Health Communication

ISSN: (Print) (Online) Journal homepage: https://www.tandfonline.com/loi/hhth20

Adding Affordances and Communication Efficacy to the Technology Acceptance Model to Study the Messaging Features of Online Patient Portals among Young Adults

Chang M. Mao & Shelly R. Hovick

To cite this article: Chang M. Mao & Shelly R. Hovick (2020): Adding Affordances and Communication Efficacy to the Technology Acceptance Model to Study the Messaging Features of Online Patient Portals among Young Adults, Health Communication, DOI: 10.1080/10410236.2020.1838106

To link to this article: https://doi.org/10.1080/10410236.2020.1838106

Published online: 26 Nov 2020.

HEALTH COMMUNICATION
https://doi.org/10.1080/10410236.2020.1838106

Routledge
Taylor & Francis Group

Adding Affordances and Communication Efficacy to the Technology Acceptance Model to Study the Messaging Features of Online Patient Portals among Young Adults

Chang M. Mao and Shelly R. Hovick

School of Communication, The Ohio State University

ABSTRACT

The use of messaging features within online patient portals could be beneficial to patients, but many patients do not utilize these features. Furthermore, it remains uncertain the reasons why patients may (or may not) use messaging features to communicate with a care provider. This study proposes and tests an extended Technology Acceptance Model (TAM), which incorporated perceived affordances (editability and persistence) and communication efficacy. An online survey was conducted with a sample of 525 young adults. Results showed that the editability affordance was conducted with perceived usefulness, while communication efficacy was associated with perceived ease of use of messaging. Editability and communication efficacy also were positively associated intention to use online patient portal messaging features, whereas persistence was negatively associated. Results suggest practitioners should emphasize editability and communication efficacy to increase patient intentions to use messaging features to communicate with a care provider.

Introduction

Primary care, which is the first-contact, comprehensive, general, coordinated, and continuous care for most patients, plays an essential role of the well-being of the health care systems (Levine et al., 2019). High-quality, trusted, and continuous relationships between patients and their providers are defining features of primary care (Parchman & Burge, 2004). Communication is key to the development of effective patient-physician relationships (Honavar, 2018; Roter, 2000). Although communication between patients and physicians often takes place face-to-face, advancements in technology have expanded the options for communication during medical encounters to telehealth and online messaging. In particular, messaging features embedded within the online patient portal (OPP) offer convenient and direct communication with a provider. OPP messaging is growing in popularity among patients (Cronin et al., 2015; Portz et al., 2019) and providers (Haun et al., 2017). The use of OPP messaging is associated with enhanced patient satisfaction, effective care delivery, and improvements on a variety of health outcomes (Wade-Vuturo et al., 2013; Zhou et al., 2010).

We know some about how patients use messaging to communicate with providers via the OPP and the effects of messaging use (e.g., Alpert et al., 2017; Dendere et al., 2019; Rathert et al., 2017; Wade-Vuturo et al., 2013); yet, we still know little about the factors that lead patients to use a messaging feature within the OPP to communicate with their provider in the first place. Drawing on the Technology Acceptance Model (TAM), we seek to understand how the perceived usefulness and ease of use of patient-provider messaging within the OPP impact patient attitudes and intentions to communicate with a care provider. Additionally, we examine how the perceived affordances or specificities of the technology itself (i.e., the ability to edit messages and their persistence within the OPP system), as well as user communication efficacy (one's confidence in his or her ability to use the technology), impact patient attitudes and intentions of using messaging features. This study focuses on young adults, who may have different attitudes toward and intentions of using OPP messaging because of their younger age (Morris & Venkatesh, 2000), lower mortality (Xu et al., 2020), and lower utilization of preventive health care (Fortuna et al., 2009) than older age groups.

The messaging feature of OPPs

To encourage greater patient engagement and involvement, health care systems have sought to provide easily-accessible ways for patients to manage their health (Kupchunas, 2007). OPP is a secure online website which gives patients convenient 24/7 access to their health information (The Office of the National Coordinator for Health Information Technology, 2017). The messaging feature is an embedded function of the OPP that allows patients and providers to exchange messages, and is one most frequently used features (Cronin et al., 2015; Portz et al., 2019). Data suggest that patients mainly use messaging to seek clarifications or medical solutions and to make administrative requests (Alpert et al., 2017).

TAM and extensions

Many theories help understand patient intentions to use OPPs and the messaging features within them, including the Theory

CONTACT Chang M. Mao mao.252@osu.edu School of Communication, The Ohio State University, Columbus, OH 43210, USA

of Planned Behavior (Emani et al., 2016), Unified Theory of Acceptance and Use of Technology (Hoogenbosch et al., 2018), and Social Cognitive Theory (Nahm et al., 2017). The TAM framework has also been used to investigate patients' intention and behaviors of adopting OPPs and the messaging features (e.g., Kornacker et al., 2019; Lazard et al., 2016; Portz et al., 2019). TAM proposes how people's attitudes and intentions to adopt a technology are influenced by two specific cognitions: perceived usefulness and perceived ease of use. This study proposes and tests an extended TAM, which incorporates perceived affordances and communication efficacy.

Model overview

The TAM draws on Fishbein and Ajzen (1975) Theory of Reasoned Action (TRA), while incorporating perceived usefulness and perceived ease of use (Davis et al., 1989; Venkatesh & Davis, 2000). Similar to the TRA, the TAM argues that an individual's likelihood of using a technology is determined by their attitudes, which are shaped by perceptions of the technology's usefulness and ease of use (Figure 1). When a technology is perceived to increase productivity and performance, and requires little effort, individuals should have a more favorable view toward the technology.

In the TAM, perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p. 320). Ease of use is defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p. 320). In the health contexts, perceived usefulness is a key predictor of attitudes toward health technology, and perceived ease of use predicts both perceived usefulness and attitudes toward using a health technology (Lu et al., 2009; Wilson & Lankton, 2004).

