discussion, reflection, and re-evaluation. By using the affordance theory as the overarching concept for the development of categories in this single case study, construct validity is provided (Yin, 2014). Further, data reliability is provided by the transparent documentation, as well as the administration of several coding cycles to ensure the data collection and analysis processes can be repeated (Yin, 2014).

5. Findings

In this section, we discuss the findings of the data analysis. The finding from the case study is used to illustrate the conceptual model's *generative base*.

5.1. Generative base

5.1.1. Goals

Respondents were first asked about their goals and their capacity to use the app in line with the existing affordance research by, e.g., Strong et al. (2014), who point out that actualizations are oriented in support of user goals. The context of artifact use was predetermined by the interview setting in round one. Given that most respondents had no prior experience using the app, they were asked about the artifact goals they perceived in the first round and their own (possibly adjusted) goals for continued app use in the second round. In general, all respondents identified the artifact goal of enabling teenagers to engage in self-help or to help close friends. For instance, respondent 20 (R20) perceived the following BTL goals from the app description:

> It is for teenagers so that they can come to terms with their problems on their own. They can find assistance with how to resolve problems or tricky situations. It helps them to manage their issues long term and also get help if they want or need. (R20).

When asked which app goals she perceived, R6 first pointed out that the app aims to provide all important information in one place and guides teenagers from one step (i.e., learning about an issue) to the next (i.e., finding help). When asked about her personal goals for using the app after continued app use in the second interview, R6 answered, "I opened the app every time I felt like looking for help." Further, R7 pointed out after continued artifact use in round two, "It's not that you only find help on the app, you can also learn about your problem on the app and check yourself or find reassurance, if you actually have the problem or not." Likewise, after continued artifact use, many respondents revealed new use situations and related use goals, such as looking up or validating information that was heard elsewhere (R14), helping friends (R13 and R17), or learning about mental health (R7, R8, R12, R15, and R16).

5.1.2. Self-efficacy

Further, most respondents indicated the need for self-efficacy to use the app, which was addressed as the respondent's ability to handle the mobile app, as well as their problem-solving capabilities and ability to ask for help from others. All respondents possessed web-enabled mobile phones, and most were highly experienced mobile phone users who frequently use a variety of different mobile apps. Examples of commonly mentioned mobile apps were social media apps, including YouTube, TikTok, Instagram, or Snapchat. Further, the same group of respondents who identified as frequent mobile app users also confirmed the ability to navigate and make use of mobile phone functionalities. In terms of problem-solving capabilities most respondents indicated being able to solve problems on their own. For instance, R8 elaborated:

> Compared to my friends, I am very independent when it comes to asking my parents for permission or help to do something. I can resolve most situations by myself. And in cases of emotionally difficult situations, I can always fall back on my closest friends. (R8)

In line with R8, all respondents indicated having relatives of close friends that they can ask for help when they are confronted with problems, they cannot solve themselves.

Only two respondents (R9, R19) indicated lower-level efficacy in handling the BTL app, as they needed permission and assistance from their parents to unlock the App Store to download the app. Further, R19 had difficulty finding the app description in the App Store, which shows that she was less adept at basic mobile phone functions related to downloading and operating mobile apps. When asked if he would feel confident about his ability to solve bigger problems or challenges on his own, R9 responded, "No, I would always call my mom first." Continued artifact use can improve users' understanding of the system and its usability, which in turn also influences perceptions of capability (Klein & Meininger, 2004). This was also supported in the data. First, R12 stated that she only realized during her continued app use that she could "swipe left and right in the video section of the discovery feature to watch even more videos concerning different topics" (R12). In addition, all respondents except for R13 and R18 indicated they will likely continue to use BTL as a source of trustworthy information about their problems. For instance, R15 explained:

> I will definitely use the app even though I don't know yet how regularly. But if I hear anything about a mental health issue, I will use the app to look up information before I go on google. And if I hear that anyone else needs mental health related help, I will recommend the app. (R15)

5.1.3. Mental models

Some of the results presented above already indicate that the respondents' idea of how an artifact works is aligned with how the system

works, which is an important requirement to enable learning and updating of MMs during continued app use (Kayande et al., 2009). In the absence of an explicit understanding of what constitutes perceptions of digital objects in the relevant literature, this article also assessed MMs and user expectations prior to interactions with the app. Thereby, the goal was to assess whether MMs as mental representations of reality and artifacts in that reality can influence user perception. MMs are mental representations of systems formed by individuals to gain an understanding of the system and predict its usability (Ltifi et al., 2019; Vitharana et al., 2016). Accordingly, to understand their reality in the context of this topic, respondents were first asked about their understanding of the youth aid system and second encouraged to indicate their level of experience with the youth aid system. The respondents' understanding of the youth aid system was in line with the information provided on the BTL app platform, which constitutes organizations, clubs, state-funded projects, or infrastructures put in place to aid teenagers in any form of predicament. As one respondent pointed out correctly:

> I would say it is a help system in any form to support teenagers and acknowledge their feelings and issues. Also, it is a system that has the awareness that issues of teenagers are not just puberty-related bad phases but can be real issues specific to the individual. (R11)

Likewise, other respondents had prior experience from interacting with the youth aid system in the form of after-school programs or summer camps. As one respondent pointed out:

> Houses for the Youth are like open houses or youth centers in my neighborhood where you can go after school when you are bored to do music, play with others, cook food, and eat. I have been going there for the past ten years and think it's a great way to find something meaningful to do and get to know other teenagers. (R5)

Like R6, other respondents had similar experiences with after-school programs as part of the youth aid system, including R1, R2, R3, R7, and R14. About half of the respondents (12/20) had prior experience with the youth help system in the forms of, e.g., counseling at their high school or after-school program (R1, R2, R5, R7, and R12), interaction with websites or child protective services (R4, R8, and R20), or even help hotlines and psychotherapy (R6, R13, R10, and R17). Of the 12 respondents, nine indicated that they have experienced depression, anxiety, and other mental health-related issues, either in themselves or in close friends. Of the nine respondents, three indicated that they themselves or their close friends have experienced more severe mental health-related illnesses, such as psychosis, sexual abuse, or manic depression.

