Interactive Affordance of Integrative Internet Social Media Platform Use by Patients and Physicians: A Mixed-Method Approach

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Abstract

Background: Integrative internet social media platform (IISMP) integrates the features of mobile and social media technologies as well as the legacy healthcare systems to support healthcare processes for patients and physicians that enables patient-centered care. To better understand the use of IISMP, especially the digital interactions between patients and physicians, we develop the concept of interactive affordance and use a mixed-method approach to identify and present the interactive affordance patterns based on patient event logs, physician-patient online consultation conversation texts, interviews, and focused group from a large hospital.

Objective: This study proposes a new type of affordance, referred to as interactive affordance, which represents the interactions between physician and patient when they both use IISMP for providing care to the patient. We identify interactive affordance patterns and investigate their impacts on organizational changes in the healthcare context.

Methods: We use a mixed-method approach to analyze various data collected from both primary and secondary sources. The data includes 45,147 archival healthcare event logs, 13,332 conversation texts, 15 interviews, and eight focus groups data from a large hospital that has implemented an IISMP. We use grounded theory analysis, process mining, text mining, and social network analysis to identify interactive affordance patterns and their impacts on healthcare processes and outcomes.

Results: Based on the results from text mining, processing mining, social network, and ground coding analysis, we identify virtual healthcare consultation between patient and physician using IISMP as interactive affordance. The analysis results from the mixed-method approach confirm that interactive affordance, virtual consultation affordance, of IISMP use contributes to the changes in the communication and decision-making processes between patients and physicians. The virtual consultation affordance promotes patient-centered care by increasing patient's access to care, empowerment, and engagement.

Conclusions: The concept of interactive affordance is proposed as a new type of affordance to represent the interactions between patients and physicians emergent by using IISMP in healthcare organizations. This new affordance type explains organizational changes toward patient-centered care.

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KEYWORDS: integrative internet social media platform; interactive affordance; patient-centered care; mixed-method approach; process mining; text mining; social network analysis; interview; focus group; grounded theory analysis

Interactive Affordance of Integrative Internet Social Media Platform Use by Patients and Physicians: A Mixed-Method Approach

Introduction

Patients increasingly need to forge partnerships with their clinicians and to gain access to their real-time health records anytime and anywhere to effectively enhance their healthcare [1]. Taking care of the patient's needs is an essential element for patient-centered care process which emphasizes access to care, patient focus, patient activity, and patient empowerment [2, 3]. Internet-enabled healthcare technologies, such as mobile technologies, sensory healthcare monitoring devices, and telemedicine tools, have been developed to enable organizations to provide pervasive healthcare that meets patients' needs for patient-centered care. Pervasive healthcare makes healthcare available to anyone, anytime, and anywhere by removing location and time constraints, while increasing healthcare coverage and quality [4]. Mobile technologies enable convenient, anytime, and anywhere access to healthcare services and health information. Mobile messages affect patient-physician communication, patient healthcare-seeking behaviors, and health outcomes [5]. Sensory healthcare devices play an essential role in actively taking care of those in need of immediate care by monitoring their critical vital signs on a real time basis. Telemedicine provides patients who have difficulty travelling or have little access to local hospitals with an alternative, convenient way to meet with doctors and get necessary diagnosis and treatments [6]. Although healthcare systems based on pervasive technologies have great potentials to for achieving on-demand remote patient consultation, both patients and providers are challenged with the uncertainties related to the use to the technologies [6,7]. There is a need to develop theories that help understand and promote effective patient-physician online consultations through internet-enabled healthcare technologies.

A new technology, a mobile app seamlessly integrated into a social media platform, has emerged. We refer to this technology as *Integrated Social Media Platform* (IISMP). IISMP combines the advantageous features of mobile (e.g., easy to access) and social media technologies (e.g., connection to others). The mobile technical features allow users to access the technology anytime and from any location [8]. Social media technology offers interactive and persistent features which provide a base for interpersonal associations between users [9]. The use of IISMP alters the patterns of how people connect and access data. Examples of IISMP include Facebook, KaKao, and WeChat. Integrated with legacy systems that support routine operations, IISMP has been used in various sectors, including banking, government, and commerce. IISMP has been adopted in healthcare organizations to offer functionalities embedded in the pervasive, integrated mobile and social media platform that provides universal access and easy connections for patients and physicians. IISMP, as a new emerging pervasive technology, changes the practices of healthcare organizations by enabling patients to reach beyond traditional hospital information systems to meet patients' needs.

Objectives of This Study

In this study, we investigate how IISMP is perceived and used by healthcare service providers and patients through the lens of the affordance theory. We also examine the effects of IISMP use on patient-centered care using a mixed-method approach with various data collected from a large hospital. The concept of affordance was originally developed based on relations of material and social actors [10-12]. Those relations represent different types of affordances

depending on an actor's perception toward technology uses and actual actions to use a technology. Researchers have studied affordances from various angles and proposed different types of affordances, including individual and organizational affordances [13, 14]. There has been a call for research on the interactive relations between social actors to explain the complex phenomenon of technology use [13, 15]. Following this call, we propose a new type of affordance, referred to as the *interactive affordance*, which represents the interactive relations between two social actors. This study reveals the users' perception and actual use of a technology when a patient and a physician interact with each other.