Empirical support for TAM in this context

Over previous decades, meta-analyses have concluded that TAM is a robust model for predicting technology adoption (King & He, 2006; Legris et al., 2003; Schepers & Wetzels, 2007; Yousafzai et al., 2007a, 2007b). TAM explains the acceptance of a wide range of health-related technologies, including genetic testing (Heinlen et al., 2019), web-based interactive self-management technology (Or et al., 2011), and Internet-based interventions for depression (Baumeister et al., 2014). Based on the TAM, we propose (Figure 1) that the perceived usefulness of an OPP messaging feature will be positively associated with attitudes toward the messaging feature (H1). Ease of use also will be positively associated with perceived usefulness (H2) and attitudes (H3), which will be positively associated with intentions to use OPP messaging features (H4).

Subjective norms

In addition to original TAM variables, this study includes subjective norms (Figure 1). A subjective norms variable was previously added to the TAM in the Technology Acceptance Model 2 (TAM2; Venkatesh & Davis, 2000) and is defined as peoples' perceptions of others' expectations for their behavior (Fishbein & Ajzen, 1975; Venkatesh & Davis, 2000). Subjective norms is shown to predict both perceived usefulness (Venkatesh & Davis, 2000) and behavioral intention (Fishbein & Ajzen, 1975) and its inclusion improves the overall predictability of the TAM (Lu et al., 2009). Furthermore, a meta-analysis of the TAM showed that over 90% of studies supported the subjective norms-perceived usefulness relationship, while over 85% supported the subjective norms-behavioral intention relationship (Schepers & Wetzels, 2007). Therefore, we hypothesize that perceived subjective norms will be associated with greater perceived usefulness (H5) and stronger intentions to use OPP messaging features (H6).

Affordances

While parsimony is one of the TAM's many strengths, it is also a limitation (Yousafzai et al., 2007b). With just two predictors, perceived usefulness and ease of use, the TAM provides limited information regarding distal predictors of technology adoption (Venkatesh & Bala, 2008). Practitioners could benefit from knowledge of the factors that influence perceived usefulness and ease of use, to assist in the development of interventions to enhance health technologies' adoption and use (Venkatesh & Bala, 2008). In TAM2, for example, Venkatesh and Davis (2000) added image, job relevance, output quality, and more to better delineate the factors that explain and predict perceived usefulness, in addition to subjective norms. The Technology Adoption Model 3 (TAM3) presents a more comprehensive set of potential determinants of perceived usefulness and ease of us (Venkatesh & Bala, 2008). However, neither

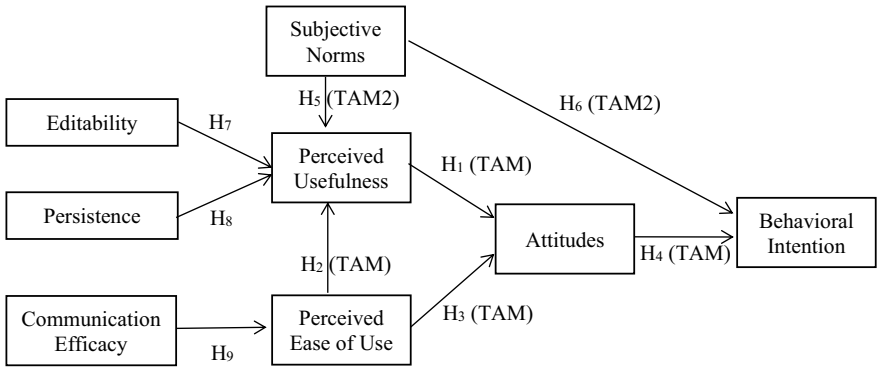

Figure 1. Proposed model of affordances, communication efficacy, and technology acceptance model.
Note. TAM = Technology Acceptance Model; TAM2 = Technology Acceptance Model 2.

model incorporates perceived technological affordances. We propose that a perceived affordances' perspective may provide insight into why some people will use messaging feature whereas others will not.

Perceived affordances. Perceived affordances refers to how individuals perceive different specificities of the communication channels (Evans et al., 2017; Gibson, 1979; Norman, 1990). Patients contact their care providers mainly three ways: face-to-face, phone, and through text-based messages. Patients who used the messaging feature within an OPP were shown to better manage their health than those who did not use the feature (Rathert et al., 2017). Likewise, the exchange of e-mail between patients and physicians was shown to increase care effectiveness among patients with diabetes and/or hypertension (Zhou et al., 2010). We propose that the perceived usefulness of a messaging feature may result from two perceived affordances: the perceived ability of portals to allow users to revise messages before sending (i.e., perceived editability) and the perceived ability to keep a permanent record of the patient-physician conversation (i.e., perceived persistence; Fox & McEwan, 2017).

Perceived editability. Perceived editability could enhance the perceived usefulness of messaging in several ways. Editability regulates expressions, improves the quality of the message, and helps users target a message to a specific audience (Treem & Leonardi, 2013). Sending messages through a messaging feature may provide users extra time to construct messages and allow them to allocate more cognitive resources, which may enable them to provide a clearer description of the health condition or problem to their provider (Haun et al., 2014). Being able to construct a more informative message could lead patients to view a messaging feature as more useful; thus, we propose that perceived editability will be positively associated with perceived usefulness of the OPP messaging feature (H7). Furthermore, we expect greater editability will be indirectly associated with patient intention to use a messaging feature via perceived usefulness and attitudes (H7a).

