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Clarifying the Relationship Between Fitness Apps' Affordances and Features

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Abstract

Affordance theory posits that users' engagement with technology can form affordances that facilitate goal-oriented actions. Studies investigating affordances of fitness apps employed diverse definitions of affordances. Relying on the affordance theory, we developed principles to help identify fitness apps' affordances: (1) affordances require users' perception of their usefulness, (2) app features exist regardless of users' perception, and (3) a single affordance can be enabled by multiple features. Using these principles, we examined fitness apps' affordances reported in the literature. Our results show that 12 affordances out of the 17 followed the principles, and the remainder are features of the apps. We then mapped the 12 affordances against Fitbit app's features. Our mapping identified several instances where multiple features can enable a single affordance and a single Fitbit feature could enable multiple affordances. Our findings enhance research studying the roles the features and affordances play in users' engagement with fitness apps.

Keywords

Fitness apps affordances, fitness apps features, affordance theory, user engagement.

Introduction

Fitness apps such as Fitbit and MyFitnessPal have appeared among the top-listed downloads in the growing market of mobile health (mHealth) apps (Kunst 2018). Such apps have created hope for users that they can pursue healthy habits (e.g., running and walking) more effectively and efficiently to improve their health and well-being (Vaghefi and Tulu 2019). Using fitness apps, users can access a variety of exercise programs, track their physical activity, set targeted exercise goals, and join a community whose members have similar goals (Vaghefi and Tulu 2019).

While installing the apps and starting to use them are the first steps to engaging with the apps, it is users' consistent engagement with the apps that leads them to enjoy the apps' benefits (e.g., tracking their activity and visualizing their progress) (Alshawmar et al. 2022; Chiu et al. 2020). User engagement with technology is "a category of user experience characterized by attributes of challenge, positive affect, endurability, aesthetic and sensory appeal, attention, feedback, variety/novelty, interactivity, and perceived user control." (p. 941) (O'Brien and Toms 2008). Unfortunately, studies have reported that many users have ineffective engagement with the apps and that they end their use of the apps within the first three months of use (Alshawmar et al. 2022; Cho 2016).

To understand users' engagement with fitness apps, several studies have explored what users have been afforded while engaging with the apps (e.g., guidance and activity monitoring), through the lens of Affordance Theory (Alshawmar 2021; Alshawmar et al. 2021; Alshawmar and Tulu ; James et al. 2019a; James et al. 2019b; Rockmann and Gewald 2018). Affordance theory holds that users' engagement with

technology (with respect to their goals, needs, characteristics, etc. and the technology's features) can lead to forming one or more affordances that fit only that particular group of users (Strong et al. 2014). For example, while some users engage with Facebook features such as "updating geographic locations" and "sharing own photo" to present themselves to others, other users might engage with other features such as "watching videos shared by others" to browse others' content (Karahanna et al. 2018). Hence, engagement with technology (Facebook) varies among users depending on which needs they can satisfy by using the technology (Karahanna et al. 2018).

In the context of fitness apps, studies have identified several affordances shared by users (Alshawmar 2021; Alshawmar et al. 2021; James et al. 2019a; James et al. 2019b; Rockmann and Gewald 2018). The studies found that fitness apps can afford users exercise guidance, self-monitoring, competing with others, comparing their performance with others, etc. (Alshawmar 2021; Alshawmar et al. 2021; James et al. 2019a; James et al. 2019b; Rockmann and Gewald 2018). Identification of these affordances is helpful for research that aims to discover how they are related to user engagement with fitness apps (Alshawmar 2021; Alshawmar et al. 2021; James et al. 2019a; James et al. 2019b; Rockmann and Gewald 2018). For example, James et al. (2019a) found that users with extrinsic exercise goals (e.g., appearance) will be less likely to use fitness apps to socialize with others. Hence, the socialization affordances will be less likely to be accepted by this group of users.

However, previous fitness app studies have employed diverse definitions when identifying the affordances and have applied different ways of using them in research. For example, in some studies, exercise coaching is a fitness app feature limited to "live, personal coaching" (James et al. 2019a; James et al. 2019b), while in other studies coaching is a fitness app affordance that can be reached through the use of various fitness app features such as on-screen visual guides, video or audio workouts, alerts for pulse zones, or interval training (Alshawmar et al. 2021; Rockmann and Gewald 2018). While the studies in the latter group found that an affordance (exercise coaching) could be provided through the use of various fitness app features, other studies indicated that a single fitness app feature (e.g., leaderboards) could lead to different affordances (e.g., performance comparison and achievement recognition). The plurality of the affordance definitions and uses raises the need for the clarification and foundation of common terms, which can lead to more advantageous future applications.