We show evidence of interactive affordance by identifying the virtual healthcare consultation affordance between a patient and a physician when they use IISMP consulting features. We also investigate how this interactive affordance changes healthcare processes and contributes to patient-centered care. The results derived from a mixed-method approach that applied both qualitative and quantitative analyses on various data sets collected from both primary and secondary sources, including IISMP system archival data, interviews, and focus group studies, show that the virtual healthcare consultation affordance changes the communication and decision-making processes between patients and physicians, and increases the level of patient access, patient empowerment, and patient satisfaction, which are the essential dimensions of patient-centered care [3].

Literature Background

Affordances

An affordance, according to Gibson's original definition, is what is offered, provided, or furnished to someone by an environment [16]. This affordance is referred to as objective affordance. Subsequently, researchers have viewed affordance as the relationship between an actor and an artifact [11] and conceptualized perceived affordance by putting more weight on the perception of the users about the affordance beyond the objective affordance of the technology [17]. More recently, Leonardi [18] and Strong et al. [14] defined affordance as the potential for behaviors associated with achieving an immediate concrete outcome and arising from the relation between an artifact and a goal-oriented actor. They extended the affordance concept to actualization, which is defined as "the actions taken by actors as they take advantage of one or more affordances through their use of the technology to achieve immediate concrete outcomes in support of organizational goals" [14]. The actualized affordance is considered as a mechanism for organizational changes [19, 20].

Leonardi [13] suggested the concept of individual affordance. An individual affordance is enacted by someone who uses a technology's features, reflecting a simple interaction between an individual and an object. He also suggested the concepts of shared affordance and collective affordance as organizational affordances. Organizational affordance represents how people in an organization actually use technology in a given context. Shared affordance is proposed as a group of people using a system in a similar way [13]. Collective affordance is proposed as an organizational affordance that many users collectively create to perform a task. Connective affordance, as a collective affordance, contributes to the connective action of an organization [21]. Strong et al. [14] proposed a similar concept, a bundle of affordances, which groups a set of affordances with dependency. Table 1 summarizes the different types and levels of affordances studied in the literature.

Table 1. Types and levels of affordances

Type	Level	Affordance name
Objective affordance	Object/technology	Objective affordance [16]
Perceived affordance	Individual	Perceived affordance [10]
Actualized affordance	Individual	Individualized affordance [11]
	Organization	Shared affordance, Collective affordance [13], Connective affordance [21], Bundles of affordances [14]

Individual and organizational affordances capture the perception and actual use of a technology at the individual and organizational levels. However, the literature has not paid attention to one important aspect of technology use, the interactive relation between two individuals when they interact with each other through using the same technology to perform an interdependent task [13, 15]. In addition to capturing technology affordance from an individual user's point of view and from an organization's point of view, it is important to capture technology affordance by considering the interactions between two users in an organization.

Conceptual Development

Interactive affordance

We propose a new type of affordance, interactive affordance. An interactive affordance is defined as two users' interactions that were facilitated by their using a technology. Interactive affordance is contextualized, i.e., the uses of a technology are determined by specific feature uses under a specific context among two users who need to interact to complete an interdependent task.

Individual affordance and interactive affordance are conceptually different. Individual affordance is related to a person's using technology to meet personal needs such as learning [22], engagement [23], or satisfaction [24]. On the other hand, interactive affordance is related to how two persons' uses of a technology enhance interactions among them. Interactive affordance enables social connections [25], continuous information sharing [22, 24], and collaboration [25] among technology users.

In this study, we consider actualized interactive affordance. Actualized affordance is considered as a mechanism for organizational changes [19, 20]. The imbrication of human agencies and the material agencies creates infrastructure in the form of routines [18]. The organizational level affordances are considered as pooled individualized affordances [13]. Therefore, understanding lower-level affordances is important because it helps organizations find ways to enact certain affordances that lead to desired organizational changes. For this reason, interactive affordance, along with individual affordance, plays a foundational role in structuring organizational affordances. The new concept of interactive afforce helps explain how technology use by two people changes organizational processes and outcomes.

Methods

Research Site

We chose a large hospital in China, which has more than 3,000 beds, 2,700 employees, and 1,200,000 outpatient visits per year, as our study site. The hospital implemented IISMP as an

enabler for transforming its processes and culture to become patient centered. The IISMP was integrated with other health information systems, including a computerized physician order entry (CPOE) system, an electronic medical records (EMRs) system, a decision support system using data mining, a patient portal, an online services platform, a knowledge management system, a medical card system for patient's identity and insurance coverage. As such, the research site is relevant and suitable to study the affordances of a new technology, IISMP, and its impacts on patient-centered process changes.