Perceived persistence. Perceived persistence refers to the degree to which users believe that the communication remains in same form and could be accessible future use (Bregman & Haythornthwaite, 2003; Donath et al., 1999; Treem & Leonardi, 2013). Located at the lower end of the persistence continuum is face-to-face or unrecorded telephone communication, which does not allow users to review the communication at a future time. OPP messaging features exist on the higher end of the continuum, as these conversations remain in their original form for some time or potentially in perpetuity. Having a record of patient-physician communication allows patients to revisit questions and provider recommendations, which may help patients better manage their health (Haun et al., 2014; Zhou et al., 2010). Therefore, we propose that the perceived persistence of a messaging feature within an OPP will be positively associated with perceived usefulness (H8). Greater perceived persistence will also be indirectly associated with patient intention to use a messaging feature via perceived usefulness and attitudes (H8a).

Communication efficacy

Finally, we propose the inclusion of communication efficacy into the TAM as a predictor of ease of use. The TAM's "ease of use" concept is rooted in Bandura's (1982) self-efficacy construct which is "judgments of how well one can execute courses of action required to deal with prospective situations" (p. 122). When an individual assesses the degree to which a device is easy to use, that person could be reflecting on their confidence in their ability to use it, which is defined as self-efficacy (Bandura, 1982).

Classical research on the TAM views "ease of use" as one's general evaluation of multiple computer domains (Yi & Hwang, 2003). However, technology-specific self-efficacy is a more precise predictor of perceived ease of use (Agarwal & Karahanna, 2000; Portz et al., 2019; Yi & Hwang, 2003). Technology-specific self-efficacy, in the context of an OPP messaging feature, is communication efficacy. Communication efficacy refers to people's evaluation of their ability and skills to perform intended communication tasks (Afifi & Weiner, 2004). When patients are confident in their abilities and skills to communicate with a care provider via an OPP messaging feature, they are exhibiting high communication efficacy. Communication efficacy should predict ease of use, because communication efficacy serves as an anchoring point to assess ease of use (Venkatesh & Davis, 1996). Before patients decide whether a messaging feature is easy to use, they would evaluate their confidence in their ability to communicate with a care provider via the messaging feature (Venkatesh, 2000; Venkatesh & Davis, 1996). Thus, we propose that greater communication efficacy will be positively associated with perceived ease of use (H9). Greater communication efficacy will also be indirectly associated with patient intention to use a messaging feature via greater perceived ease of use and attitudes (H9a).

Method

This study was approved by the university Institutional Review Board. Undergraduates taking introductory communication courses at the large Midwest public university were recruited through a research participant pool to complete an online survey. A study advertisement was posted on the participant pool website. Inclusion criterion was being age 18 years or older. There were no exclusion criteria. Participants completed the survey online. To ensure the quality of the data, participants were told to access the survey on a computer. Students were awarded course credit for their participation.

Because some participants may not have been familiar with key terms used in the study, they were provided definitions of "primary care provider" (a healthcare professional who practices general medicine, the first stop for medical care) and "OPP" (an online website or a smart phone application that gives patients access to personal health information on the Internet) at the beginning of the survey. Participants were then asked if they had a primary care provider. If participants did not have a primary care provider, they were instructed to talk about their most recent visit to a healthcare provider; thus, the term "care provider" was used when describing the measures and results. Participants were then asked about their general health, relationship with their care

provider, and reason for their most recent visit. Then, participants were asked about their frequencies of using a messaging feature within the OPP. Finally, they were assessed on the model variables.

Four attention check questions were included on the survey (e.g., "please pick Slightly Agree ONLY this line. And answer other questions as usual."). Amongst the 607 participants who completed the survey, 82 missed two or more attention check questions and were removed from the data set; thus, the final sample size was 525. Participants who failed attention checks did not differ significantly from those who passed the attention checks in terms of age (χ^2 (21) = 20.47, p =.49), but more males (χ^2 (2) = 10.79, p = .01) and nonwhite participants (χ^2 (5) = 27.89, p < .001) failed attention checks.

Measures

A complete list of measures is included below. All were measured on a 1 (*strongly disagree*) to 7 (*strongly agree*) scale, unless noted. Cronbach's alphas were calculated to assess scale reliability and Confirmatory Factor Analysis (CFA) was used to assess scale validity. The mean of the items in each scale was used in the analyses.

Individual characteristics

Several demographic and individual characteristic variables were measured such as gender, age (continuous), ethnicity, their general health condition (measured from *poor* (1) to *excellent* (7)), and their relationship with their care provider. We also assessed whether participants had ever used any type of OPP to communicate with their care provider as a control variable (1 = *yes*, 0 = *no*).

Perceived usefulness

Perceived usefulness was measured with nine items from Davis (1989). Items included, "Using a patient portal improves the quality of my communication with a [care provider]" (α = .96).

Perceived ease of use

Perceived ease of use was measured by four items from Davis (1989). A sample item was "Learning to use a patient portal to communicate with [care provider] was easy for me" (α = .94).

Attitudes

Attitudes were measured using the Davis (1989) scale. Participants were provided with nine, 7-point semantic differential pairs. The question asked participants "all things considered, using a patient portal to communicate with [care provider] is . . . ." using pairs of bad/good, foolish/wise, unfavorable/favorable, harmful/beneficial, worthless/valuable, negative/positive; not helpful/helpful, unproductive/productive, and not useful/useful (α = .96).

Intention to use OPP messaging

Intention was measured by three items from Davis (1989) scale. A sample item is "If I need to ask [care provider] a question, I will use a patient portal" (α = .92).

Subjective norms

Subjective norms was measured using four items (Ajzen, 1991) that measured both injunctive and descriptive norms. A sample item included "Most of my friends use a patient portal to communicate with their [care provider]" (α = .73).

Communication efficacy

Communication efficacy was measured with two questions, based on Afifi et al. (2006), including "I know how to communicate with [a care provider] on the patient portal" and "I know what I need to successfully use a patient portal to communicate with a [care provider]" (r = .87).