MMs (i.e., mental representations of reality) can form due to prior experience with or knowledge of the same or a similar artifact. Accordingly, in a second step, respondents were asked about their previous knowledge of or experience with BTL. While only one respondent had previously used the app, nine respondents had prior knowledge of the app, which they elaborated on as part of the interview. For instance, one respondent explained when asked what he heard about BTL:

> My friend Mathilda told me it is an app for individuals who are struggling with mental illness. It can also be used by their close friends, relatives, or significant others to look around locally to learn about relevant possibilities to get help. And secondly, affected individuals and their friends can receive a general assessment of their situation. I did not entirely understand how the app works yet but that is the information I received. (R17)

Regardless of whether respondents had perceived prior information about the app from others, all respondents were asked to read the description of the BTL app. This was done given that external information provided about the usability of an app can form user expectations, which can influence the MMs of an artifact and the respective perception of the action potentials provided by the artifact (García García et al., 2021). Overall, 108 initial expectation codes were identified in the analysis, most of which matched the provided app features. The only features that were expected but not provided in the app were real-life chat features with professionals or other affected individuals, as proposed by R4, R7, R10, and R18. All respondents correctly expected one or all BTL features, such as some form of onboarding, an information platform, stories of others, and contact information to the aid system or therapists nearby. In addition, concerning the app description, R16 also indicated that the design of the icon influenced his expectations, stating:

> The logo speaks for itself, I think. You can interpret the logo as two individuals hugging each other or that one person embraces the other person. In my opinion, the logo is very welcoming and that creates this expectation that you are welcomed with open arms in the app. (R16)

In addition to assessing MM influence on user perceptions, another key aspect was to assess how perception evolves over time, given that the existing literature lacks explicit explanations. Similar to the initial expectations, the analysis generated 102 initial perception codes. Half of the respondents confirmed their initial perception of the most helpful app feature for their individual purposes in the second interview (R1, R3, R5, R7, R8, R9, R13, R15, and R20). After continued app use between interview rounds one and two, R4 changed his perception of the most useful feature for his individual purposes from the help feature to the discovery feature. Further, R16 changed his perception of the most useful feature from the help feature to the questions and definitions section of the discovery feature, and R17 changed his perception of the most helpful for his individual app use purposes from the help feature to the stories feature. Likewise, R2, R6, R10, R11, R12, R14, and R18 all indicated a change in perception regarding the most useful feature for their individual purposes after continued artifact use.

5.2. Feedback and adjusted affordances

Moreover, affordance feedback, which in consequence may also influence perception, was also addressed in the study. We assessed feedback from reinforced or adjusted expectations during continued app use. We found that about half of the respondents indicated their initial expectations of the BTL app as satisfied (R1, R3, R5, R6, R9, R10, R11, R14, R16, R18, and R19) while one respondent was disappointed (R13). Against the expectations of R13, which were formed by external information, as well as her own MMs from experiencing the difficulties of finding available psychotherapists, the respondent had to adjust her expectations of the app. Only during the continued app use did R13 learn that the BTL app did not provide a "recommender system for finding appropriate therapists specialized for individualized problems" (R13).

However, eight respondents indicated that their initial expectations were exceeded by the BTL app during continued artifact use (R2, R4, R7, R8, R12, R15, R17, and R20). For instance, R17 pointed out:

> Like I told you before, I have been looking for information about what to do in a psychosis for the past weeks. In fact, all my roommates and I have been searching on the internet together. The most helpful information we could find was this emergency number to call. All the other information was either not helpful or addressing different topics altogether. And so, I think, the thing that surprised me the most and exceeded my expectations about BTL is that it summarizes and provides all the information you need at a really low threshold. It provides precisely what you usually have to find through lengthy searches and effort on the Internet. (R17)

This shows that initial user expectations can be influenced through continued artifact use, which can generate feedback loops in form of updating initial user expectations and thereby adjusting perceptions of artifact features and their action potentials. For instance, one respondent stated that through her continued app use, she realized that she can also learn more about the accompanying symptoms of her illness, such as

panic attacks, which she did not initially expect from the discovery feature of the app (R6). This prompted R6 to "open the app more often and not just superficially scan the information but actually make long term plans based on the information provided in the app." In addition, R6 has also contacted help institutions nearby, stating:

> I called different places. One place, like a women's aid institution, I did not know before, but I found the information on the BTL app and called them. The app has definitely helped me find information about these institutions way faster and at a lower effort. I need less self-initiative, which is a big help. (R6)

Further, through continued artifact use, respondents also indicated that the update of initial user expectations let to new user experiences (actualizations) based on learning from artifact interactions. Overall, 90 new experience codes were identified in the data set, which indicates some form of feedback loop that either updated initial user expectations about the usability of the app or indicated a learning curve individuals experienced from interacting with the app. For instance, R17, who used the app to help a close friend through a psychosis, described how feedback loops from continued interaction updated his initial user expectation sand led to new experiences while using the app. He stated:

> My number one takeaway is from the stories feature, where I learned that it does not help people suffering from depression or mental illness to treat them differently as you otherwise would. Because you make them smaller than they actually are. That's no way to have an honest conversation. I thought the help feature would be what I use most, instead I was captivated by the stories of people feature. And it helped me so much in communicating with my friend. (R17)

Likewise, R10 described the video feature about specific problems (here: having trouble sleeping) as the most helpful feature during the first round of interviews. However, after continued app use, R10 stated during the second round of interviews, "I didn't use the keyword search feature as much in the beginning. But the keyword search feature is by far the best feature because you can really look for specific problems and information." Table 5 presents a summary of the findings.