The IISMP technology integrates the social media features and the functions of health information systems, being implemented in the WeChat platform, one of the most widely used mobile social media platform in China. Primary users of the IISMP technology are patients and physicians who can access the same technology in a unified platform to perform e-healthcare administrative processes or virtual medical consultations. The IISMP technology enable the patients and the physicians to access and sharing information on a real-time basis, receive alerts that support their decision-making process, and conduct online consultations. The online consulting feature is one of the most commonly used features in IISMP. It provides both patients and physicians with an inexpensive, easy-to-use means of communication to hold interpersonal or multi-group chatting sessions. Another popular IISMP feature is online scheduling where patients can schedule appointments to visit doctor's offices at the hospital and alerts to get timely notifications regarding upcoming appointments.

Data Collection

Drawing upon the prior literature [27, 28], this study adopts a mixed-method approach which utilizes both qualitative and quantitative analyses to identify potential affordances and investigate their impacts on the clinical process changes. Accordingly, two different types of data were collected for the analyses: 1) primary qualitative data, including the transcripts of individual interviews and focus groups studies, and 2) secondary system data, including user event logs and patient-physician conversation texts archived in the IISMP system.

To collect the qualitative data, we conducted in-depth interviews with patients and healthcare providers to understand their perceptions of IISMP and the actual IISMP uses. Semi-structured interviews were conducted with nine physicians, three patients, an information systems project manager, and two executives. Two focus groups consisting of eight physicians were held to understand their perceptions of IISMP uses and actual experience using the IISMP technology.

As per the system archival data, to investigate the actual usages of the IISMP technology, we obtained system data of event logs that cover nine months before IISMP implementation and event logs that cover nine months after IISMP implementation (starting from three months after IISMP was launched). The collected data includes the conversation texts between patients and corresponding physicians and the event logs of all IISMP users. The conversation data consists of 13,332 text messages, and the event log data consists of 45,147 logs.

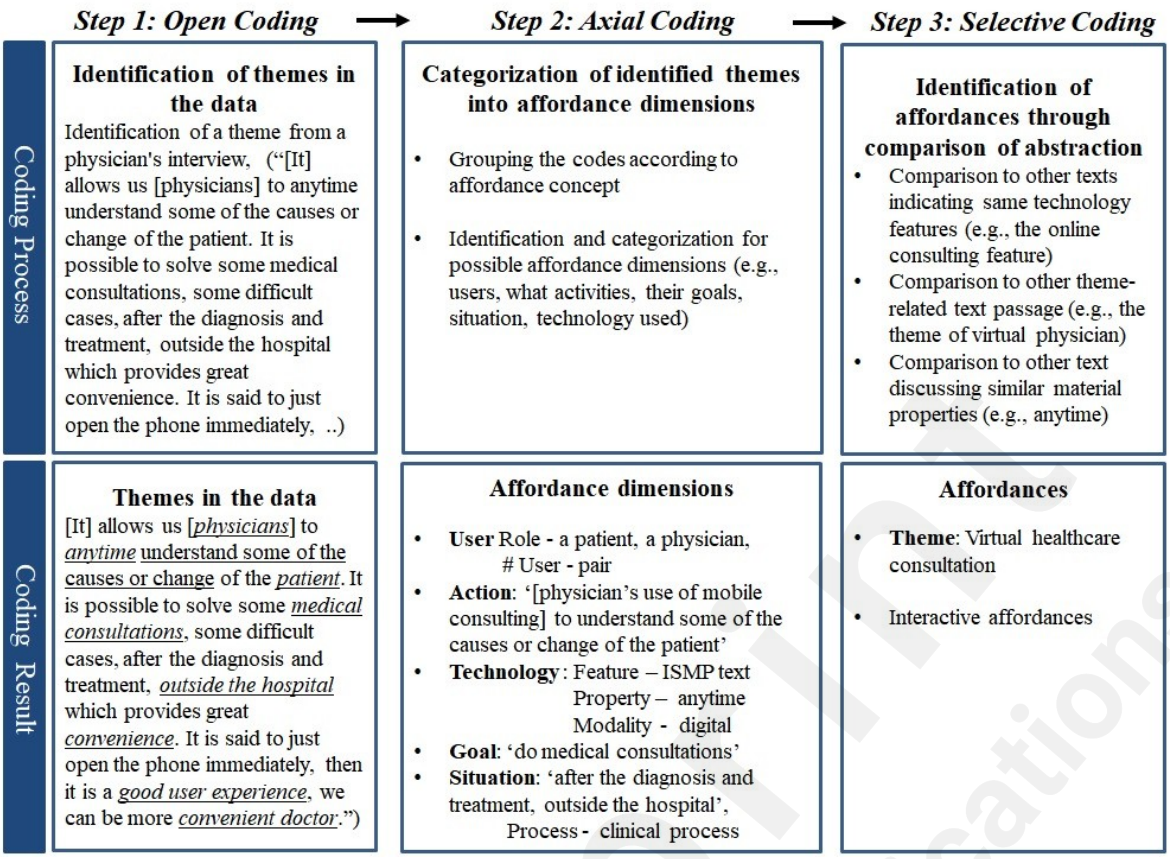
The system data are digital traces which are a new type of instrumentation capturing individual technological activities [29]. Digital traces reveal routines in digital artifacts. Existing affordance research (e.g., [14, 18, 24]) suggests that the affordance theory naturally lends itself to qualitative means of examination [29]. Perceived affordances are identified based on the interview and focus group which help us to understand user’s perceptions related to the use of IISMP. The quantitative system data enables us to identify what affordances are actualized.

