WHAT DOES IT DO? THEORIZING FUNCTIONAL AMBIGUITY AS A FACTOR INFLUENCING USER PERCEPTIONS OF INFORMATION TECHNOLOGY

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Completed research paper

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Abstract

The digital era is characterized by the widespread diffusion of information technologies (IT) offering great degrees of malleability in how their features may be interpreted and used. While there are immediate advantages to leveraging the malleability of IT, this could also prove a source of confusion for lay users who are faced with multiple interpretations of what IT can do. Despite growing evidence of this phenomenon, current research lacks the concepts and tools to adequately capture its impact on IT acceptance, adoption, and use. In this paper, we first deploy the "perceived functional ambiguity" (PFA) construct, describing its dimensionality and relationships with measures. Then, we develop and validate the corresponding multidimensional measurement instrument. Finally, we test the effect of the construct across three studies assessing how users perceive social media (N=419), smartphones (N=411) and smart speakers (N=346). Our results suggest that ambiguity has a double-edged sword effect on users' perception of IT: greater levels of ambiguity are associated with greater utilitarian and hedonic value, but they also entail substantial learning costs. This research contributes to advancing our theoretical understanding of IT use by introducing ambiguity as a factor underpinning contemporary IT use.

Keywords: ambiguity, user perception, technology acceptance, multidimensional constructs, scale development.

1 Introduction

IT vendors have strong incentives to release information technology (IT) offering great degrees of flexibility in how their features may be interpreted and used: smartwatches, smart speakers, smartphones, but also social media are ITs that may serve a wide range of user purposes. These tools tend to offer few restrictions concerning how their features may be used, combined, or repurposed in order to favour appropriation (Barki et al. 2007) and innovation (Sun 2012). Yet evidence suggests that conflating the flexibility of an IT can compromise its acceptance among users. For example, some have argued that the failure of Google Glass is due to the lack of clarity on why the product existed and its intended use (Yoon 2018). Similarly, virtual worlds such as Second Life may not have reached their expected market due to cryptic and sometimes antagonistic interpretations of what virtual worlds are all about (Nardon and Aten 2012). Thus, there seems to be a tension between the ambiguity of IT and the adoption these tools that the information systems (IS) literature has not yet fully come to grips with.

Despite the potential of IT offering great levels of flexibility to benefit individuals and organizations (Schmitz et al. 2016), evidence suggests that the returns are often below expectations (Jasperson et al. 2005; Nambisan et al. 1999). IS scholars have advanced two main explanations for this. First, users fail to actively leverage the functional potential of IT, not necessarily in terms of frequency of use but rather in terms of extent of use (Jasperson et al. 2005; Venkatesh et al. 2008). Research indicates that lay users are generally reluctant to expand the basket of features that they already know, or to revisit how they use features they are already familiar with (Jasperson et al. 2005; Sun 2012). Users stick to a limited set of features because they lack the resources (i.e., time or technical skills) to experiment with IT (Ahuja and Thatcher 2005), or because they are not really aware of all the possibilities an IT can offer (Thatcher et al. 2018). The second reason for the underutilization of IT has to do with the absence of a predetermined purpose for the IT. In contrast to traditional IT that are intended for a specific goal and whose performance can easily be gauged, the value of malleable IT emerges over time and is provisional (Garud et al. 2008; Richter and Riemer 2013). Users start with a "blank slate" and are invited to bring about novel, custom interpretations through intense sensemaking activities at the individual and collective levels (Berente et al. 2011; Griffith 1999; Hsieh et al. 2011). Should this sensemaking process be hindered, it is unlikely that the expected benefits will accrue from IT use.

