Perceived IT Ambiguity: Development of a Measurement Instrument

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Abstract

Information technologies (IT) have reached such degrees of functional richness that forming a complete, coherent, and stable understanding of a given IT product may be challenging for some users. The need to theorize this phenomena and to measure its effect on IT adoption empirically is rife. This paper introduces the construct of perceived IT ambiguity (PITA), which captures the extent to which a user has difficulties making sense of an IT artifact. A multi-item measurement scale is developed and its validity and reliability pre-tested on a pilot sample. The effect of the focal variable on technology adoption is tested using covariance-based SEM. Preliminary results indicate that ambiguity is a double-edged sword that simultaneously boosts and impede IT adoption.

Keywords

Survey instrument development, technology adoption, theory of planned behavior, consumer, social media, ambiguity

Introduction

Information technologies (IT) that are intentionally incomplete and constantly in the making are compelling alternatives to traditional technologies that have clearly delineated and stable boundaries (Garud et al., 2008). Indeed, having no fixed functional limits makes them particularly suited to an environment that requires dynamic adaption and constant innovation (Avital & Te'Eni, 2009). Although there may be more apparent motives than ever before to adopt these technologies (Lowry et al., 2015), their versatility can directly hinder the ability of users to understand them fully. In a Jan. 2017 article[1], Quartz questioned the very purpose of the iPad seven years after its launch, concluding that "The iPad seems stuck in the same existential quandary about what it actually is that it did when it was first released." Similarly, developing a clear and stable understanding of software technology (e.g. social media, open platforms, enterprise 2.0 technology, etc.) that are constantly in the making is a challenge. The measurement instrument we present in this paper aims at capturing the extent with which an individual user has difficulties making sense of an IT, and assessing the impact of ambiguity on user's beliefs and attitudes.

[1] https://qz.com/896561/seven-years-after-its-launch-its-still-not-entirely-clear-what-an-ipad-is-for/

In this research in progress paper, we introduce the construct of perceived IT ambiguity and its conceptual roots. We then explain what steps we followed to develop the measures and to verify that they tap into the appropriate conceptual domain. Finally, we present the results of a pilot study in which 192 individuals were asked about their beliefs and use of the Facebook online application.

Conceptual Background

A fundamental observation from the discipline of psychology is that concepts function as filters through which we make sense of the external world (Goldstone & Kersten, 2003; Medin & Coley, 1998; Smith & Medin, 1981). A central tenet of this perspective is that individuals naturally divide the world of objects into categories to make their environment intelligible. In the case of man-made objects such as technology, having a clear understanding of its function is essential (Smith & Medin, 1981). When an IT has a relatively univocal function, it fits nicely in the individual's knowledge structure, and is thus perceived clearly. On the contrary, when an IT lacks clearly bounded and stable functional attributes, it is perceived as ambiguous, leading to a "what is it?" type of questions (Moreau et al., 2001). Ultimately, ambiguity has to relate with the high-level cognitive processing involved in the development of meanings (Winkielman et al., 2003). Given that purposively incomplete technologies are characterized by imprecise and evolving functional boundaries, we expect that users are likely to perceive them as ambiguous to varying degrees.

Measurement Development

To develop the measures that would tap into this conceptual domain, we followed the development method proposed by MacKenzie et al. (2011). We started by developing a pool of items that is about five times larger than the target scale, including numerous redundant items (DeVellis, 2003). The items were presented to 28 individuals (13 faculty members and 15 master students) who agreed to provide feedback on their wording. This led to either deletion or adjustment of the initial list of items. Throughout the item development phase, particular attention was paid to item bias (i.e. ambiguity, leading items, social desirable items) because of the artefactual covariance it might create in the final results (Podsakoff et al., 2003). We conducted a content validity assessment using Hinkin & Tracey's (1999) procedure, as recommended (MacKenzie et al., 2011). The study participants evaluated the extent to which a given item is representative of each dimension of the construct. The results of the repeated ANOVA (N = 191) helped identify the candidate items that are consistent with their posited domain.