5.3. The conceptual model of feedback mechanisms in adjusted affordances

In Section 3, we presented our conceptual model of feedback mechanisms in adjusted affordances. Later, we applied the conceptual model as a theoretical base to analyze our data. Finally, based on the insights from the case study findings, we refined the proposed conceptual model (see Fig. 5 at the end of this section for a summary).

First, we were able to show the main elements of the generative base, including the in-situ *conditions of actor–artifact relations*. More specifically, it includes the artifact (mHealth app)–artifact (mHealth app user)–context triad. Focusing on the analytical unit 'user', to perceive affordance, human individuals must have not only specific *goals* and *self-efficacy*, but also *MMs* concerning how and for what the artifact can be used. The use case showed that MMs contribute a more nuanced understanding of affordance perception. The concept of MMs was added as an additional aspect of the user to explain cognitive and intangible influences on the perception of the artifact action potentials of digital objects. Here, the use of MMs in the affordance context could show that the internal (mental) or external information that mHealth app users had prior to their first interaction with the app influenced their expectations and consequent initial perceptions of the mHealth app. For instance, some users heard about the app through word of mouth. This influenced the action potentials they expected and actively looked for during the first interaction with the app. Other users, who had no prior information about the specific app, could draw from their experiences with the youth help system or similar apps in general. Consequently, they expected the app to provide help and services, and they made inferences from prior experiences with the mHealth app. Lastly, the

Table 5
Summary of the Findings.

Model Elements	Representative Data
Generative Base	
Goals	"I wanted to use the app out of curiosity. When I heard about the project, I wanted to see what it is like. And also, it is comforting to have the app. Because I know whenever I have any questions, I can ask the in the app" (R3). "I opened the app every time I felt like looking for help" (R6). "It's not that you only find help on the app, you can also learn about your problem on the app and check yourself or find reassurance, if you actually have the problem or not" (R6).
Mental Models	"I visited a drug counseling center for teenagers with my school class once but that is the only time I got in contact with the youth help system" (R10). "I understand the youth help system as places that provide programs and activities for teenagers who need help" (R1). "I would say it is a help system in any form to support teenagers and acknowledge their feelings and issues. Also, it is a system that has the awareness that issues of teenagers are not just puberty-related bad phases but can be real issues specific to the individual" (R11). "I have used 'Gute Frage.net' before. It's an open forum where you can ask all kinds of questions anonymously. I imagine the BTL app works like 'Gute Frage.net'. You can ask your questions anonymously and other people react or answer to your questions" (R4). "Ah, the app also lists 'Nummer gegen Kummer'. This hotline was also shown to us in my school as a place to turn to when we need help" (R18) "I have heard of BTL at my school. To me the youth help system is something like BTL or child protective services or school counselors. Just any place for teenagers to turn to when they need help" (R2). "The youth aid systems I personally have been in contact with are in the context of sexism and violence. I know places like 'Wildwasser' or 'Lara'. And my friend also told me about BTL" (R13).
Self-efficacy	"I would say, I find solutions for most of my problems. And if I don't, I always find someone whom I can ask. I usually find solutions" (R5).
Perception of Affordances	"I like that when I type in panic attacks in the open field, the app automatically presents applicable aid institutions to help me find adequate help" (R2) "For instance, the logo, you see two people hugging each other, at least that is what it looks like to me. It tells me that I can use this app and feel 'hugged' or get help" (R16).
Outcomes	[initial expectation] "I expect different topics to choose from in the app. Topics that you can choose to learn more about, get help for and also people to contact" (R6). [outcome] "I like the great variety of options – I mean the topics that I can choose to get more information about or help for. Yes, and also that the app offers me different places where I can get help nearby" (R6).
Feedback and Adjusted Affordances	
Adjusted Perception/ Expectation	[initial perception] "The encyclopedia of topics feature is very helpful, and I like that you can search for aid institutions nearby" (R13). [adjusted perception/ expectation] "The search for aid institutions feature was not what I expected. I thought the feature mediates therapists who have capacities for new clients. Instead, it only shows existing institutions" (R13). [initial perception] "The map to find organizations is the most helpful feature" (R17). [adjusted perception/ expectation] "I thought using the map would be the main feature I use but instead I ended up using the 'hero stories' of other people most. It helped me communicate with my friend" (R17). [adjusted perception/ expectation] "A lot of the things I expected were there. But the 'hero stories' and the 'explore' feature exceeded my expectations (…) I can use

(*continued on next page*)

Table 5 (*continued*)

Model Elements	Representative Data
Adjusted Outcome	that, if I don't want to talk to people and need a reliable source to look something up really quickly" (R4). "I thought the help feature would be what I use most, instead I was captivated by the "hero stories" feature. And it helped me so much in communicating with my friend" (R17).

respondents were asked to read the app description if they had never before used an mHealth app in general or the BTL app specifically. Naturally, the app description itself also provided some initial information, which one respondent described as welcoming and caring. The results presented in the use case show that pieces of *external information*, as well as *personal experiences or expectations predate the perception* of any action potentials. Further, there is an interconnectedness between external information and internal mental representations of what the mHealth app affords its users (García García et al., 2021). In turn, phrases like "this is exactly how I expected it to be" or "I did not expect this at all" underline the influence of MMs on the initial, as well as continuous perceptions of technology action potentials.