Affordances

Affordances were measured using Fox and McEwan (2017). Four items measured perceived editability, including "A patient portal allows me to create a message and delete it before I communicate it" (α = .84). Six items measured perceived persistence, including "A patient portal keeps a record of communication that I can go back and look at" (α = .87).

Confirmatory factor analysis

An initial CFA with all model variables (i.e., persistence, editability, and perceived usefulness, communication efficacy, perceived ease of use, subjective norm, and attitude) showed that two reverse-coded items measuring persistence (i.e., "Communication in a patient portal exists only in the moment." and "A patient portal keeps no permanent record of what I say or do.") loaded weakly on the persistence factor (loadings < .50). Additionally, one item measuring editability (i.e. "If I make a mistake when creating a message in a patient portal, I can change it before my receiver gets it.") loaded weakly on its corresponding factor. Therefore, the three items were dropped and the model was retested (χ^2 (539) = 1483.60, p < .001; RMSEA = .058; CFI = .95; SRMR = .039). The model showed an acceptable fit to the data (per Browne & Cudeck, 1992; Hu & Bentler, 1999). Item loadings ranged from .52 to .96. Reliability statistics also improved for both perceived editability (α = .91) and perceived persistence (α = .95).

Data analysis

Descriptive statistics and correlations between model variables were first assessed (Table 3). Ordinary least squares (OLS) hierarchical regression was used to test models predicting perceived ease of use, perceived usefulness, attitudes, and intentions to use OPPs to communicate with a care provider. All models controlled for whether the participant had ever used an OPP to communicate with a care provider. Indirect effects were calculated using the PROCESS macro (Hayes, 2013). PROCESS uses a bootstrapping technique to generate indirect effects (Preacher & Hayes, 2004, 2008). In this study, we instructed PROCESS to generate 5,000 random samples from the data. Based on those 5,000 bootstraps, PROCESS provides a bootstrap estimate, and a 95% bias-corrected and accelerated confidence interval (CI; Hayes, 2018).

Results

Demographics

The mean age of participants was 20.57 (SD = 3.30), with a range of 18 to 44 years. Of participants, most were female (72.6%) and White (non-Hispanic; 71.8%). Other participant race/ethnicities included Asian (12.8%) and Black or African Americans (8.2%). Of participants, 98 (18.67%) reported that they did not have a primary care provider. Participants who reported having a primary care provider did not differ significantly from those who did not on perceived usefulness (χ^2 (47) = 29.89, p = .98), ease of use (χ^2 (25) = 30.71, p = .20), attitudes (χ^2 (45) = 44.19, p = .51) and intention to use OPPs to communicate a care provider (χ^2 (18) = 22.24, p = .22); thus, participants were combined for further data analyses. Participants reported they were generally healthy (M = 5.68, SD = 0.92; Range 1–7) and reported a good relationship with a care provider (M = 5.40, SD = 1.44; Range 1–7). Of participants, close to 30% (n = 159) reported ever using an OPP to communicate with a care provider online. Among the 159 users of an OPP to communicate with a care provider, they contacted their provider an average of 3.12 times in the past year. Users were asked to report the types of OPPs they had used to communicate with a provider online. Over half (n = 84; 52.83%) reported using MyChart, while others reported using a student health center OPP (n = 58, 34.48%) and/or some other self-reported systems (n = 40, 25.16%). Among the 366 nonusers of an OPP to communicate with a care provider, about a quarter (24%) believed that they had obtained enough medical information in regards their health questions through other means, about one fifth (20.8%) did not know how to activate the OPP, and less than one fifth (17.2%) believed that they did not have a severe enough condition to use the portal. Differences between users and nonusers on model variables are summarized in Table 1. Zero order correlations between key variables are shown in Table 2.

Direct relationships

As shown in Table 3, perceived usefulness was positively associated with attitudes (p < .001, H1 supported) and perceived ease of use was positively associated with perceived usefulness (p < .001, H2 supported) and attitudes (p < .001, H3 supported). Attitudes also predicted behavioral intentions (p < .001, H4 supported) and subjective norms were positively associated with perceived usefulness (p < .001, H5 supported) and intentions to use the messaging feature to communicate with a care provider (p < .001, H6 supported).

In terms of the proposed additions, perceived editability was positively associated with perceived usefulness (p < .05; H7 supported), but not perceived persistence (H8 unsupported). Communication efficacy was positively associated with perceived ease of use (p < .001; H9 supported). Perceived ease of use, usefulness, subjective norms, and perceived persistence were positively associated with attitudes (p < .05), but not editability or communication efficacy. Finally, perceive usefulness, subjective norms, persistence (negatively), and communication efficacy statistically significantly predicted intentions to use the OPP messaging feature (p < .05). The proposed additions to TAM, subjective norm, perceived editability, perceived persistence, and communication efficacy, increased total variance explained in behavioral intention from 49.4% to 53.6% (ΔF(4, 516) = 11.51, p < .001).

Indirect relationships

Indirect effects were calculated using PROCESS model 4 for mediation paths and modified B matrix for serial mediation paths. All tests controlled for participants' previous OPP communication. In support of H7a, we detected a significant indirect effect of perceived editability on behavioral intention via perceived usefulness and attitude (bootstrap estimate = .17, 95% CI = [.12, .24]). In support of H8a, a significant indirect effect was detected for perceived persistence on behavioral intention via perceived usefulness and attitude (bootstrap estimate = .18, 95% CI = [.11, .24]). Finally, in support of H9a, a significant indirect effect was detected from communication efficacy to behavioral intention via ease of use and attitude (bootstrap estimate = .11, 95% CI = [.08, .15]).

Discussion

Results of this study provide support for the TAM in the context of using OPP messaging features to communicate with a care provider. Hypotheses derived from the TAM were all supported. Most importantly, our data support the addition of affordances (particularly editability) and communication efficacy. Results of this study also provide suggestions for practitioners on how to advocate the use of OPP messaging among young adults.