For this study, we used items that aim to capture the overall understanding of an IT by a user rather than specific dimensions of ambiguity: "Generally speaking, Facebook does not make clear sense to me." (PITA_1), "In general, it is not clear what this device is and is not." (PITA_2), "Generally speaking, I find it hard to define Facebook." (PITA_3), "Overall, I find it difficult to make sense of Facebook." (PITA_4), and "All in all, Facebook is hard to fully comprehend." (PITA_5).

Nomological Network and Data Collection Method

Our theoretical model is rooted in the literature on attitudes and behavior (Fishbein & Ajzen, 1975), and the associated attitudinal models developed in IS (Davis, 1989; Venkatesh et al., 2003, 2012). Indeed, there are extensive evidence that the perception of ambiguity exerts effects on attitudes and judgments. However, these effects are seemingly contradictory. On the one hand, previous research suggests that individuals are likely to negatively evaluate ambiguous objects (Noseworthy & Trudel, 2011; Uekermann et al., 2010). This stems from the fact that individuals may have a negative disposition towards things that they do not clearly understand (Cacioppo et al., 1986), or to ambiguous

situations in general (Frenkel-Brunswik, 1949; Furnham & Ribchester, 1995). On the other hand, numerous examples of successful ambiguous IT can be found. A seminal study from Meyers-Levy & Tybout (1989) indicates that moderately ambiguous products are more favorably evaluated than non-ambiguous products. Indeed, it appears that ambiguity can signal novelty, leading to more favorable judgments (Goode et al., 2013). Taken together, these results indicate that perceived ambiguity might be a double-edge sword: it can lead to more positive evaluations when present in reasonable proportion, but can also backfire and lead to negative evaluations when it is excessively present.

Our study seeks to tease out these simultaneous mechanisms in the context of IT adoption and use (i.e., TAM or UTAUT models). To test the nomological validity of Perceived IT Ambiguity (PITA), our model includes three other constructs (Usage, Effort Expectancy and Performance Expectancy) from seminal research on consumer technology adoption (Venkatesh et al., 2008, 2012) and three control variables (age, gender and education level). All variables except the control variables are measured using a 5-points Likert scale. We sampled 192 individuals aged between 18 and 73 (M = 36) to collect their view of the Facebook online application. All the participants (70% female) were paid and recruited via the crowdsourcing platform Prolific Academic. Our model is tested using covariance-based SEM in Stata v. 14.2. In the model assessment process, we first analyze the measurement model and then the structural relationships among constructs (Anderson & Gerbing, 1988).

Findings

Assessment of the Measurement Model

Problematic indicators were eliminated on the basis of their relationships with the posited latent construct. A common rule of thumb is to retain the items which loadings are greater than 0.707 (Straub & Gefen, 2004). This analysis led to the deletion of one item for performance expectancy (λ = .67), and the deletion of the indicator of intensity of usage (λ = .56). Table 1 provides evidence of the reliability of the measurement model.

Constructs	Cronbach's Alpha	Composite reliability	Average Variance Extracted (AVE)
Perceived IT Ambiguity (PITA)	0.952	0.953	0.802
Effort Expectancy (EE)	0.885	0.888	0.665
Performance Expectancy (PE)	0.910	0.912	0.777
Use (USE)	0.900	0.905	0.763

Table 1. Measurement Model (after purification)

Both Cronbach's Alpha and Composite Reliability coefficients are above the recommended 0.70 threshold, which indicates satisfactory internal reliability of the instrument (Nunnally, 1978). All constructs' Average Extracted Variance (AVE) were highly above 0.5 indicating good levels of construct convergent validity (Fornell & Larcker, 1981). The assessment of construct discriminant validity did not raise any concern since all the item loadings were higher in their respective construct than with any of the other constructs (Campbell & Fiske, 1959). Meanwhile, the square root of the AVE of each construct was found to be greater than the correlations of the construct with the other constructs (Fornell & Larcker, 1981).