In addition, the case study provided a detailed assessment of *feedback mechanisms* to unbox and understand better how feedback from affordance actualizations may influence perceptions during continued artifact use. The results show that feedback from initial affordance actualizations may lead users to develop new goals or gather new internal (mental) or external information about how to use the artifact. The results hence showed how *initial perceptions and expectations can be adjusted or reinforced during continued artifact use*. Any user–artifact relation is context-dependent and driven by specific user goals. Respondents who did not have immediate issues or mentally ill friends and still felt that the mHealth app met all their prior expectations commonly went through a process of reinforcement. However, respondents who had an immediate need for the app themselves or to support users commonly had more specific goals for using the mHealth app, having gone through multiple cycles of updating their generative base during continued app use. This opens the feedback mechanism's black box by disclosing that adjustments to perceptions and expectations are the result of updating the generative base through user–artifact interactions.

The following Fig. 5 summarizes the above-described conceptual model of feedback mechanisms in adjusted affordances.

6. Discussion

In the following, we will first highlight our theoretical contributions and derive research propositions (6.1), followed by a description of practical implications (6.2) as well as a discussion of limitations and future research directions (6.3).

6.1. Theoretical contributions and propositions

The research question addressed in this article is the following: How can the emergence of affordance perceptions, actualizations, and outcomes be made more explicit to extend the current understanding of adjusted technological affordances? Hence, the study focuses on two aspects under scrutiny: 1) affordance perception and 2) adjustments in perception and actualization from feedback. Based on existing research gaps in the literature, this article sets out to build on the current understanding of affordances in socio-technical relationships in contribution to the affordance literature. In line with the research question, this article contributes a detailed assessment of affordance perceptions, based on the observation that existing studies provide explanations of how human agents come to perceive technology action potentials (see, e.g., Bernhard et al., 2013; Pozzi et al., 2014). The conceptual model developed in Section 5 closes existing gaps based on the works of Bernhard et al. (2013), Pozzi et al. (2014), Strong et al. (2014), Bygstad et al. (2016), Tim et al. (2017), and Dremel et al. (2018). In more detail, existing explanations regarding the perception of affordances are rather general and often based on the knowledge of affordance perception as a process of recognizing directly perceivable action potentials (Greeno, 1994). In addition to the contribution to the affordance perception, actualization, and feedback literature, this article further contributes an extended conceptual model to affordance research.

While many affordance models have provided important foundations, a nuanced understanding of feedback and an explicit explanation of adjustments to or reinforcements of perception have not yet been provided. Accordingly, this article contributes a more nuanced understanding of perceptions of what digital objects afford users, even if not directly perceivable (Hausvik & Thapa, 2017), as well as factors influencing perception, even before the emergence of affordances. With that, the conceptual model developed in this article provides a nuanced understanding of feedback from affordance actualizations, including how feedback can lead to adjustments or reinforcements of affordance perceptions during continued artifact use. To accommodate such factors in the theory of affordances, we integrated MM theory to extend existing explanations of affordance perceptions. Based on the identified research gaps and our contribution, in the following, we will outline four propositions:

Proposition 1. The perception and adjustment of affordances is a highly dynamic socio-technical process.

Often, previous literature worked with a non-recursive model of affordance perception and actualization (e.g., Bernhard et al., 2013; Pozzi et al., 2014), while studies with a dynamic perspective (e.g., Tim et al., 2017; Dremel et al., 2018) do not provide a detailed explanation regarding how adjustments of affordance perception come about, or focus on only one adjusted concept (e.g., individuum, artifact or context). Our study shows that the individuals' perceptions of affordances (in relation to the mHealth app) depend on various individuum- (e.g., experience with similar apps in the past), artifact- (e.g., features to receive help) and context-related (e.g., general structure of the youth aid system) aspects at the same time, which may dynamically change over time. Hence, the actualization of affordances directly influences several of these socio-technical elements, leading to a continuous and recursive interdependency of such concepts.

Proposition 2. The in-situ conditions of an actor-artifact relation form a "generative base", which represents the fundament for perceiving (expecting) technological affordances.

While existing literature declares that certain aspects may influence the perception of affordances, an ontological discussion and understanding of what these elements represent together in affordance theory is missing. Therefore, based on the empirical results and existing literature, we suggest a new concept termed *generative base*, which we understand as the in-situ *conditions of actor-artifact relations*, from which affordance perceptions and actualizations emerge. In other words, the generative base breaks down the complexity of in-situ conditions required for the emergence of affordances. In this generative base, relevant analytical units and concepts on affordances, including users, artifacts, and contexts are subsumed. In our article, we focus on the analytical unit "user", which, according to the literature, involves their self-efficacy and goals (e.g., Leonardi, 2013; Klein & Meininger, 2004), and which we complemented by the individual's MMs (e.g., Yang et al., 2003; Vitharana et al., 2016). We propose that all these concepts together generate an expectation of what artifacts can (not) be used for.

Proposition 3. Users' mental models significantly determine which affordances are (not) perceived.

Zooming into the generative base and the analytical unit "user" specifically, our conceptual model introduces MMs, that is, internal or external representations about the users' environment and hence the

basis for understanding actor-artifact relations. We propose that MMs constitute tested or untested assumptions about how the artifact works and what it affords users in pursuit of specific outcomes (Yang et al., 2003). Through artifact interactions (using the mHealth app), users can test their prior assumptions or external information about how the artifact works, as well as gain their own experience, which explains consequent adjustments or reinforcements of perception (e.g., what the mHealth app can (not) be used for). Thereby, the introduction of MMs introduces internal (mental), as well as external facets of user perception (see, e.g., García García et al., 2021) to affordance research, contributing to a comprehensive explanation of the adjustments to or reinforcements of perceptions of the affordances of digital objects.

Proposition 4. Feedback mechanisms via the process of actualization lead to an adjustment or reinforcement of previously perceived (expected) affordances.