This paper aims to clarify the difference between affordances and features of fitness apps in two steps. First, we will employ affordance theory to examine fitness app affordances discovered in the literature and explain their relationships to the app features. Second, we will follow the methodology utilized by Karahanna et al. (2018) to empirically map affordances of fitness apps with features of Fitbit, one of the most downloaded and comprehensive fitness apps. This will increase our understanding of the distinctions and relationships between fitness app affordances and features.

Background

Affordance Theory

Affordance theory was originally proposed by Gibson (1977), who coined the term "affordance" to denote the relationship between humans and objects. Gibson (1977) explains that humans interact with an object directly by perceiving what it offers or affords to them, for either good or ill. For example, humans use a chair to sit, stand, or lie down based on their perception of its usefulness. Gibson (1977) explained that the notion of affordance cuts through the dichotomy of humans and objects and is not related to one over the other.

Ecological Psychology scholars added additional explanations to Gibson's view, arguing that humans and objects have several properties that influence and create affordances (Chemero 2003). Specifically, they argued that humans and objects have properties that lead humans to reach affordances (Chemero 2003). For example, some described the properties as systems of humans and objects taken together (Chemero 2018; Stoffregen 2003). Human systems include physical and mental characteristics such as body scale, power, talents, flexibility, beliefs, and emotional states, while an object's system compensates for its physical features, such as its shape and color (Chemero 2018; Stoffregen 2003).

Affordance Theory and IT

In the technology context, Markus and Silver (2008) explained that affordances are not technology features but rather are enabled by technology features, and a group of users can share them. In this view, the technology features are treated separately from technology affordances; however, there is a relationship between the features and the affordances. Leonardi (2011) pointed out that "people do not interact with an object prior to or without perceiving what the object is good for" (p. 153). Volkoff and Strong (2017) added, "A technical artifact does not have any affordances except in relation to a goal-directed actor" (p. 4). In this view, a user's perception of a technology's usefulness is required for affordances to exist. These studies emphasize the requirement of users' perceptions of the usefulness of the technology and provide a clear distinction between the technology's features and its affordances. Furthermore, the definitions create a way to distinguish the technology's features and affordances.

Since users' identification of a technology's affordances require their perception of what the technology is useful for, the elements of the technology that can be described in the absence of the user's perception are the features of that technology. For example, we can describe a chair element in terms of its size and the materials used to build it (e.g., a large wooden chair) before considering its sitting affordance. Similarly, we can describe an app or website's (e.g., Facebook's) elements by its features (e.g., direct messaging) before considering its affordances (e.g., communicating). Since a chair is made of simpler elements than a technology, it is easy to determine which elements are used to enable the sitting affordances. A technology object like Facebook has many features (elements) which users can use that could enable communicating, such as comments, posts, and chat. Hence, determining features used to enable an affordance requires an investigation of how users engage with the technology. Based on the affordance theory literature, we define the technology's features as a set of technical properties implemented in the technology by the designers envisioning that they can be useful in some ways to the users. We define technology affordances as the results of users' interactions with these features, specifically their perceptions of what they are useful for.

Affordance Theory in fitness apps research

In fitness app studies, several overlapping affordances and features have been found. For example, while sharing activity progress is an affordance of fitness apps in some studies (James et al. 2019a; James et al. 2019b; Suh 2018), it is considered a feature that enable an affordance such as self-presentation (being able to present oneself to others) in other studies (Rockmann and Gewald 2018). Furthermore, the self-presentation affordance can be enabled by various other features such as a setting profile page and posting activities (Rockmann and Gewald 2018). Karahanna et al. (2018) explain that sharing one's own photo or video is a Facebook's feature that enables a self-presentation affordance, while sharing links of videos or blogs of others are features that enable a content-sharing affordance. In this case, sharing activity progress is similar to sharing one's own photo on Facebook in that both could enable users to present themselves to others. Thus, sharing activity progress and setting profile are features of fitness apps that could be used by users to present themselves to others (affordance).