Table 1. Differences between users and nonusers of OPP messaging features (N = 525).

	Users (n = 159)	Nonusers (n = 366)			Marginal
Variable	*M (SD)*	*M (SD)*	*t*	*df*	*M (SD)*
Editability	5.70 (1.01)	4.96 (1.09)	7.29***	523.00	5.18 (1.12)
Persistence	5.95 (0.99)	5.07 (1.12)	8.97***	334.83[a]	5.34 (1.15)
Comm efficacy	6.05 (1.38)	3.97 (1.86)	14.19***	399.30[a]	4.60 (1.98)
Perceived usefulness	5.22 (1.24)	4.51 (1.23)	6.08***	523.00	4.73 (1.28)
Perceived ease of use	5.56 (1.24)	4.22 (1.08)	11.89***	267.03[a]	4.63 (1.29)
Subjective norms	4.72 (1.10)	3.96 (1.13)	7.15***	523.00	4.19 (1.17)
Attitudes	5.80 (1.12)	5.23 (1.13)	5.31***	523.00	5.40 (1.15)
Intentions to use	4.29 (1.82)	3.13 (1.70)	7.01***	523.00	3.48 (1.81)

*** p < .001 (two-tailed).
[a]equal variances not assumed.

Table 2. Zero-order correlations between model variables (N = 525).

	2.	3.	4.	5.	6.	7.	8.
1. Editability	.582***	.468***	.379***	.362***	.307***	.362***	.312***
2. Persistence		.438***	.389***	.351***	.364***	.382***	.253***
3. Comm efficacy			.606***	.367***	.501***	.362***	.451***
4. Perceived usefulness				.608***	.543***	.550***	.553***
5. Perceived ease of use					.542***	.742***	.677***
6. Subjective norms						.577***	.544***
7. Attitudes							.547***
8. Intentions to use							

*** $p < .001$ (two-tailed).

Table 3. Results of multiple regression analyses predicting ease of use, usefulness, attitudes, and intentions to use patient portals to communicate (N = 525).

	Ease of use	Perceived usefulness		Attitudes		Behavioral intentions	
	Model *B (SE)*	Model 1 *B (SE)*	Model 2 *B (SE)*	Model 1 *B (SE)*	Model 2 *B (SE)*	Model 1 *B (SE)*	Model 2 *B (SE)*
User or nonuser	0.69*** (0.11)	−0.17 (0.10)	−0.24* (0.105)	−0.05 (0.08)	−0.12 (0.08)	0.49** (0.14)	0.12 (0.14)
Perceived ease of use		0.47*** (0.04)	0.44*** (0.04)	0.15*** (0.04)	0.09* (0.04)		0.11 (0.07)
Perceived usefulness				0.59*** (0.03)	0.49*** (0.03)		0.70*** (0.07)
Attitudes						0.53*** (0.07)	0.01 (0.08)
Subjective norms		0.33*** (0.043)	0.30*** (0.03)		0.22*** (0.04)	0.48*** (0.07)	0.27*** (0.06)
Editability			0.12** (0.05)		0.05 (0.04)		0.06 (0.06)
Persistence			(0.05)		0.08* (0.04)		−0.18** (0.06)
Comm efficacy	0.32*** (0.03)				−0.03 (0.02)		0.14** (0.04)
R^2	.41	.44	.45	.57	.61	.39	.54
F	183.86***	134.33***	75.43***	227.053**	114.52***	111.64***	74.41***
ΔR^2			.01		.04		.15
ΔF			58.90**		112.53***		37.23***

B are unstandardized coefficients. * $p < .05$, ** $p < .01$, *** $p < .001$.

Theoretical implications

Our study contributed to health communication in three ways (DeAndrea & Holbert, 2017; Slater & Gleason, 2012). First, we tested the TAM in a novel context, showing that the TAM is useful for predicting patient intention to use messaging features within an OPP to communicate with a care provider. Second, we extended the TAM by adding subjective norms, perceived editability and persistence affordances, and communication efficacy variables, which in total explained 54% of the variance in intentions to use an OPP to communicate with a care provider. Third, we were able to show indirect effects of persistence, editability, communication efficacy on intentions to use messaging feature via perceived usefulness, perceived ease of use, and attitudes.

We are the first to incorporate affordance predictions into TAM. Perceived editability was positively associated with the perceived usefulness, which predicted attitudes and intentions to use. These findings suggest that practitioners should emphasize the editing capacity of messaging, which allows patients to carefully craft questions and messages to health care providers. Persistence, on the other hand, was not only unassociated with perceived usefulness, it was negatively associated with intentions to use. This finding suggests that beliefs that messaging communication may persist could negatively impact patients' intentions to use the function. Existing research suggests that patients do express some privacy and security concerns when using the messaging features of patient portals (Haun et al., 2014). Although perceived persistence is often touted as a benefit of OPPs, emphasizing the persistence of messaging content may actually hinder patients' intention to use the messaging feature; thus, this is an important topic for future research.

In addition to affordances, our data suggest communication efficacy is an important new addition to TAM. Patients' perceptions of their skills and abilities to use the messaging feature were indirectly associated with intention via ease of use. This finding suggests that increasing patients' perception of their ability to use OPP messaging features could ultimately increase their intentions to use it. Thus, information provided to patients regarding OPP messaging features should build confidence in a patient's ability to use these tools and stress ease of use of OPPs to communicate with a care provider.