Bringing the mechanisms and ontological units together, we first propose that the perception of technological affordances can also be described as an individual expectation regarding a potential actor-artifact relation. This expectation, so we argue, is an outcome of specific in-situ conditions of that actor-artifact relation, including the user background and his or her mental model about the same or similar artifacts, based on previous experience (internal representations) and/or new information (external representations). We hence propose that with the process of affordance actualization, the user receives feedback regarding the validity of previously built expectations as well as effects (e.g., on the environment) of applying the artifact. This feedback leads to an update of the generative base, leading to adjustments or reinforcements of the users' expectation towards potential affordances.

6.2. Implications for practice

Based on our findings we suggest the following implications for practice. Regarding the creation of artifacts such as mental mHealth apps or other information systems, it is necessary for designers to be aware of the highly dynamic, socio-technical characteristics of actor-artifact relations, represented by the generative base. Hence, designers should not only focus on the artifact's intended affordances and hence features but also on understanding the user's background and the context, in which an information system is applied. It also means, that designers need to acknowledge the existence of various backgrounds users can have, which influence how artifacts and their affordances are perceived. More specifically, designers need to realize that users have different MMs about the world and hence expectations about how 'things are'. Thus, MMs have a significant impact on actor-artifact relations and can be shaped by user-internal as well as -external representations. Consequently, designers need to better understand how users perceive their environment to better meet their expectations but also what kind of information is suitable to extend or change existing MMs. Such information could be related to, for instance, how an artifact works and what it can or cannot be used for. For instance, the content and design of any mental mHealth app for teenagers should reflect aspects of teenagers' reality to help them perceive available action potentials but also to provide a user experience that aligns with their expectations. We hence advocated that the designers should be familiar with the day-to-day engagement of users in the real world. The concept of a generative base, and zooming in on the analytical unit "user", was also introduced to better capture the complexity of permanent (e.g., self-efficacy, previous experience) and temporary (e.g., goals, use context) knowledge components that are required for the emergence of affordances. At the same time, the generative base components are each updated individually or collectively during continued artifact use via feedback mechanisms, and they therefore contribute sources of feedback to artifact designers. Designers therefore need to realize that with actualizing perceived affordances, the user gains additional experience regarding the use of a specific artifact, which can lead to unintended (by the designer) outcomes.

The study shows that mHealth app design that considers the generative base has a higher probability of adoption by users. The result of our study shows that teenagers respond well if it meets their expectation based on their previous MMs and experience such as simplicity and anonymity. Several respondents positively complemented the simplicity of the Discovery feature's keyword searches and short answers, as well as the Stories feature allowing users to swipe left and right through their video options. The testimonials confirm that, for instance, app users who previously used other online youth aid services on the Internet, will be especially satisfied with the simplicity and intuitive structure of the app when they first use it (Between The Lines, 2022). Overall, a likeness in the design of the app with existing online platforms frequented by teenagers, such as Google, YouTube, or Instagram, allowed respondents to feel comfortable using the BTL app. This also aligns with the research model presented in this article, which highlights the relevance of MMs and their influence on user perceptions. To cross reference the relevance of MMs in terms of external information, personal experience or expectations that predate the perception of action potentials, the app testimonials on the official BTL website were reviewed.

Our study also provides relevant implications for the practitioners who are, for example, working in the youth aid system (in our study part of the "context"). For instance, until today, the increase in public awareness of mental illnesses has not yet been matched by the visibility of adequate institutions that can provide help. Mental mobile apps, like BTL, provide a potential solution to bridge this gap. To cross reference this overall positive opinion of the BTL app within the target community, research on second-hand data revealed that the app has recently been awarded for its work in child protection in 2020 and children's rights contexts in 2022 (Nord Wirtschaft, 2022; WDR, 2022). More generally speaking, organizations that are part of the context of an actor-artifact relationship should understand how they are represented and linked with the artifact, as well as how this representation is perceived by users and may influence their mental models about what an information system can be used for. Such institutions most probably have valuable experience in their respective domain and knowledge about potential users, and therefore should get in contact with the designers so that those can benefit from the contextual organizations' experience. In sum, with our proposed conceptual model of feedback mechanisms in adjusted affordances, organizations can better understand how such affordances in correspondence with a given context are perceived, actualized and reinforced or adjusted, which allows them to better analyze their own role within that system as well as possibilities to influence the dynamic, socio-technical actor-artifact relation.

There are also implications for users as potential stakeholders. Users should be aware that their individual perception of affordances is a result of three concepts coming together, namely the artifact, a specific context and their own individual background. From that generative base, other perceptions may emerge than intended by the designers. Hence, unexpected outcomes regarding the actualization of affordances could be consciously held against existing mental models in order to better understand potential mismatches and conflicts. Also, before usage of an artifact, or if there is a gap between perceived (expected) and observed affordances, users may actively seek for external representations to make sense of deviations and hence update their mental models, for instance via reading information provided by the artifact itself or in exchange with peers regarding their experience. Our proposed model hence allows users to learn more about how they dynamically adjust or reinforce their perception of affordances, thus supporting them in making use of technological artifacts in a more self-determined manner.

6.3. Limitations and future research directions

The research design includes some limitations, as is typical with single case studies. Namely, the focus on one single phenomenon in one context may raise generalizability concerns. However, with a single case

study we are also able to dive deep into the context and explore how as well as why things happen or do not happen, leading to a better substance for our theoretical statements and propositions. Nevertheless, future studies may conduct quantitative surveys with a higher number of participants. In addition, while the mobile app not only targets teenage users struggling with mental illness, the recruitment of only directly affected teenagers could have resulted in even more intensive app use during the defined period. Therefore, future research could identify similar use cases with the same design to study affordance perceptions, actualizations, and outcomes of affordances during continued artifact use. Also, as a limitation, we integrated the theory of MMs and described differences regarding internal and external representations but did not analyze the relationship of the latter in more detail. Hence, scholars could zoom in on the role of mental models for the perception of affordances, and with that on the question how internal and external representations may complement each other or result in a mismatch of, for example, experience with previous artifacts in contrast to information about the artifact by designers. While regarding the generative base we concentrated on the analytical unit "user" to contribute to this specific concept, future research may focus, for instance, on the "context" and how exactly updates of it influence the emergence of affordance perception.