Assessment of the Structural Model

We specify a recursive structural model in which PITA is modeled as an antecedent of both PE and EE, who are themselves predictors of USE. In order to test whether the effect of PITA on use is partially or fully mediated, we also modeled a direct path from PITA to USE.

In the model, we allowed the error terms of PE and EE to covary. After controlling for the relevant variables, the resulting model's fit indices are close from the cutoff values for fit indices in confirmatory factor analysis using a maximum likelihood estimation algorithm (RMSEA ≤ .06; CFI ≥ .95; TLI ≥ .95; SRMR ≤ .08), indicating that the latent model fits the data moderately well (Hu & Bentler, 1999) (Table 4).

RMSEA	0.087
CFI	0.937
TLI	0.924
SRMR	0.071

Table 4. Model Fit Indices

	Path Coef.	S.E.	P. Values
Direct effects			
EE -> USE	0.654	0.152	0.000
PE -> USE	0.165	0.050	0.001
PITA -> EE	-0.409	0.044	0.000
PITA -> PE	-0.131	0.072	0.070
PITA -> USE	0.178	.069	0.010
Age -> PITA	0.024	0.006	0.000
Gender -> USE	0.187	0.097	0.052
Sum of indirect effects			
PITA -> USE	-0.289	0.063	0.000

Table 5. Structural Model (direct and indirect effects)

The research model is analyzed to simultaneously assess direct and indirect effects of perceived IT ambiguity on the use of Facebook. An analysis of the indirect effects of PITA on USE reveals that perceived IT ambiguity influences usage through its effect on beliefs about whether Facebook is useful and easy to use (β=-.29, p=.010). This indirect effect is a combination of the specific indirect effect exerted trough the belief that Facebook is easy to use (-.41*.65=-.27) and, to a much lesser extent, via the belief that Facebook is useful (-.13*.17=-.02). We also found that, all other things being held constant, PITA has a significant and positive direct influence on the adoption of Facebook (β=.18, p=.010). These results suggest that although perceived IT ambiguity has an adverse impact on adoption because it weakens the belief that the IT is useful and easy to use, it positively affects IT use when these negative effects are controlled (a potential case of *competitive mediation* - Zhao et al., 2010).

Conclusion

In this paper, we provide preliminary empirical evidence that the concept of perceived IT ambiguity is an important mechanism in the adoption of IT, especially those that are designed for incompleteness (Garud et al., 2008). The early results show that perceived IT ambiguity may be modeled as an antecedent of effort and performance expectancy (Venkatesh et al., 2003), and exerts an indirect effect on use through these beliefs. However, these early results must be interpreted with the caution necessary when conducting mediation analysis using latent variables without correcting the confidence intervals with bootstrapping (MacKinnon et al., 2002, 2004).

Instances of technology use in which ambiguity is unlikely to manifest with adequate variability across users are limited to specific tools that offer a narrowly delineated, unique, and consistent user experience. Very specific software applications may fit into this definition, such as games with simple rules (e.g. Solitaire card game) or weather forecast apps. However, some have argued that incompleteness - and by extension ambiguity – is constitutive of digital artifacts (e.g., Kallinikos et al., 2013), and the construct may have wide-ranging applications in both hardware and software contexts of use.

Future research would seek to expand the nomological network of the construct using insights from cognitive psychology. For example, differences in cognitive style can explain why some individuals are more inclined towards ambiguous situations than others

(Frenkel-Brunswik, 1949; Furnham & Ribchester, 1995). Individual tolerance to ambiguity may exert a conditional effect on the process of adopting IT with blurry functional boundaries. Besides, perception of ambiguity has been associated with attitude strength (Krosnick et al., 1993; Petrocelli et al., 2007). We can expect that users that are unsure about their understanding of a given IT are likely to experience greater levels of attitudinal uncertainties.

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