Data Analysis

By employing a mixed-method approach on both primary and secondary data sources, we use qualitative analyses to mainly identify interactive affordance of IISMP, which was confirmed by quantitative analysis. We use quantitative analyses to mainly show how interactive affordance contributes to patient-centered care, which was confirmed by qualitative analysis results. The integration of quantitative and qualitative approaches helps address the limitations of each approach and add different analytical values by providing means to theoretically and empirically triangulate phenomena that are not available when utilizing only a single approach [27, 28]. We discuss below the specific mixed methods used in this study.

Grounded Theory Analysis. We conduct a grounded theory building approach based on Berente and Seidel [31] regarding sampling, synchronic analysis, reference lexicon, and diachronic analysis of qualitative data. First, in order to develop categories and their associations, we use coding techniques associated with a grounded theory approach with the data of interview transcripts and focus group transcripts by categorizing open, axial, and selective codes [32, 33]. Then during the open coding, we use an inductive approach to identify common patterns related to the IISMP technology uses emerge. During the axial coding, we code the data for affordance dimensions (e.g., action, object properties, user characteristics, and goals) and sub-dimensions adopted from the study of Gaskin et al. [34]. We consolidate the emerging themes into distinct theoretical patterns during the selective coding through constant comparisons of affordance dimensions and existing affordance literature. Then, the coding results to reveal a theme that indicates affordance in the IISMP uses with the abstraction and comparison of other affordance dimensions. Figure 1 depicts the overall coding process of the ground theory approach used in this study.

Figure 1. Data coding process of the grounded theory approach



Process Mining Analysis. In order to analyze the event log data from system archival, we apply a process mining technique suggested by Gaskin et al. [35]. Process analysis is performed along with statistical clustering methods that reveal the sequences of healthcare activity routines. The process mining technique supports real healthcare processes in a bottom-up fashion from the actual data. The results of the process mining analysis reveal vital actions in the real healthcare processes and the clusters of affordance dimensions.

Text Mining Analysis. With the patient-physician conversation text data during their IISMP consultation session, text clustering and conceptual map are applied as text mining techniques to find similarities of conversation text data. A text clustering algorithm measures the overlap of words in pairs of texts and computes the word similarity, using the standard term frequency-inverse document frequency similarity [36, 37]. A text clustering result represents clusters with label words based on the word similarity. A conceptual map uses a similar approach with a pairwise topical distance between texts. The result uncovers latent topic in a text corpus, using Latent Dirichlet allocation based on the distribution of co-occurred words in the same document [35]. As such, the process mining analysis and the text mining analysis enable us to identify interactive affordance of IISMP and its impacts on patient-centered care.

Social Network Analysis. Network analysis methods are used to explore the social networks between patients and physicians. Nodes represent individual patients and physicians, and edges represent connections between them. The social network analysis result shows how human networks are affected by the affordances of IISMP technology [38, 39].

Results

We present our main results in two parts. First, we show the results to support the identification of a new interactive affordance, the virtual health consultation affordance. Then, we present the results

showing the impact of this new affordance on patient-centered care.

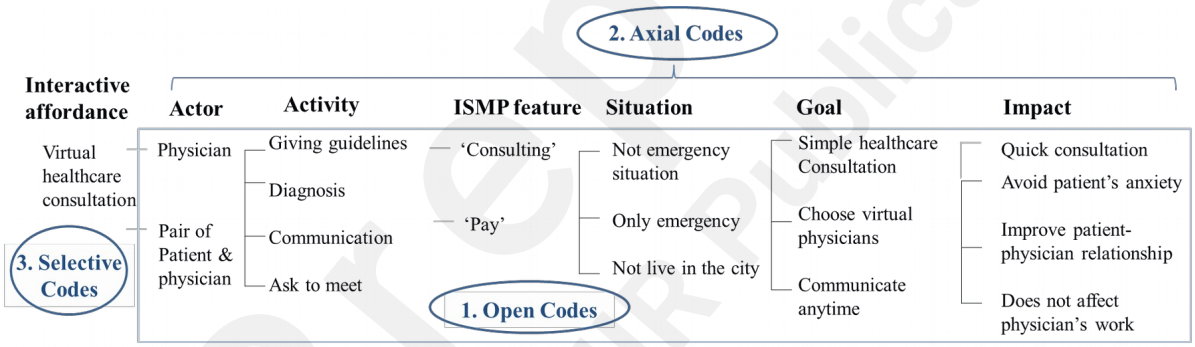
Result 1: Identification of the Virtual Healthcare Consultation Affordance

We found from various data sources that patients and physicians recognize the usefulness of the IISMP consulting feature and use the features to perform healthcare consultation tasks. Providing guidelines and pre-diagnosis were facilitated with the emergence of a new interactive, actualized affordance, referred to as the *virtual healthcare consultation* affordance.