Based on the literature on affordance theory, we created three principles that distinguish fitness apps affordances and features and explain their relationship:

1. affordances require users' perception of their usefulness
2. app features exist regardless of users' perception of them as enablers (capabilities)
3. a single affordance can be enabled by multiple features

The first principle is that affordances require users' perception of their usefulness to a particular user or group of users. Thus, when we examine fitness apps studies sharing affordance studies (James et al. 2019a; James et al. 2019b; Suh 2018), we found that they mention the sharing of users' activity progress. One of the benefits of sharing activity progress is that it will enable users to present themselves to others, as a fitness apps study indicated (Rockmann and Gewald 2018). Thus, self-presentation is an affordance, and sharing achievements is a feature' that enables it. However, one should realize that since an affordance (e.g., self-presentation) can be perceived by group of users, some users may acknowledge its existence but do not find it useful. Therefore, it is important to apply the second principle to avoid confusion.

The second principle is that fitness app features are the enablers of the apps affordances and cannot be changed based on users' perceptions; users can either use them to enable an affordance or not. For example,

when a fitness app is designed with a sharing activity progress feature, no one can argue that the app does not have the sharing activity progress feature, while they can argue that they use other features (e.g., setting profile page) to reach self-presentation. Thus, features are enablers that can be identified by asking the users what they use, while affordances can be identified by asking the users what they use the features for (showing the distinction of usability vs. usefulness).

The third principle is that an affordance can be enabled by multiple features. For example, self-presentation affordance could be enabled by a user through editing their profile page and through sharing their activity progress (Rockmann and Gewald 2018). On the other hand, creating a profile feature can only be accessed when a user is interacting with their profile page. Therefore, an affordance can be enabled by multiple features while a feature can only be access when a user is interacting with that feature.

Methodology

To differentiate between fitness apps' affordances and features, we followed three steps introduced by Karahanna et al. (2018). First, we identified fitness apps' affordances documented in previous studies. However, we did not cover affordances documented in all fitness apps studies. Instead, we searched for papers that have uncovered fitness apps affordances in their studies. As a result of our initial search, we found seven papers (Alshawmar 2021; Alshawmar et al. 2021; James et al. 2019a; James et al. 2019b; Rockmann and Gewald 2018; Suh 2018; Suh and Li 2022) that have mentioned fitness apps affordances in their research. After conducting full paper review, we excluded three papers that did not independently identify affordances. Instead, these studies applied affordances identified by previous researchers. We compared the affordances uncovered by the remaining four papers with each other. The comparison showed various definitions when they identified some of the affordances. We stopped our research after discovering the four papers that could be used as an example to support our argument. The documented affordances are social comparison, self-monitoring, goal promoting, exercise guidance/coaching, share activity progress, self-presentation, rewards, performance analysis, compete, watching others, remind, goal sitting, updates, search, and visualizing. We note that conceptually similar affordances frequently have been titled with different names (see Table 1). Second, each affordance was scrutinized based on the three principles and discussed among the authors until we reached a consensus regarding whether a given affordance satisfies all three principles. Third, the first author gathered features found on the Fitbit app (iOS version) through exploration of functionality and supplemented this list by reviewing the information on the Fitbit website www.fitbit.com/global/us/products/services/premium. Focusing on a single platform (Fitbit app) will allow us to conduct fine-grained research focusing on specific features rather than generalized features. We selected Fitbit because it was the most downloaded fitness app at the time of this study (Ceci 2022), and it has a substantial variety of features. Features were grouped based on their high-level functionality. The first author initially mapped the identified fitness apps affordances with the Fitbit app features and discussed them with the other authors until we reached an agreement.