7. Conclusion

This article aimed to improve current understandings of affordance perception and feedback from actualizations and outcomes of affordances during continued artifact use. A case study of teenage users of a mental mHealth app was used to identify nuances in perception. Here, the theory of mental models was integrated as a user aspect to contribute a more complete picture of the internal (mental) and external factors that influence user perceptions, even prior to artifact interaction. Further, the case study was used to open the feedback mechanism black box by showing how affordance perception can change based on adjustments to or reinforcements of expectations gained from user experiences with the artifact. The concept of the generative base was introduced to capture the complexity of the permanent (e.g., self-efficacy, previous experience) and the temporary (e.g., goals, use context) to inform artifact designers.

CRediT authorship contribution statement

Christian Meske: Writing – review & editing, Conceptualization, Data curation, Funding acquisition, Investigation, Methodology, Project administration, Supervision, Writing – original draft, Writing – review & editing. **Ireti Amojo:** Conceptualization, Data curation, Investigation, Methodology, Project administration, Writing – original draft, Writing – review & editing. **Devinder Thapa:** Conceptualization, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Declarations of interest

None.

References

Abhari, K., Davidson, E., & Xiao, B. (2022). Inventing together: The role of actor goals and platform affordances in open innovation. *Journal of the Association for Information Systems, 23*(1), 264–302.

Bandura, A. (1982). Self-efficacy mechanisms in human agency. *American Psychologist, 17*(2), 122–147.

Bardram, J. E., & Houben, S. (2018). Collaborative affordances of medical records. *Computer Supported Cooperative Work (CSCW), 27*(1), 1–36. https://doi.org/10.1007/s10606-017-9298-5

Benbunan-Fich, R. (2019). An affordance lens for wearable information systems. *European Journal of Information Systems, 28*(3), 256–271. https://doi.org/10.1080/0960085X.2018.1512945

Berend, H., & Deken, F. (2021). Composing qualitative process research. *Strategic Organization, 19*(1), 134–146.

Bernhard, E., Burton-Jones, A., & Recker, J. (2013). Understanding the actualization of affordances: A study in the process modeling context. In Proceedings of the Thirty Fourth International Conference on Information Systems, 1–12.

Between The Lines E., Accessed: 08/23/2022. From: https://between-the-lines.info.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology, 3*(2), 77–101.

Bygstad, B., Munkvold, B. E., & Volkoff, O. (2016). Identifying generative mechanisms through affordances: a framework for critical realist data analysis. *Journal of Information Technology, 31*(1), 83–96.

Charmaz, K. (2006). *Constructing grounded theory: A practical guide through qualitative analysis*. Thousand Oaks, CA: Sage,.

Chemero, A. (2003). An outline of a theory of affordances. *Ecological Psychology, 15*(2), 181–195.

Davern, M., Shaft, T., & Te'eni, D. (2012). Cognition matters: Enduring questions in cognitive IS research. *Journal of the Association for Information Systems, 13*(4), 273–314.

Dremel, C., Herterich, M. M., Wulf, J., & Vom Brocke, J. (2018). Actualizing big data analytics affordances: A revelatory case study. *Information & Management, 57*(1), 1–21.

Du, W., Pan, S. L., Leidner, D. E., & Ying, W. (2019). Affordances, experimentation, and actualization of FinTech: A blockchain implementation study. *Journal of Strategic Information Systems, 28*(1), 50–65.

Effah, J., Amankwah-Sarfo, F., & Boateng, R. (2021). Affordances and constraints processes of smart service systems: Insights from the case of seaport security in Ghana. *International Journal of Information Management, 58*. https://doi.org/10.1016/j.ijinfomgt.2020.102204

Faik, I., Barrett, M., & Oborn, E. (2020). How information technology matters in societal change: An affordance-based institutional logics perspective. *MIS Quarterly, 44*(3), 1359–1390.

Faraj, S., & Azad, B. (2012). . The materiality of technology: An affordance perspective. In P. M. Leonardi, B. A. Nardi, & J. Kallinikos (Eds.), *Materiality and organizing* (pp. 237–258). Oxford: Oxford University Press.

Fu, J., Shang, R.-A., Jeyaraj, A., Sun, Y., & Hu, F. (2020). Interaction between task characteristics and technology affordances: Task-technology fit and enterprise social media usage. *Journal of Enterprise Information Management, 33*(1), 1–22.

García García, P., Costanza, E., Verame, J., Nowacka, D., & Ramchurn, S. D. (2021). Seeing (movement) is believing: The effect of motion on perception of automatic systems performance. *Human–Computer Interaction, 36*(1), 1–51.

Gaver, W. W. (1991). Technology affordances. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 79–84). New Orleans, LA: ACM.

Gerlach, J. H., & Kuo, F.-Y. (1991). Understanding human–computer interaction for information systems design. *MIS Quarterly, 15*(4), 527–549.

Gibson, J. J. (1979). *The Ecological Approach to Visual Perception*. Boston: Houghton-Mifflin.

Greeno, J. G. (1994). Gibson's affordances. *Psychological Review, 101*(2), 336–342.

Hausvik, G.I., & Thapa, D. (2017). "What You See is Not What You Get"-Challenges in Actualization of EHR Affordances. In 38th International Conference On Information (ICIS), paper no. 9.

Huotari, K., & Hamari, J. (2017). A definition for gamification: Anchoring gamification in the service marketing literature. *Electronic Markets, 27*, 21–31.

Karahanna, E., Xu, S. X., Xu, Y., & Zhang, A. (2018). The needs–affordances–features perspective for the use of social media. *MIS Quarterly, 42*(3), 737–756.