Implications for health communication

Regardless of the wide availability and benefits of OPP messaging, less than a third of our sample (30.28%) used the feature to communicate with a care provider. This result was surprising, particularly since younger populations tend to be more technologically-savvy (Morris & Venkatesh, 2000). Reasons for patients' lack of use, as our data suggest, could be their ability to obtain information through other means, lack of familiarity with OPPs in general, or not believing that their health concerns are serious enough to warrant the use of an OPP; lack of physician endorsement also may be a valid reason (Kornacker et al., 2019). Therefore, if practitioners hope to increase younger adults' use of an OPP messaging feature, they should emphasize the ease and quality of information received

through the messaging feature and provide more information about OPP access and features. Care providers' endorsement of OPP messaging features for all types of health issues could also minimize concerns about severity and increase usage.

Our results also suggest that to encourage the use of OPP messaging features, practitioners should incorporate promotional messages that stress the usefulness and ease of use of these features. Messages aimed at patients should emphasize that messaging offers direct communication to a health care provider and is useful for addressing non-urgent medical concerns from virtually anywhere. Messages should also communicate that messaging with provider is easy and "just a few clicks away" via an online website or app. Additionally, as our data suggest, care providers must build patient confidence in their ability and skills to increase perceived ease of use and intentions to use OPP messaging. Finally, given our findings regarding affordances, messages promoting the perceived edibility of the tool (i.e., reminding patients that they can edit a message before sending) may also enhance intentions to use the feature. However, practitioners should be cautious that an emphasis on the persistence affordance could decrease patients' intention to use the feature.

Limitations and future research

Due to the naturalistic design of this study, no causality could be inferred from this study. Experiments with random assignment should be used to test the causality of the antecedents of the variables. The external validity of this study is also limited by the sample. We used a college sample, with mainly female and White participants. However the overall usage rate of OPP messaging is very similar to studies with OPP use among other population (Alpert et al., 2017: 33%; Hoogenbosch et al., 2018: 32%). Testing this model with other patient samples will provide more insight.

Conclusion

In conclusion, we have made both theoretical and practical contributions to the fields of health communication. In this study, we have studied how affordances and communication efficacy variables help explain patients' understandings, attitudes, and decision to use the messaging feature of OPP to communicate with their care providers. We have evaluated how the antecedents directly and indirectly influenced users' intention to use the portals to contact their health providers. By establishing these antecedents, we learned more about the mechanisms of the adoption of health-related technologies and practices for designing effective messages to advocate the adoption of health-related technologies.

ORCID

Shelly R. Hovick http://orcid.org/0000-0001-7665-8966

References

Afifi, W. A., Morgan, S. E., Stephenson, M. T., Morse, C., Harrison, T., Reichert, T., & Long, S. D. (2006). Examining the decision to talk with family about organ donation: Applying the theory of motivated information management. *Communication Monographs*, *73*(2), 188–215. https://doi.org/10.1080/03637750600690700

Afifi, W. A., & Weiner, J. L. (2004). Toward a theory of motivated information management. *Communication Theory*, *14*(2), 167–190. https://doi.org/10.1111/j.1468-2885.2004.tb00310.x

Agarwal, R., & Karahanna, E. (2000). Time flies when you're having fun: Cognitive absorption and beliefs about information technology usage. *MIS Quarterly*, *24*(4), 665–694. https://doi.org/http://doi.10.2307/3250951

Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, *50*(2), 179–211. https://doi.org/10.1016/0749-5978(91)90020-T

Alpert, J. M., Dyer, K. D., & Lafata, J. E. (2017). Patient-centered communication in digital medical encounters. *Patient Education and Counseling*, *100*(10), 1852–1858. https://doi.org/http://doi.10.1016/j.pec.2017.04.019

Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, *37*(2), 122–147. https://doi.org/http://doi.10.1037/0003-066x.37.2.122

Baumeister, H., Nowoczin, L., Lin, J., Seifferth, H., Seufert, J., Laubner, K., & Ebert, D. D. (2014). Impact of an acceptance facilitating intervention on diabetes patients' acceptance of Internet-based interventions for depression: A randomized controlled trial. *Diabetes Research and Clinical Practice*, *105*(1), 30–39. https://doi.org/10.1016/j.diabres.2014.04.031

Bregman, A., & Haythornthwaite, C. (2003). Radicals of presentation: Visibility, relation, and co-presence in persistent conversation. *New Media & Society*, *5*(1), 117–140. https://doi.org/10.1177/1461444803005001913

Browne, M. W., & Cudeck, R. (1992). Alternative ways of assessing model fit. *Sociological Methods & Research*, *21*(2), 230–258. https://doi.org/10.1177/0049124192021002005

Cronin, R. M., Davis, S. E., Shenson, J. A., Chen, Q., Rosenbloom, S. T., & Jackson, G. P. (2015). Growth of secure messaging through a patient portal as a form of outpatient interaction across clinical specialties. *Applied Clinical Informatics*, *6*(2), 288–304. https://doi.org/10.4338/ACI-2014-12-RA-0117

Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319–340. https://doi.org/10.2307/249008

Davis, F. D., Bagozzi, R. P., & Warshaw, P. R. (1989). User acceptance of computer-technology - A comparison of 2 theoretical-models. *Management Science*, *35*(8), 982–1003. https://doi.org/http://doi.10.1287/mnsc.35.8.982

DeAndrea, D. C., & Holbert, R. L. (2017). Increasing clarity where it is needed most: Articulating and evaluating theoretical contributions. *Annals of the International Communication Association*, *41*(2), 168–180. https://doi.org/10.1080/23808985.2017.1304163

Dendere, R., Slade, C., Burton-Jones, A., Sullivan, C., Staib, A., & Janda, M. (2019). Patient portals facilitating engagement with inpatient electronic medical records: A systematic review. *Journal of Medical Internet Research*, *21*(4), e12779. https://doi.org/http://doi.10.2196/12779

Donath, J., Karahalios, K., & Viégas, F. (1999). Visualizing conversation. *Journal of Computer-Mediated Communication*, *4*(4), Article JCMC442. https://doi.org/http://doi.10.1111/j.1083-6101.1999.tb00107.x

Emani, S., Healey, M., Ting, D. Y., Lipsitz, S. R., Ramelson, H., Suric, V., & Bates, D. W. (2016). Awareness and use of the after-visit summary through a patient portal: Evaluation of patient characteristics and an application of the theory of planned behavior. *Journal of Medical Internet Research*, *18*(4), Article e77. https://doi.org/10.2196/jmir.5207

Evans, S. K., Pearce, K. E., Vitak, J., & Treem, J. W. (2017). Explicating affordances: A conceptual framework for understanding

affordances in communication research. *Journal of Computer-Mediated Communication*, *22*(1), 35–52. https://doi.org/http://doi.10.1111/jcc4.12180

Fishbein, M., & Ajzen, I. (1975). *Belief, attitude, intention and behavior: An introduction to theory and research*. Addison-Wesley.