Grounded Theory Approach

Figure 2 shows the structure of open, axial, and selective codes based on analyzing the scripts of the interviews and the focus groups. The results suggest that interviewees and focus group participants perceive virtual healthcare consultation as the most emergent, interesting use of IISMP features. This is consistent with the findings of prior studies. Virtual healthcare consultation using telemedicine and social media has been introduced as an emerging and important area in healthcare literature [40, 41]. Our results also show that this new interactive affordance emerges only when both a patient and a physician use the mobile consulting feature provided by the IISMP technology to conduct virtual healthcare consultations. This indicates the virtual health consultation is an interactive affordance, which we propose as a new type of affordance between two users, the patient and the physician, in this study.

Figure 2. Results of grounded theory approach

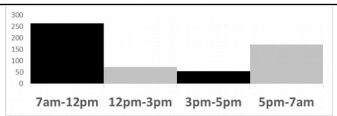


Process Mining Analysis

The sequence analysis with the system event logs data reveals not only activity sequences but also patterns in user roles, technology features, locations, and time [35]. Figure 3 depicts the four main process variants revealed from the process mining analysis. The results show that IISMP consulting process emerged and occurred in two ways: mobile consultation using IISMP in a virtual world or face-to-face consultation at the hospital. The face-to-face consultation had been practiced before the implementation of IISMP; therefore, the results indicate that the virtual healthcare consultation using IISMP's chatting feature emerged as a new way of consultation. The time distribution of IISMP consulting feature use in Figure 3 reveals virtual consultations occur during both regular operation hours (black bar) and off operation hours (grey bar), suggesting patients accept the use of IISMP consulting for healthcare service at off hours as well as regular hours.

Figure 3. Results of process mining analysis

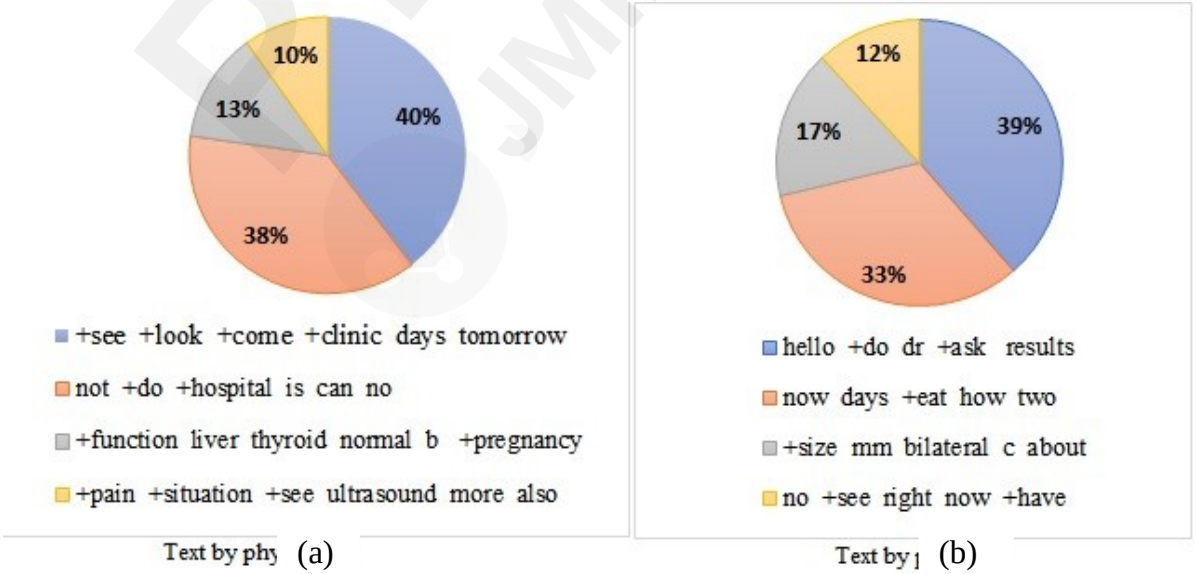
Variant	Activity sequence	Technology feature	Time distribution of technology use

1	Initiate ISMP Consulting	IISMP consulting	
2	Initiate ISMP Consulting → Complete ISMP Consulting	IISMP consulting	
3	Initiate ISMP Consulting → Continue → Complete ISMP Consulting	IISMP consulting	
4	ISMP Scheduling → Onsite Consulting → Initiate ISMP Consulting → Complete ISMP Consulting	IISMP scheduling, Onsite consulting	