Research on malleable IT use is receiving growing interest (Richter and Riemer 2013; Schmitz et al. 2016), but there remain several conceptual issues to be solved. One issue relates to the high degree of ambiguity that characterizes malleable IT use. Ambiguity here stems from a difficulty to perceive the purpose the IT might serve (i.e., what the IT is about) or the task domain to which it may be put (i.e., how to use it) (Sun 2013). Recent research has linked the sensemaking activities taking place in the wake of IT implementations with such ambiguity as users attempt to dissipate ambiguity to engage in effective use (Berente et al. 2011; Griffith 1999; Hsieh et al. 2011). Yet although ambiguity is a running thread in contemporary research on IT, it has not yet been conceived as a specific attribute of IT. This paper will thus explore the following question: *What is the influence of functional ambiguity on users' perceptions of IT?*

Against these theoretical considerations, the objectives of this paper are (1) to develop and validate a construct that captures the ambiguity of IT, and (2) to test its effects on affective evaluations of IT (i.e., attitudes). Accordingly, we begin by defining the "perceived functional ambiguity" (PFA) construct, describing its dimensionality and relationships with measures. Then, through three replication studies, we develop and validate a multidimensional scale that captures user perceptions of IT functions as being unclear. We then demonstrate the value of the proposed scale by testing its influence on user evaluations of IT attributes. Finally, we discuss the theoretical and practical implications of this research as well as its limitations. Collectively, these three studies result in a useful tool for assessing the ambiguity of IT and provide preliminary evidence that embracing such ambiguity can pave the way to new research avenues.

2 Construct Definition and Specification

2.1 Defining Perceived Functional Ambiguity

Ambiguity resides between a person and a stimulus and gives rise to subjective feelings of uncertainty for the person who experiences it. It generally arises when individuals are exposed to stimuli that are novel, complex, or lack internal coherence (Budner 1962). Ambiguity causes a range of interrelated cognitive (e.g., mental elaboration), emotional (e.g., anxiety) and attitudinal reactions (e.g., attraction, avoidance) (Krohne 1989; Petty and Cacioppo 1986). This makes the concept particularly relevant to study individual-level phenomena. Ambiguity explains a range of behaviors in management research, from marketing (e.g., Uekermann et al. 2010) to organizational behaviors (e.g., Smithson 1999). To the best of our knowledge, ambiguity has not been explored as a factor that influences IT use.

In this paper, we propose that IT-related stimuli are inherently ambiguous and that users might have difficulties making sense of IT as a whole. We unpack the PFA construct to capture *users' perception that the function of an IT is unclear*. This perception might manifest with varying degrees across users, with some users acknowledging having difficulties in identifying the function of an IT, while others feeling confident in their understanding of what a given IT can do. The construct is expected to be fairly dynamic over time (i.e., subject to change as the user integrates new information about the IT) and to differ across contexts and types of IT.

To provide a conceptual definition of the construct that would pave the way to the development of a measurement instrument, we reviewed connected work in reference disciplines (mainly marketing and personal psychology). It turned out that no consensual definition of ambiguity existed and that the concept encompasses a wide range of connected notions and meanings (Norton 1975). We closely examined the marketing literature on "ambiguous products" (e.g., Noseworthy et al. 2012; Rajagopal 2005; Yi 1993) and although we could not find a readily available conceptual definition, this literature directed us towards categorization issues as the root cause of perceptual ambiguity, which provided boundaries for the conceptual domain underlying the construct. In parallel to the literature review, we interviewed users of general consumer ITs (e.g., social media, smartwatches, etc.) and implemented a one-hour focus group to further advance our conceptualization. Drawing on these sources and following recommended steps (Podsakoff et al. 2016), we organized the emerging attributes of the construct around three themes, each representing different manifestations of ambiguous perceptions. We favoured a parsimonious rather than exhaustive approach when retaining these themes so that they would complement each other by minimizing overlap. To determine which themes to retain, we used the categorization framework, as ambiguity is often related to a person's difficulty in confidently categorizing a perceptual stimuli (Lakoff 2008). This effort led to the identification of three themes representing as many manifestations of ambiguous perceptions: (1) "vagueness-incompleteness-fragmented", when parts of the whole stimulus are missing; (2) "inconsistencies-contradictions-contraries", when a stimulus lacks internal coherence or contains discrepancies; (3) "instability-unpredictability-changeability", when a stimulus shifts form or nature over time.