Fortuna, R. J., Robbins, B. W., & Halterman, J. S. (2009). Ambulatory care among young adults in the United States. *Annals of Internal Medicine*, *151*(6), 379–385. https://doi.org/http://doi.10.7326/0003-4819-151-6-200909150-00002

Fox, J., & McEwan, B. (2017). Distinguishing technologies for social interaction: The perceived social affordances of communication channels scale. *Communication Monographs*, *84*(3), 298–318. https://doi.org/10.1080/03637751.2017.1332418

Gibson, J. J. (1979). *The ecological approach to visual perception*. Houghton Mifflin.

Haun, J. N., Hathaway, W., Chavez, M., Antinori, N., Vetter, B., Miller, B. K., Martin, T. L., Kendziora, L., Nazi, K. M., & Melillo, C. (2017). Clinical practice informs secure messaging benefits and best practices. *Applied Clinical Informatics*, *8*(4), 1003–1011. https://doi.org/10.4338/ACI-2017-05-RA-0088

Haun, J. N., Lind, J. D., Shimada, S. L., Martin, T. L., Gosline, R. M., Antinori, N., Steward, M., & Simon, S. R. (2014). Evaluating user experiences of the secure messaging tool on the veterans affairs' patient portal system. *Journal of Medical Internet Research*, *16*(3), 266–281. https://doi.org/http://doi.10.2196/jmir.2976

Hayes, A. F. (2013). *Introduction to mediation, moderation, and conditional process analysis a regression-based approach*. Guilford Press.

Hayes, A. F. (2018). *Mediation, moderation and conditional process analysis: A regression-based approach*. Guilford Press.

Heinlen, C., Hovick, S. R., Brock, G. N., Klamer, B. G., Toland, A. E., & Senter, L. (2019). Exploring genetic counselors' perceptions of usefulness and intentions to use refined risk models in clinical care based on the Technology Acceptance Model (TAM). *Journal of Genetic Counseling*, *28*(3), 664–672. https://doi.org/10.1002/jgc4.1079

Honavar, S. G. (2018). Patient-physician relationship - Communication is the key. *Indian Journal of Ophthalmology*, *66*(11), 1527–1528. https://doi.org/http://doi.10.4103/ijo.IJO_1760_18

Hoogenbosch, B., Postma, J., De Man-van Ginkel, J. M., Tiemessen, N. A. M., Van Delden, J. J. M., & Van Os-medendorp, H. (2018). Use and the users of a patient portal: Cross-sectional study. *Journal of Medical Internet Research*, *20*(9), Article e262. https://doi.org/10.2196/jmir.9418

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling-A Multidisciplinary Journal*, *6*(1), 1–55. https://doi.org/http://doi.10.1080/10705519909540118

King, W. R., & He, J. (2006). A meta-analysis of the technology acceptance model. *Information & Management*, *43*(6), 740–755. https://doi.org/10.1016/j.im.2006.05.003

Kornacker, D., Fitzgerald, K., & Elder, S. (2019). A patient portal push toward acceptance and utilization of the technology. *Patient Experience Journal*, *6*(2), 20–27. https://doi.org/http://doi.10.35680/2372-0247.1327

Kupchunas, W. R. (2007). Personal health record - New opportunity for patient education. *Orthopaedic Nursing*, *26*(3), 185–191. https://doi.org/http://doi.10.1097/01.NOR.0000276971.86937.c4

Lazard, A. J., Watkins, I., Mackert, M. S., Xie, B., Stephens, K. K., & Shalev, H. (2016). Design simplicity influences patient portal use: The role of aesthetic evaluations for technology acceptance. *Journal of the American Medical Informatics Association*, *23*(e1), e157–161. https://doi.org/10.1093/jamia/ocv174

Legris, P., Ingham, J., & Collerette, P. (2003). Why do people use information technology? A critical review of the technology acceptance model. *Information & Management*, *40*(3), 191–204. https://doi.org/10.1016/S0378-7206(01)00143-4

Levine, D. M., Landon, B. E., & Linder, J. A. (2019). Quality and experience of outpatient care in the united states for adults with or without primary care. *JAMA Internal Medicine*, *179*(3), 363–372. https://doi.org/10.1001/jamainternmed.2018.6716

Lu, Y. B., Zhou, T., & Wang, B. (2009). Exploring Chinese users' acceptance of instant messaging using the theory of planned behavior, the technology acceptance model, and the flow theory. *Computers in Human Behavior*, *25*(1), 29–39. https://doi.org/10.1016/j.chb.2008.06.002

Morris, M. G., & Venkatesh, V. (2000). Age differences in technology adoption decisions: Implications for a changing work force. *Personnel Psychology*, *53*(2), 375–403. https://doi.org/10.1111/j.1744-6570.2000.tb00206.x

Nahm, E. S., Diblasi, C., Gonzales, E., Silver, K., Zhu, S. J., Sagherian, K., & Kongs, K. (2017). Patient-centered personal health record and portal implementation toolkit for ambulatory clinics a feasibility study. *CIN-Computers Informatics Nursing*, *35*(4), 176–185. https://doi.org/http://doi.10.1097/Cin.0000000000000318

Norman, D. A. (1990). *The design of everyday things*. Doubleday.