Kayande, U., De Bruyn, A., Lilien, G. L., Rangaswamy, A., & van Bruggen, G. H. (2009). How incorporating feedback mechanisms in a DSS affects DSS evaluations. *Information Systems Research, 20*(4), 527–546.

Klein, E. E., & Herskovitz, P. J. (2007). Philosophy of science underpinnings of prototype validation: Popper vs. Quine. *Information Systems Journal, 17*(1), 111–132.

Klein, H. A., & Meininger, A. R. (2004). Self-management of medication and diabetes: Cognitive control. *IEEE Transactions on Systems, Man, and Cybernetics - Part A: Systems and Humans, 34*(6), 718–725.

Lanamäki, A., Thapa, D., & Stendal, K. (2015). What does a chair afford? A Heideggerian perspective of affordances. *Proceedings of the 38th Information Systems Research Seminar, 6*, 1–14.

Leidner, D. E., Gonzalez, E., & Koch, H. (2018). An affordance perspective of enterprise social media and organizational socialization. *Journal of Strategic Information Systems, 27*(2), 117–138. https://doi.org/10.1016/j.jsis.2018.03.003

Leonardi, P. M. (2013). When does technology use enable network change in organizations? A comparative study of feature use and shared affordances. *MIS Quarterly, 37*(3), 749–775.

Liu, F., Ngai, E., & Ju, X. (2019). Understanding mobile health service use: An investigation of routine and emergency use intentions. *International Journal of Information Management, 45*, 107–117.

Ltifi, H., Benmohamed, E., Kolski, C., & Ayed, M. B. (2019). Adapted visual analytics process for intelligent decision–making application in a medical context. *International Journal of Information Technology & Decision Making, 19*(1), 241–282.

Maier, J. R. A., & Fadel, G. M. (2009). Affordance based design: A relational theory for design. *Research in Engineering Design, 20*(1), 13–27. https://doi.org/10.1007/s00163-008-0060-3

Majchrzak, A., & Markus, M. L. (2014). In E. Kessler (Ed.), *"Technology Affordances and Constraints Theory (of MIS)," in Encyclopedia of Management Theory* (pp. 832–836). Thousand Oaks, CA: SAGE Publications.

Mansour, O., Ghazawneh, A., & Askenäs, L. M. H. (2020). An affordances apparatus for enterprise social media. *Scandinavian Journal of Information Systems, 32*(2). Article 1.

Markus, M. L., & Silver, M. S. (2008). A foundation for the study of IT effects: A new look at DeSanctis and Poole's concepts of structural features and spirit. *Journal of the Association for Information Systems, 9*(10), 609–632.