Text Mining Analysis

A text clustering algorithm is applied to analyze 13,332 conversation text messages. As shown in Figure 4, the analysis results reveal how physicians and patients interact with each other and what information they exchange, and when they use the IISMP mobile consulting feature. We identify new practices that patients and physicians ask and respond to questions about test results and healthcare guidelines using the IISMP mobile consulting feature. These actions capture the virtual healthcare consultations occurred through the patient's and the physician's uses of IISMP. According to Figure 4 (a), physicians' texts are clustered around the following three main activities using the IISMP mobile consulting feature: an in-person visit to the hospital (78%), discussing test results (13%), and giving guidelines (10%). Giving guidelines is related to physicians' medical consulting tasks such as pain management, dietary, or physical routines. The other two activities are related to the pre-diagnosis task that a physician recommends patients visit the hospital the next day when the physician suspects a disease after reading the patient's medical testing results. The result indicates that the pre-diagnosis task appears as IISMP consulting feature is newly adopted.

Figure 4. Text clustering results for conversation texts



The main actions based on the patients' conversation texts include asking physician's opinions about patients' test results (56%), asking for guidelines (33%), and updating patients' conditions (12%). More than half of the conversations are inquiries about test results that

patients have viewed. Below is a typical example of written conversations between a patient and a physician. A patient sees his or her test results and initiates an IISMP consulting conversation by stating, "Dr. A, my test results came out. Is 125 high? Will it be no problem, right?" Within one minute, the doctor responds to the patient with a simple answer, "Not too high." They continue the conversation by exchanging follow-up questions and answers. Patients initiate healthcare consultations with physicians as IISMP mobile consulting feature becomes available, indicating patient engagement.

The virtual healthcare consultation is an actualized affordance because the process mining result and the text clustering result with actual IISMP usage data reveal the actions [14]. It is also an interactive affordance because two individuals (i.e., a patient and a physician) use the technology (i.e., IISMP consulting feature) to perform an interactive and interdependent task (i.e., health consultation).

Result 2: Impacts of the Virtual Healthcare Consultation Affordance on Healthcare Processes

This section shows how interactive affordance, virtualization healthcare consultation, leads to patient-centered process changes. The analysis results suggest that virtual *healthcare consultation* affords access to care, patient-focus, patient activity, patient empowerment, which are the four dimensions of patient-centered care [3]. The virtual healthcare consultation affordance also improves patient satisfaction.

Process Mining Analysis

The process mining results show patterns in user roles, technology features, location, and time-related to the sequence of activities with the IISMP mobile consulting feature. As shown in Figure 3, the interaction pattern in terms of time suggests that close to half of the conversation texts were generated during off operation hours (46%). This indicates that the new affordance increases patient *access to care* during off-operational hours. The 'anytime' characteristics of the IISMP consulting technology provides patients and physicians with more time choices for virtual healthcare consultation service beyond regular operation hours.

Social Network Analysis

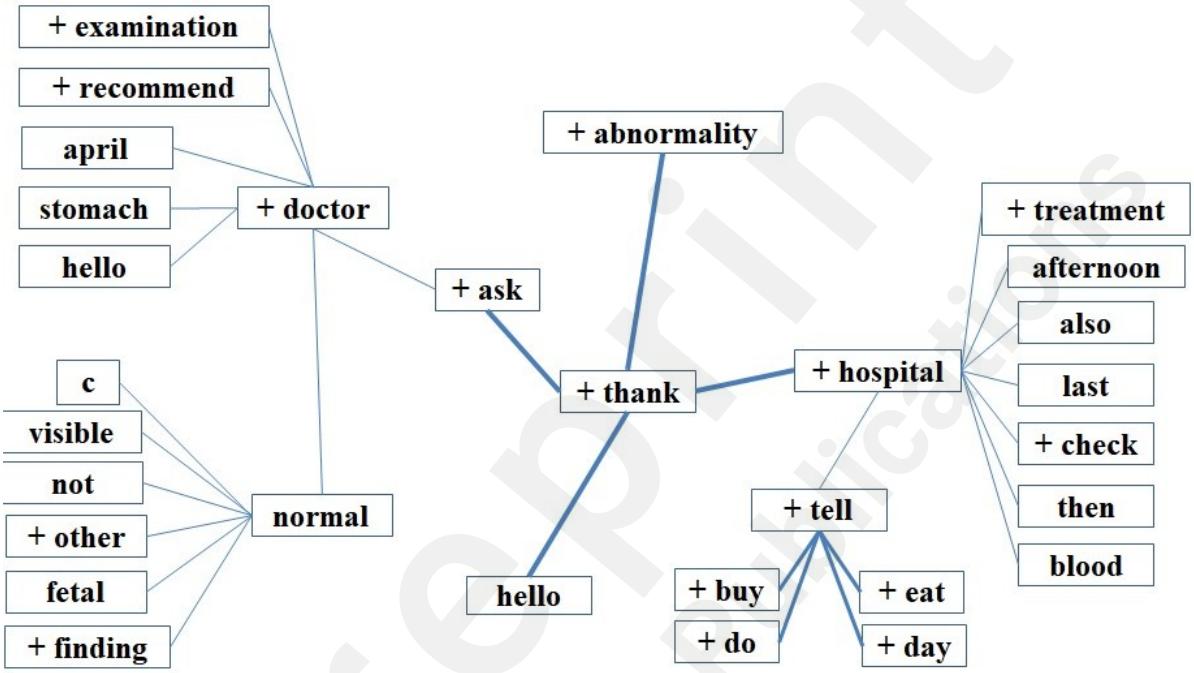
We utilize a social network analysis to examine the relationships between patients and physicians. The results reveal that many patients try first to contact the same physician who previous attended them at the hospital. However, if a patient cannot reach her attending physicians for some reasons (e.g., the physician is too busy to use IISMP or does not want to give opinions over IISMP chat), she quickly switches to a new physician. Once the patient receives responses from the new physician, a new relationship is formed, and is maintained in subsequent IISMP consultations. The results suggest IISMP affords patients with more choices for consulting physicians, either with their attending physicians or with newly formed ties with other physicians. As such, virtual healthcare consultation affordance alters the relationships between patients and physicians. In some cases, we also notice that an interactive affordance fails to emerge if a physician does not use the IISMP consulting feature, even though the technology affords them to be connected.