No	Affordance definition	(James et al. 2019b)	(Suh 2018)	(Rockmann and Gewald 2018)	(Alshawmar et al. 2021)
1	To compare exercise performance with others	Compare		Social Comparison	Comparing Self to others
2	To collect users' exercise data	Collect	Tracking	Self-Monitoring	
3	To be guided in how to do the exercise			Exercise Guidance	Coaching
4	To be coached by a live trainer	Coach			
5	To share exercise information with others	Share	Sharing		

6	To express a preferred image of oneself			Self-Presentation	
7	To be rewarded for my exercise	Rewards		Rewards	
8	To statistically analyze exercise performance	Analyze	Visualizing	Performance Analysis	
9	To be encouraged by others for their exercise activity	Encourage			
10	To be recognized by others for their exercise activity			Social Recognition	
11	To compete with other exercisers	Compete			
12	To watch others			Watching Others	
13	To be reminded of one's exercise activity	Remind			
14	To set an exercise goal to be reached	Goal			
15	To be pushed to carry out the task				Goal promoting
16	To be updated about their exercise progress	Updates			
17	To search for exercise information	Search			

Table 1. Fitness app affordances identified in prior studies

Results

Identifying fitness apps affordances

Among the 17 affordances identified in Table 1, only 12 followed the three principles we outlined in our methodology. Hence, we excluded 5 affordances (collecting activity data, sharing activity progress, setting exercise goals, analyzing data, and live personal coaching) because they are not affordances but rather features of the fitness apps. For example, "To statistically analyze exercise performance" and "To collect users' exercise data" don't need users' perception of their usefulness to occur. Moreover, these features enable affordances, such as becoming updated on one's activity progress or competing with oneself by comparing trends in daily data.

Some affordances needed further investigation due to having similar names but different definitions. For example, while coaching affordance is found in various studies, some studies limited it to the live trainer coach that some fitness apps provide as features (James et al. 2019a; James et al. 2019b). Another study defined coaching as receiving instructions on how to accomplish their exercise task (Alshawmar et al. 2021). A different study defined this concept as guidance (Rockmann and Gewald 2018). We decided to consider guidance and coaching as an affordance that could be enabled by features such as live personal coaching as well as other features such as visual media with exercise tips. Table 2 shows the relationships among affordances and features that resulted from our analysis.

Fitness app affordances	Fitness app features enabling affordances				
	Collecting activity data	Sharing activity progress	Setting activity goals	Analyzing activity data	Live personal coaching
Comparing self to others					
Guidance					⬅ Enables
Rewards					
Encouraging					
Competing					
Reminding					
Updates				⬅ Enables	
Searching for exercise information					
Self-presentation		⬅ Enables			
Social recognition					
Watching others					
Goal promoting			⬅ Enables		

Table 2. Relationships among fitness app affordances and features

Identifying Fitbit app's features

Table 3 presents a list of Fitbit features identified and categorized under high-level functionality. Instead of listing the feature as it appeared on the app and Fitbit website, we added a verb describing how the feature could be used in different ways. For example, we add create and view to profile page features since this feature can be used in two ways. We categorized these features based on their functioning similarities to simplify the mapping task in the next step. For example, we categorized features such as call, text, and app notifications as *notifications features*.

Community features	Notifications features
- View others' profiles	- Text message
- Add new friends	- Call
- Join a group	- App
- Create a family account	**Searching features**
- Create a profile	- Available educational articles
Competition Features	- Available real-life location
- Daily or weekly step goal	- Available new activity
- Badges (with friends or by yourself)	**Analysis features**
- Trophies (with friends or by yourself)	- Dashboard daily summary panel
Communication features	- Dashboard daily history chart
- Post	- Dashboard hourly trends panel
- Cheer (likes)	- 30-day overview - PDF summary of activity

- Comment	**Sharing features**
- Chat	- Sharing your journey
Activity Tracking features	- Sharing users' activity data
- Daily steps	**Workouts features**
- Distance traveled	- Video workouts
- Calories burned	- Audio workouts
- Heart rate	- Expert advices