McGrenere, J., & Ho, W. (2000). Affordances: Clarifying and evolving a concept. In. *Proceedings of Graphics Interface*, 1–8.
Meske, C., & Amojo, I. (2020). Enterprise Social Bots as Perception-Benefactors of Social Network Affordances. International Conference on Information Systems (ICIS), 5.
Mettler, T., & Wulf, J. (2019). Physiolytics at the workplace: Affordances and constraints of wearables use from an employee's perspective. *Information Systems Journal, 29*(1), 245–273.
Nisar, T., Prabhakar, G., Ilavarasan, P., & Baabdullah, A. (2019). Facebook usage and mental health: An empirical study of role of non-directional social comparisons in the UK. *International Journal of Information Management, 48*, 53–62.
Nord Wirtschaft. Accessed 08/23/2022. Between The Lines - Digitale Hilfe für psychisch belastete Kinder und Jugendliche. From: https://www.nordwirtschaft.de/between-the-lines.
Orlikowski, W. J. (2000). A practice lens for studying technology in organizations. *Organization Science, 11*(4), 367–472.
Osmundsen, K., Meske, C., & Devinder, T. (2022). Familiarity with digital twin totality: Exploring the relation and perception of affordances through a Heideggerian perspective. *Information Systems Journal, Online first*, 1–28.
Pandey, V., Gupta, S., & Kim, H.-W. (2021). Exploring the role of technology affordance and social capital in promoting citizen's political participation on social media. *Pacific Asia Journal of the Association for Information Systems, 13*(4). Article 1.
Parchoma, G. (2014). The contested ontology of affordances: Implications for researching technological affordances for collaborative knowledge production. *Computers in Human Behavior, 37*, 360–368.
Porter, A. J., & van den Hooff, B. (2020). The complementarity of autonomy and control in mobile work. *European Journal of Information Systems, 29*(2), 172–189. https://doi.org/10.1080/0960085X.2020.1728200
Pozzi, G., Pigni, F., & Vitari, C. (2014). Affordance theory in the IS discipline: A review and synthesis of the literature. *Proceedings of the Twentieth Americas Conference on Information Systems* (pp. 1–12). Savannah.
Saldana, J. (2009). *The coding manual for qualitative researchers*. London, UK: Sage Publications Ltd.
Samhan, B. (2017). Patients' resistance towards health information technology: A perspective of the dual factor model of IT usage. *Proceedings of the 50th Hawaii International Conference on System Sciences (HICSS)*, 3401–3410.
Scarpetta, S., Pearson, M., & Takino, S. (2021). Supporting young people's mental health through the COVID-19 crisis. *Tackling Coronavirus (COVID-19): Contributing to a global effort* (pp. 1–14). OECD,.
Shaw, R. E., Turvey, M. T., & Mace, W. M. (1982). Ecological psychology: The consequence of a commitment to realism. In W. Weimer, & D. Palermo (Eds.), *Cognition and the Symbolic Processes* (pp. 159–226). Hillsdale, NJ: Lawrence Erlbaum Associates.
Strong, D. M., Johnson, S. A., Tulu, B., Trudel, J., Volkoff, O., Pelletier, L. R., … Garber, L. (2014). A theory of organization–EHR affordance actualization. *Journal of the Association for Information Systems, 15*(2), 53–85.
Sun, Y., Fang, S., & Zhang, Z. (2021). Impression management strategies on enterprise social media platforms: An affordance perspective. *International Journal of Information Management, 60*.
Sun, Y., Shao, X., Li, X., Guo, Y., & Nie, K. (2019a). How live streaming influences purchase intentions in social commerce: An IT affordance perspective. *Electronic Commerce Research and Applications, 37*, Article 100886.
Sun, Y., Wang, C., & Jeyaraj, A. (2020). Enterprise social media affordances as enablers of knowledge transfer and creative performance: An empirical study. *Telematics and Informatics, 51*, Article 101402.
Sun, Y., Zhou, X., Jeyaraj, A., Shang, R.-A., & Hu, F. (2019b). The impact of enterprise social media platforms on knowledge sharing: An affordance lens perspective. *Journal of Enterprise Information Management, 32*(2), 233–250.
Thapa, D., & Sein, M. (2017). Trajectory of affordances: Insights from a case of telemedicine in Nepal. *Information Systems Journal, 28*(5), 796–817.
Tim, Y., Ouyang, T., & Zeng, D. (2020). Back to the future: Actualizing technology affordances to transform Emperor Qin's terracotta warriors Museum. *Information and Management, January.* , Article 103271. https://doi.org/10.1016/j.im.2020.103271
Tim, Y., Pan, S. L., Bahri, S., & Fauzi, A. (2017). Digitally enabled affordances for community-driven environmental movement in rural Malaysia. *Information Systems Journal, 28*, 48–75.
Vandenbosch, B., & Higgins, C. (1996). Information acquisition and mental models: An investigation into the relationship between behaviour and learning. *Information Systems Research, 7*(2), 198–214.
Vitharana, P., Zahedi, M. F., & Jain, H. K. (2016). Enhancing analysts' mental models for improving requirements elicitation: A two-stage theoretical framework and empirical results. *Journal of the Association for Information Systems, 17*(12), 804–840.
Volkoff, O., & Strong, D. M. (2013). Critical realism and affordances: Theorizing IT-associated organizational change processes. *MIS Quarterly, 37*(3), 819–834.
Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems, 15*(3), 320–330.
WDR. Accessed: 08/23/2022. WDR Kinderrechtepreis 2022. From: ⟨https://presse.wdr.de/plounge/wdr/programm/2022/06/20220603_kinderrechtepreis.html⟩.
Xu, J., Du, H. S., NingShen, K., & Zhang, D. (2022). How gamification drives consumer citizenship behaviour: The role of perceived gamification affordances. *International Journal of Information Management, 64*. article no. 102477.
Yang, C. C., Chen, H., & Hong, K. (2003). Visualization of large category map for internet browsing. *Decision Support Systems, 35*(1), 89–102.
Yang, H.-S., & Park, J.-W. (2019). A study of the acceptance and resistance of airline mobile application services: With an emphasis on user characteristics. *International Journal of Mobile Communications, 17*(1), 24–43.
Yin, R. K. (2014). *Case study research design and methods* (5th ed.). Thousand Oaks, CA: Sage.
Zhao, Y., Ni, Q., & Zhou, R. (2018). What factors influence the mobile health service adoption? A meta-analysis and the moderating role of age. *International Journal of Information Management, 43*, 342–350.

Christian Meske is a Full Professor of Socio-technical System Design and Artificial Intelligence at the Institute of Work Science, Faculties of Mechanical Engineering and Computer Science at Ruhr-Universität Bochum, Germany. His research on the design and management of digital innovations has been published in journals such as Business & Information Systems Engineering (BISE), Communications of the Association for Information Systems (CAIS), Information Systems Frontiers (ISF), Information Systems Management (ISM), Information Systems Journal (ISJ), International Journal of Information Management (IJIM), Journal of Enterprise Information Management (JEIM), Journal of the Association for Information Science and Technology (JASIST), or MIS Quarterly Executive (MISQE).

Ireti Amojo is Research Assistant and PhD Candidate in her final year at the Department of Information Systems, Freie Universität Berlin, Germany. Ireti is member of the Einstein Center Digital Future and holds a scholarship from the Foundation of German Businesses. She received her B.A. in Organizational Communications at the Washington State University and her M.Sc. in Applied Cognitive and Media Science at University of Duisburg-Essen. Her research on the design and diffusion of digital innovations has been published in outlets like Communications of the AIS (CAIS), International Conferences on Information Systems (ICIS), and others.

Devinder Thapa is a professor at the University of South-Eastern Norway and is also affiliated with the University of Agder, Norway. He completed his PhD in Industrial Engineering in 2008 from Ajou University, South Korea, respectively, completed his second PhD in Information Systems in 2012 from the University of Agder, Norway. His research interest is Information and Communication Technology for Development (ICT4D). He is also interested in the Philosophy of Science and Technology. Especially, to explore the harmony between eastern and western philosophy and their application in ICT4D research. His work has been published in international conferences such as IFIP WG 9.4, IFIP WG 8.2, ICIS, DESRIST, PACIS, and HICCS. He has published in international journals such as Information Systems Journal (ISJ), International Journal of Information Management (IJIM), Springer Lecture Notes in Computer Science, International Journal of Control, Automation, and Systems (IJCAS), Communications of the Associations for Information Systems (CAIS), Electronic Journal of Information Systems in Developing Countries (EJISDC), Information Technology for Development (ITD), Journal of Information Technology and International Development (ITID), and Journal of Pattern Recognition Letters. He is currently on the Editorial Board of ISJ, EJISDC, CAIS, and IJIM data insights. Academic Memberships: AIS, AOM, IFIP9.4, SIGGlovDev, SIGPHIL.