2.2 Formal Specification and Operationalization

While the attributes outlined above cover abstract aspects of the conceptual domain, they are not directly connected to IT-related stimuli. An additional step was thus to further specify the construct so that it matches the nature of IT. Feedback and interviews with users helped tremendously in achieving this step of the conceptualization, bridging the gap between abstract themes and concrete manifestations. As a result, we specify PFA as a superordinate, second-order construct composed of three first-order dimensions: (1) vagueness, (2) inconsistency and (3) unpredictability (Figure 1). Embracing a feature-centric perspective, these dimensions are further defined below:

- *Vagueness* is characterized by a difficulty to form a finite understanding of the IT due to the fuzziness of its functional boundaries. It materializes as a strain to represent the IT as a clearly

bounded entity with a finite domain of application. The scope of things that can be done with a given IT has expanded dramatically over the past decade, mainly thanks to the rise of digital platforms offering services and content (Constantinides et al. 2018), resulting in a perception that IT has no limit in terms of the tasks they may be employed for. Yet as the functional scope that an IT covers expands, so does the potential for users to perceive the overall IT ambiguously. Functional vagueness compromises the mental mapping of an individual IT into established knowledge structures that facilitate interpretation of what the IT is about. ITs may be viewed as entities that can do almost anything, resulting in some conceptual confusion for lay users.

- *Inconsistency* is characterized by a difficulty to form a coherent understanding of the IT due to great disparities in the functional features it contains. Whereas some ITs are meant to fulfil a single function, others are conceived with diversity in mind. Users may perceive these functions as overly disparate or even conflicting. Hybrid products (e.g., smartwatches) that borrow core features from distinct product categories (e.g., computer and watch categories) are a case in point. For new ITs that straddle multiple product categories (e.g., smartphones integrating core features from mobile phones, music players, web browsers, personal assistants, etc.) the confusion may be even greater. Integrating seemingly disparate functions into a coherent whole may represent a great cognitive challenge.
- *Unpredictability* is characterized by a difficulty to form a lasting conceptual understanding of the IT due to a lack of stability in its primary function. This dimension captures the impact of the dynamic nature of IT on the development of mental representations. Assuming that core features define the identity of a given IT (Griffith 1999), perceptions that such features can be organized in novel ways can lead users to feel uncertain about what the IT is about. Such unpredictability could result from the designers introducing new features that change the nature of the IT, or in a non-orchestrated manner by the bottom-up emergence of unforeseen applications leading to questioning an IT's value proposition. Initially developed for the video game entertainment industry, virtual reality helmets have found unforeseen applications in the professional environment areas of HR or manufacturing. Such developments question provisional interpretations of what the IT is about, making the user uncertain about the IT.