Text Mining Analysis

We use a text mining analysis to examine if and how virtual healthcare affordance affects patient-centered care. Figure 5 presents a conceptual map obtained by analyzing the conversation texts made by patients. The results suggest that the IISMP consultation feature is useful to patients who live far away from the hospital. For example, one patient states that "I do

not live [in the city where the hospital is], but I will go down [to the city where the hospital is] tonight". The virtual healthcare consultation is also suitable for caregivers who want to talk with physicians on behalf of such patients as seniors, pregnant women, or children who are not able to travel to the hospital. The IISMP enables the consultation services to be available regardless of a physician's operation hours ("Oh Dr. B, sorry to disturb you so late," conversation text by a patient), even when a physician is off ('Today, I am out of the clinic," a conversation text by a physician). As such, the characteristics of anytime and anywhere of the mobile consulting feature enhancing patient centered care by improving *access to care*.

Figure 5. Text conceptual map from text mining analysis



Our analysis results also show that the IISMP consultation feature offers emotional comfort and support to patients. For example, as a response to a doctor's simple text message, "normal," a patient expresses a feeling like, "you say normal, which makes me quite at ease." The quick delivery of these simple text messages through the IISMP consulting feature gives patients immediate emotional relief. This illustrates the positive effect of virtual healthcare consultation affordance on patient satisfaction in healthcare processes.

The text mining analysis confirms that virtual healthcare consultation affordance is positively associated with patient satisfaction. As shown in Figure 5, the terms co-occur with the centered term "thank you or thanks." The result suggest that patients thank doctors for all doctor's medical services using the IISMP consulting feature, which indicates the mechanism through which the IISMP technology improves patient satisfaction. It also shows the patient's appreciation to the hospital which offers this virtual space to give patient on-demand access to physicians regardless of location and time. This result suggests that virtual healthcare consultation affordance provided by the IISMP improves patient satisfaction toward the physicians and the hospital.

Grounded Theory Approach

Patients often initiate a conversation using the IISMP consulting feature which rarely happened

before the era of the IISMP. Patients become more proactive and engaged in their healthcare processes. Also, physicians can understand more about the patients by building an everyday basis relationship with patients. A physician in the focus group points out how the IISMP technology use has changed the healthcare processes:

> "Patients sent the results of several check-ups through [the IISMP technology]. I do give him answers to some personal questions. I recently discovered that communicating with a patient may be a starting point, but it also increases the number of exchanging communications with the patient. After we [physician and patient] communicate on WeChat, I have a *basic understanding* of the patient."

The focus group results indicate that virtual interaction promotes shared understanding which plays a foundational role in shared healthcare decision making. Hence, virtual healthcare consultation using the IISMP consulting feature enhances patient-centered care.

Interestingly, we find that the IISMP virtual consultation feature has been more frequently used by patients than physicians, which indicates that even the same technology may be used differentially depending on user's roles. Physicians envision that they can be convenient doctors to the patients by becoming virtual physicians who offer virtual medical services. The IISMP's features, anytime and anywhere, positively affect the enactment of patient's interactive affordance. However, the same feature often negatively affects physicians who are under pressure to respond to patients within a certain period. As such, physicians may choose not to respond to patients due to their workload during the operational hours or to their lack of time during off hours. A pediatrician in the focus group, for example, addressed difficulties in answering patient's messages in a timely manner. Physicians or surgeons are often too busy to check the alerts or messages in IISMP. A neurosurgeon added that the IISMP use interrupts doctors' ponderation, which may eventually lower patient satisfaction. This interruption is a negative perception of a doctor toward IISMP technology use.

Discussion

Principal Results

We propose interactive affordance as a new type of affordance that emerges when two users are involved together in using a technology to perform interdependent tasks. This study focuses on technology use for interpersonal patient-physician digital interaction. Using a mixed-method approach with both primary and second data, we identify virtual healthcare consultation as an actualized, interactive affordance.