Table 3. Fitbit app related features

Mapping Fitbit features to fitness apps affordances

We mapped each affordance with the Fitbit features that could potentially enable it (see Figure 1). For example, we mapped the updating affordance (users are updated about their exercise progress) to the analysis features provided in the app, such as the dashboard daily summary panel, daily history chart, and hourly trends panel. Some users will be updated about their exercise progress by engaging with these features. We present our results in a visualized map that contains all identified fitness app affordances and their relationship to the Fitbit app's features for better visualization. Some affordances are mapped with more than one group of features. For example, the comparing affordance could be reached through competition features such as trophies as well as community features such as viewing others' profiles. While we color coded Fitbit features based on their high-level categories listed in table 3, we excluded some features under a particular category when their use was not relevant to their relationships with the affordances.
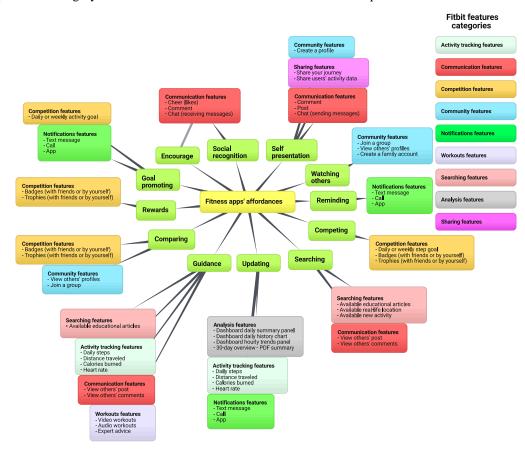

Figure 1. Fitness apps' affordance and related features of Fitbit app

Discussion

The purpose of this study was to clarify the relationship between fitness apps' affordances and their features. We proposed three principles that can be used to identify and distinguish fitness apps' affordances and features. We applied these principles to examine fitness app affordances documented in the literature and found several features that were identified as affordances in the literature. After excluding these features from the affordances list, we mapped the remaining affordances with Fitbit features.

Applying the three principles, researchers can distinguish between features of the apps and what these features could possibly enable users to reach. This distinction is essential for researchers, especially when discovering factors (e.g., users characteristics) impacting users' engagements with fitness apps. For example, James et al. (2019a) found that users with extrinsic exercise goals (e.g., appearance) will be less likely to use fitness apps to socialize with others. However, since our results show that affordances could be reached through various features, socialization affordance could also be reached through various features. These features may impact how users actualize socializations affordances. For example, if features such as comments, posts, chat are designed in a way that force users to expose their real identity, some users who feel uncomfortable exposing their real identity may not use these features. Thus, concluding that some users do not want to socialize because they have different exercise goals (e.g., appearance) may not be accurate. These users may want to socialize but the design of related features may prevent them from actualizing socialization affordance. Hence, researchers also need to uncover users' relationship with the app features that enable socializations affordance.

Our result of mapping fitness apps affordances with their related Fitbit features shows that some Fitbit features could enable multiple affordances (e.g., badges enable both rewards and comparing self to others). Therefore, studying only which app features are used may provide a limited understanding of affordances. Given that users' goals of using a feature might be different, it is important to study fitness apps features and affordances together. Our mapping of fitness app affordances and features may be useful for further research to uncover factors impacting users 'engagement with fitness apps. Researchers can use the identified affordances and Fitbit app's features to discover which features that enable a particular affordance are more likely to be used by a specific group of users.

This study provided an overview of the relationship between fitness apps affordances and features. As a result, we encourage fitness apps researchers to consider this relationship carefully and investigate fitness apps' affordances and their related features together whenever they study users' engagements with the apps to see the whole picture of the engagement.

Limitation and future research

Our goal has been to clarify the relation between fitness apps' affordances and features. Thus, we included relevant fitness app studies as a means to identify generalized affordances, i.e., those shared by fitness apps. We then examined these affordances by the principles we developed in this paper and mapped these affordances to Fitbit app features. We did not systematically collect all fitness app affordances and features, as it is beyond the scope of the present study. However, a systematic collection of all previous studies' affordances and features would be useful to show the bigger picture of the relationship. Future research could systematically collect additional fitness apps' documented affordances and features and draw on the three principles to examine their relationships.

This study did not investigate whether Fitbit app features enable other affordances beyond those we found in our literature review. Instead, we focused on documented affordances. Future research could use these features to uncover different affordances.

We note that Fitbit may be used as an app-only or wearable device linked to the app. In this study, we identified the features that are available by using the app alone. Hence future research could include features and affordances of the wearable device.

Conclusion

This study contributes to the fitness app literature by clarifying the relationship between the apps' features and affordances. Drawing upon affordance theory literature, we created three principles that can help

researchers and designers distinguish between fitness apps' features and affordances. We examined some fitness apps' affordances in the literature and identified those affordances that are features of the apps. We mapped the identified affordances with the Fitbit app's features to reveal the bigger picture of the relationship. This study can be used as a guide for fitness apps researchers when using affordance theory to study user-fitness apps engagement.

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