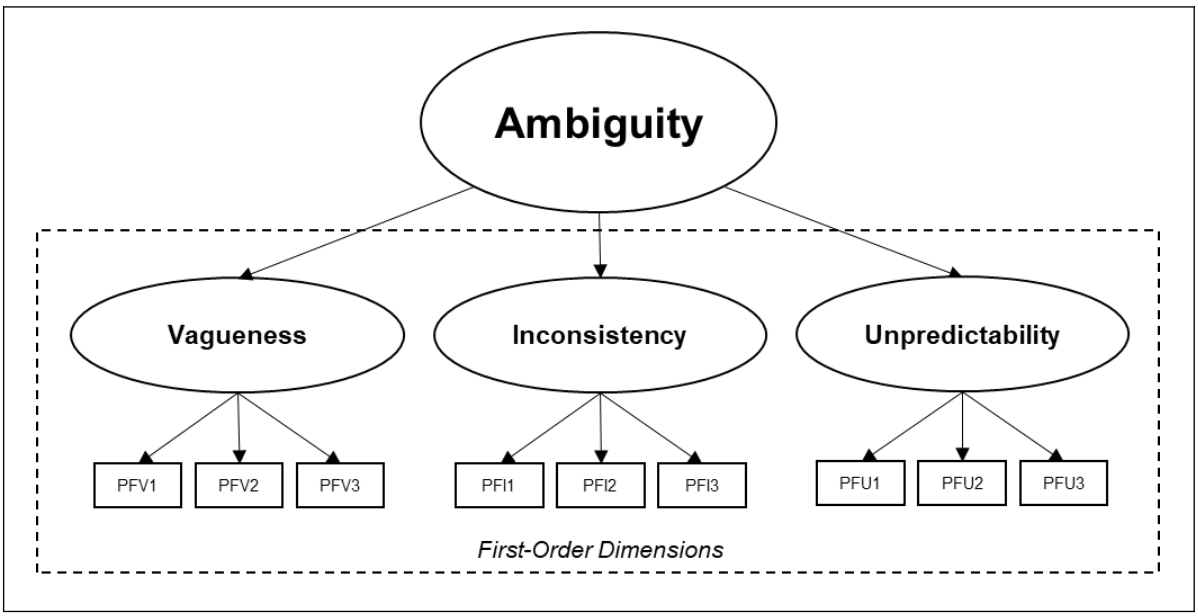

Figure 1. Superordinate Second-Order Conceptualization of PFA

We expect users who have difficulties to form a clear (i.e., bounded, cohesive and stable) conceptual understanding of an IT to score high on all three dimensions. Consistent with the formal specification

of a Type I superordinate construct (Jarvis et al. 2003), we consider each first-order dimension as an independent reflective construct (i.e., indicator of the same dimension covary and are interchangeable). While indicators may covary across their respective dimensions due to the fact that they belong to the same conceptual domain, each dimension is a unique theoretical manifestation of the overarching construct. Consequently, the second-order construct (i.e., PFA) is considered the only source of covariation among these dimensions and a unit change in the second-order construct may result in similar degrees of change across all dimensions (Edwards 2001; Williams et al. 2003). This means that a user who has difficulties forming a clear conceptual understanding of an IT is expected to experience all three aspects of ambiguity to comparable degrees.

2.3 Discriminating from Related Constructs

PFA should be distinguished from existing related concepts. First, a distinction should be made with the concept of "equivocality" that has permeated IS research since its inception (Daft et al. 1987; Daft and Macintosh 1981) and continues to attract the attention of IS scholars (Berente et al. 2011; Lim and Benbasat 2000). Ambiguity shares a strong thematic commonality with the concept of equivocality, including the possibilities of an entity being interpreted in multiple and potentially diverging ways (Weick 1990). The main difference is in the distinct research paradigms that underly the two concepts: while the concept of equivocality has its roots in social constructivism, our understanding of ambiguity is rooted in a psycho-cognitive perspective. Consequently, these concepts call for distinct research objectives: while research on equivocality typically accounts for organizational dynamics such as the emergence of diverging interpretations at the group level (Davidson 2002; Doherty et al. 2006; Orlikowski and Gash 1994), the focus of ambiguity in this paper is on individual behavior in relation to IT.

Second, the construct is distinct from that of "cognitive load", which refers to the amount of cognitive processing people incur to process IT-related information (Jen-Hwa Hu et al. 2017), or "technology overload" resulting from a quantitative excess of system features, information, or communication possibilities caused by an IT (Karr-Wisniewski and Lu 2010). Functional ambiguity arises when one is unable to achieve a sense of conceptual clarity on a given IT, which we theorize as a *qualitative* issue with functional features and their interpretation. Conversely, cognitive load is concerned with the processing of perceptual cues, which is primarily a *quantitative* issue of processing a large number of features at once. Thus, ambiguity involves the open interpretation of the features that make up the IT, while load is directly connected to the number of available features. Thus, feature-limited IT may be perceived ambiguously because it is unclear what purpose the IT might serve. Conversely, ITs that are packed with features may lead to cognitive load without being perceived ambiguously. For instance, users of Mercedes-Benz cars might experience overload due to the excess of electronic functions available - more than 600 - but it is unlikely that they will doubt the purpose of their car (Rust et al. 2006).

3 Hypotheses Development

Research has consistently shown that ambiguity can influence affective evaluations, but the direction of this effect is not consensual among scholars. On the one hand, ambiguity may lead to positive evaluations because it conveys novelty and triggers curiosity. For this reason, ambiguous products that defy straightforward understanding may be evaluated more positively than unambiguous products (Goode et al. 2013; Meyers-Levy and Tybout 1989). On the other hand, ambiguity may lead to rejection because it undermines the ability to interpret and interact with the world (Oppenheimer 2008; Winkielman et al. 2003). This dual nature makes the ambiguity concept a particularly appealing one from a theoretical standpoint as it seems that these paradoxical effects on evaluations can operate simultaneously (e.g., Hoch 2002). In the remaining part of this section, we elaborate on the expected influence that PFA may have on user perception of IT. Three evaluated attributes are considered: ease of

use of IT, utilitarian value of IT, and hedonic value of IT. The resulting model that is tested in presented in Figure 2.