The Office of the National Coordinator for Health Information Technology. (2017, September 29). *What is a patient portal?* Office of the National Coordinator for Health Information Technology. https://www.healthit.gov/faq/what-patient-portal

Or, C. K. L., Karsh, B. T., Severtson, D. J., Burke, L. J., Brown, R. L., & Brennan, P. F. (2011). Factors affecting home care patients' acceptance of a web-based interactive self-management technology. *Journal of the American Medical Informatics Association*, *18*(1), 51–59. https://doi.org/http://doi.10.1136/jamia.2010.007336

Parchman, M. L., & Burge, S. K. (2004). The patient-physician relationship, primary care attributes, and preventive services. *Family Medicine*, *36*(1), 22–27. https://pubmed.ncbi.nlm.nih.gov/14710325/

Portz, J. D., Bayliss, E. A., Bull, S., Boxer, R. S., Bekelman, D. B., Gleason, K., & Czaja, S. (2019). Using the technology acceptance model to explore user experience, intent to use, and use behavior of a patient portal among older adults with multiple chronic conditions: Descriptive qualitative study. *Journal of Medical Internet Research*, *21*(4), Article e11604. https://doi.org/10.2196/11604

Preacher, K. J., & Hayes, A. F. (2004). SPSS and SAS procedures for estimating indirect effects in simple mediation models. *Behavior Research Methods Instruments & Computers*, *36*(4), 717–731. https://doi.org/http://doi.10.3758/Bf03206553

Preacher, K. J., & Hayes, A. F. (2008). Asymptotic and resampling strategies for assessing and comparing indirect effects in multiple mediator models. *Behavior Research Methods*, *40*(3), 879–891. https://doi.org/10.3758/BRM.40.3.879

Rathert, C., Mittler, J. N., Banerjee, S., & McDaniel, J. (2017). Patient-centered communicaiton in the era of eletronic health records: What does the evience say? *Patient Education and Counseling*, *100*(1), 50–64. https://doi.org/http://doi.10.1016/j.pec.2016.07.031

Roter, D. (2000). The enduring and evolving nature of the patient-physician relationship. *Patient Education and Counseling*, *39*(1), 5–15. https://doi.org/http://doi.10.1016/S0738-3991(99)00086-5

Schepers, J., & Wetzels, M. (2007). A meta-analysis of the technology acceptance model: Investigating subjective norm and moderation effects. *Information & Management*, *44*(1), 90–103. https://doi.org/10.1016/j.im.2006.10.007

Slater, M. D., & Gleason, L. S. (2012). Contributing to theory and knowledge in quantitative communication science. *Communication Methods and Measures*, *6*(4), 215–236. https://doi.org/10.1080/19312458.2012.732626

Treem, J. W., & Leonardi, P. M. (2013). Social media use in organizations: Exploring the affordances of visibility, editability, persistence, and association. *Annals of the International Communication Association*, *36*(1), 143–189. https://doi.org/10.1080/23808985.2013.11679130

Venkatesh, V. (2000). Determinants of perceived ease of use: Integrating control, intrinsic motivation, and emotion into the technology acceptance model. *Information Systems Research*, *11*(4), 342–365. https://doi.org/10.1287/isre.11.4.342.11872

Venkatesh, V., & Bala, H. (2008). Technology acceptance model 3 and a research agenda on interventions. *Decision Sciences*, *39*(2), 273–315. https://doi.org/10.1111/j.1540-5915.2008.00192.x

Venkatesh, V., & Davis, F. D. (1996). A model of the antecedents of perceived ease of use: Development and test. *Decision Sciences*, *27*(3), 451–481. https://doi.org/10.1111/j.1540-5915.1996.tb01822.x

Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, *46*(2), 186–204. https://doi.org/10.1287/mnsc.46.2.186.11926

Wade-Vuturo, A. E., Mayberry, L. S., & Osborn, C. Y. (2013). Secure messaging and diabetes management: Experiences and perspectives of patient portal users. *Journal of the American Medical Informatics Association*, *20*(3), 519–525. https://doi.org/10.1136/amiajnl-2012-001253

Wilson, E. V., & Lankton, N. K. (2004). Modeling patients' acceptance of provider-delivered e-health. *Journal of the American Medical Informatics Association*, *11*(4), 241–248. https://doi.org/http://doi.10.1197/jamia.1475

Xu, J., Murphy, S. L., Kockanek, K. D., & Arias, E. (2020). Mortality in the United States, 2018. *NCHS Data Brief*, *355*, 1–8. https://www.cdc.gov/nchs/data/databriefs/db355-h.pdf

Yi, M. Y., & Hwang, Y. J. (2003). Predicting the use of web-based information systems: Self-efficacy, enjoyment, learning goal orientation, and the technology acceptance model. *International Journal of Human-Computer Studies*, *59*(4), 431–449. https://doi.org/10.1016/S1071-5819(03)00114-9

Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007a). Technology acceptance: A meta-analysis of the TAM: Part 1. *Journal of Modelling in Management*, *2*(3), 251–280. https://doi.org/10.1108/17465660710834453

Yousafzai, S. Y., Foxall, G. R., & Pallister, J. G. (2007b). Technology acceptance: A meta-analysis of the TAM: Part 2. *Journal of Modelling in Management*, *2*(3), 281–304. https://doi.org/10.1108/17465660710834462

Zhou, Y. Y., Kanter, M. H., Wang, J. J., & Garrido, T. (2010). Improved quality at Kaiser Permanente through e-mail between physicians and patients. *Health Affairs*, *29*(7), 1370–1375. https://doi.org/10.1377/hlthaff.2010.0048