We examine how interactive affordances contribute to patient-centered care. Our analysis results show that the interactive affordance of virtual healthcare consultation improves access to care, patient activity, patient focus, and patient engagement, which improves patient satisfaction. This finding suggests that the virtual healthcare consultation affordance, enabled by the IISMP consulting feature, contributes to patient-centered care. Interactive affordance of IISMP provides a main driver for clinical process changes that enhancing patient engagement experiences and satisfaction.

Leonardi [13] mentioned the explanatory power of affordance theory for organizational network changes can be viewed as a pool of individual affordances. Organizational changes may be explained by the dependencies among affordances between technologies and complex assemblages of users [20]. Vaast et al. [21] suggest that multiple affordances and dependencies among them enable organizational changes. However, to the best of our knowledge, the affordances that prior literature

investigated are individual or organizational level. Mechanisms for organizational changes through affordances characterized by the interactions between two users have not been adequately studied in the literature. This study aims to fill this gap by developing a novel way to understanding complicated IT phenomena in organizations with interactive affordance as a primary type of affordance. Our results empirically uncover interactive affordance and demonstrate that the virtual healthcare consultation affordance enabled by the IISMP technology brings changes in patient-physician relationships and shared decision-making, which influences patient-centered care.

Furthermore, to examine how interactive affordance emerges, we compare the relationships of interactive affordance and the relationships of individual affordance. To do, we collected the archival data of event logs for two periods: nine months before IISMP implementation and nine months after IISMP implementation (starting from three months after IISMP was launched). We collected the number of IISMP consulting features that represent interactive affordance, the number of IISMP scheduling feature for individual behavior affordance, hospital visit volume and productivity for outcome measure, and patients' and physicians' demographic information. Independent *t*-tests and regression tests are performed to compare interactive affordance and individual affordance by examining their relationships with other measures. The results suggest that individual affordance measure (i.e., the number of IISMP scheduling use) shows significant relationship with demographic information of patients (i.e., gender) and the outcome measure (i.e., hospital visit volume). However, interactive affordance (i.e., the number of IISMP consulting uses) shows no significant relationship with either demographic information or outcome measure. As such, the two types of affordance show different relationships with other measures. Therefore, they represent conceptually two different types of affordances and should be treated as such in both research and practice. The insignificant relationships of interactive affordance may indicate that interactive affordance, a new type of affordance between two users, is much more complex than a single user's technology use affordance, that is individual affordance.

Contributions

Existing studies with health technologies mainly focus on healthcare providers' practices [42, 43]. They primarily examine the healthcare technologies designed mainly for healthcare providers, not patients [42]. This study focuses on a new technology, IISMP, that focuses on supporting patients' healthcare needs as well as those of the providers.

In the affordance literature, different types of affordances have been studied [13, 45, 46]. This study adds to the affordance literature by proposing the interactive affordance at a pair level, which has not been studied before. Interactive use of a technology between two individuals is much more complex than individual use of a technology alone. This study serves as a starting point and stepstone for developing new theories that can better explain the interactive use of a technology, the interactive affordance.

By identifying the interactive affordance in the healthcare domain, this study contributes to healthcare literature. Hospitals can improve healthcare processes by promoting the actualization of the virtual healthcare consultation. Additionally, understanding what and how interactive affordances lead to desired outcomes like patient satisfaction and patient-centered care helps healthcare organizations devote appropriate attention and efforts to achieve the goals.

Methodologically, this study applies a mixed-method approach by collecting both primary and secondary data, including interviews, focus groups, conversation texts, event logs. Analyzing data from multiple sources, both qualitatively and quantitatively, enable us to triangulate our analyses and to provide holistic insights regarding the emergent interactive affordance enactment. This holistic

and triangulation approach helps researchers identify interactive affordances and understand the complex use of technology and its impacts on patient-centered care.

Limitations

The study results should be interpreted with cautions due to limitations. First, the number of participants in the interviews and the focus groups are relatively small, especially the number of patients. Our use of a mixed-method approach with both primary and secondary data serves to triangulate the data results. The findings from the qualitative analyses are reconfirmed by several quantitative analyses using extensive secondary system archival data. We believe that the converged findings from various analyses from different data sets sufficiently justify our findings.

Second, affordance enactment may be affected by situations. This paper uses a specific context and data sets provided by a hospital in China. Although the hospital adopts standard healthcare technologies and follows global healthcare processes and guidelines, the idiosyncratic nature of the hospital may affect our study. Replicative research in other hospital settings may be necessary.

Conclusions

Our study suggests new healthcare processes enabled by IISMP alters the traditional healthcare delivery. The findings suggest potentials to transform the healthcare process. IT-related phenomena are complex. The same technology is used differently by different users. To understand the complex IT phenomena, this study empirically develops a new type of affordance, interactive affordance, and provides insights on how interactive affordance enhances patient-centered healthcare.

Conflicts of Interest

None declared.

Abbreviations

IISMP: integrative internet social media platform

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