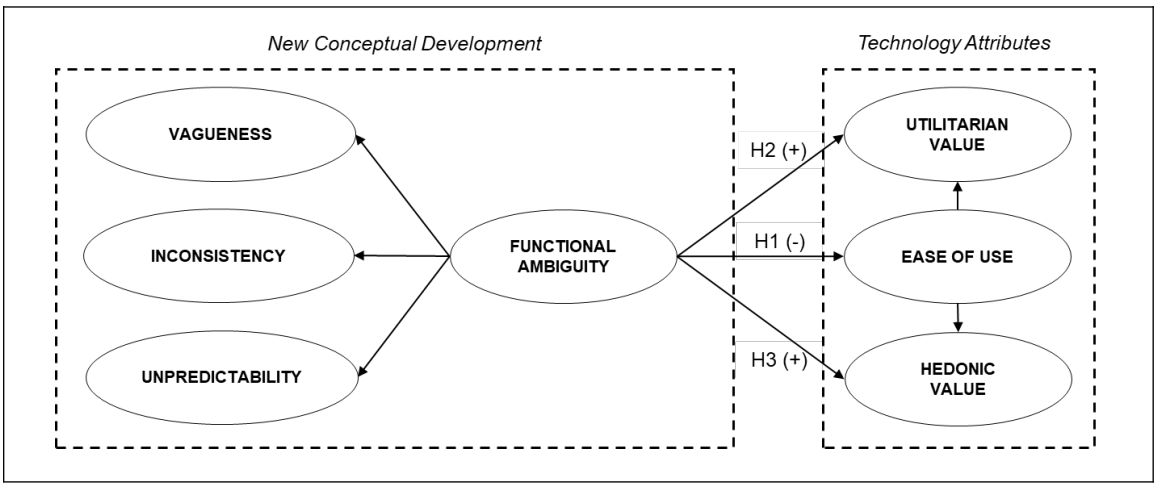

Figure 2. Research Model

Effect on ease of use: Ease of use is the degree to which a person believes that using an IT would be free of effort (Davis 1989). Although ease of use has mainly been treated in a monolithic way, research on metacognitive processes suggests that the learning aspects inherent to the "ease of use" construct involve distinct cognitive operations (Metcalfe and Shimamura 1994; Oppenheimer 2008; Whittlesea 1993): (1) low-level cognitive operations, and (2) high-level cognitive operations involved in the development of conceptual meaning. Low-level cognitive operations involve the processing of perceptual information such as when users want to learn how to properly interact with an IT. Traditional interpretations of the "ease of use" construct mirror such low-level cognitive operations and have their root in the usability and ergonomics of the IT (Agarwal and Venkatesh 2002; Palmer 2002; Thong et al. 2002). A high level of usability implies that users will have to spend less energy to learn how to use a given IT because of less strain on low-level cognitive operations (Venkatesh 2000; Venkatesh and Ramesh 2006). Our understanding of the "ease of use" construct differs from conceptions rooted in "usability" research mirroring low-level cognitive operations given that we locate cognitive effort to understand how to use an IT in high-level cognitive operations of meaning-making (Winkielman et al. 2003). Hence, we theorize PFA as a factor that increases the amount of effort users will exert trying to gain a conceptual understanding of the IT. Accordingly, we propose the following:

H1: Perceived functional ambiguity will be negatively related to ease of use.

Effect on utilitarian value: We expect PFA to trigger positive affective reactions associated to the utilitarian value IT, namely the perception that the IT is instrumental in achieving certain things or doing things more quickly (Venkatesh et al. 2012). The idea that functional ambiguity is beneficial to individual effectiveness or productivity may seem counter-intuitive, but new a IT that appears as ambiguous may be seen as full of utilitarian potential that is not yet realized. Previous research shows that ITs are full of unrealized potential that users uncover as they find out about new features as well as new ways of using features they already know (Jasperson et al. 2005; Sun 2012). When properly leveraged, the ambiguity inherent to user experience allows the creation of new uses that help users accomplish things more quickly than before (Schmitz et al. 2016; Sun et al. 2016). In contrast, an IT that appears with great conceptual clarity may lack the functional flexibility that could lead to more positive evaluations of its utilitarian value. Accordingly, we propose the following:

H2: Perceived functional ambiguity will be positively related to the utilitarian value of IT.

Effect on hedonic value: The hedonic value of IT refers to the enjoyable and fun property that users typically ascribe to new technologies, in particular if those are designed to fulfil users' needs for en-

joyment (Van Der Heijden 2004). Considering that contemporary IT may serve a wide range of purposes including entertainment, the relation between functional ambiguity and the hedonic value of IT is theoretically relevant. The theoretical mechanism that ties the two constructs together does not lie in the appeal of ambiguity itself, but rather in the prospects of its resolution. Personnel psychology research suggests that solving problems that might appear ambiguous, complex, or with uncertain outcomes is inherently rewarding (Furnham and Ribchester 1995). Recent literature on product usage corroborates these findings by revealing that users derive pleasure from the active process of making sense of ITs that appear complex to apprehend (Lakshmanan and Krishnan 2011). Innovative individuals who like to experiment with IT enjoy dissipating the ambiguity inherent to innovations that defy straightforward understanding (Agarwal and Prasad 1998). Accordingly, we propose the following:

H3: Perceived functional ambiguity will be positively related to the hedonic value of IT.

4 Research Methodology

4.1 Scale Development and Validation

Once a clear conceptual definition of the focal construct is provided, we move forward to the assessment of its effects by developing the corresponding scale (Podsakoff et al. 2016). We developed and validated a measurement instrument following the procedures recommended by MacKenzie et al. (2011) and detailed in Figure 3. The first step consisted in generating the items and verifying content validity. We deductively created thirty items which were then subject to face validity assessment (10 subjects), expert judgement (13 experts) and cognitive interviewing (13 subjects). The feedback collected allowed us to further specify the items so that they better reflected the negative connotation of the ambiguity construct. After discarding closely worded items, the list of candidates was reduced to fifteen items. These were subject to a definitional correspondence test and content validity was established for each item using ANOVA F-test as decision criteria (see Hinkin and Tracey 1999).

The next steps involved data collection procedures in order to validate the psychometric properties of the new instrument. We validated the scale using data collected through three studies assessing how users perceive social media (N=419), smartphones (N=411) and smart speakers (N=346). We selected these types of IT because they emerged consistently in the interviews as exemplar of functional ambiguity. For example, one interviewee noted that "Social media are hyper general tools, which are ambiguous by nature because they are entirely open, it's a blank sheet, and people may not know how to fill that blank sheet." We selected a mix of hardware and software technologies because the theoretical phenomenon being explored in this paper is expected to apply to a wide range of IT.

Accordingly, the second step consisted in evaluating the fifteen items and reducing the size of the scale through statistical procedures. We used data from Study 1 (N = 419 Facebook users) and conducted an exploratory factor analysis (EFA) followed by a confirmatory factor analysis (CFA). After examining item cross-loadings using modification indices and estimated parameter change, we removed two near substitute items within each dimension to achieve a parsimonious instrument of nine items. The purpose of step three was to test the multidimensional structure of the scale. We used data from Study 2 (N = 411 smartphone users) to test the convergent and discriminant validity of the dimensions, to compare different measurement models using chi-square difference tests, and to test the addition of direct paths between the dimensions and the variables of the nomological network. We found that the model with the multidimensional higher-order structure and no additional paths fit the data best. The fourth and final step was the cross-validation of the scale using a new sample. Using observations from Study 3 (N = 346 smart speaker users), we confirmed that the psychometric properties of the scale are stable across IT types and samples. We finally achieved the development of the instrument to measure the extent to which a user perceives the function of an IT as unclear. Details about the data collection procedures and demographic properties the three samples used to validate the instrument are provided in Appendix A.

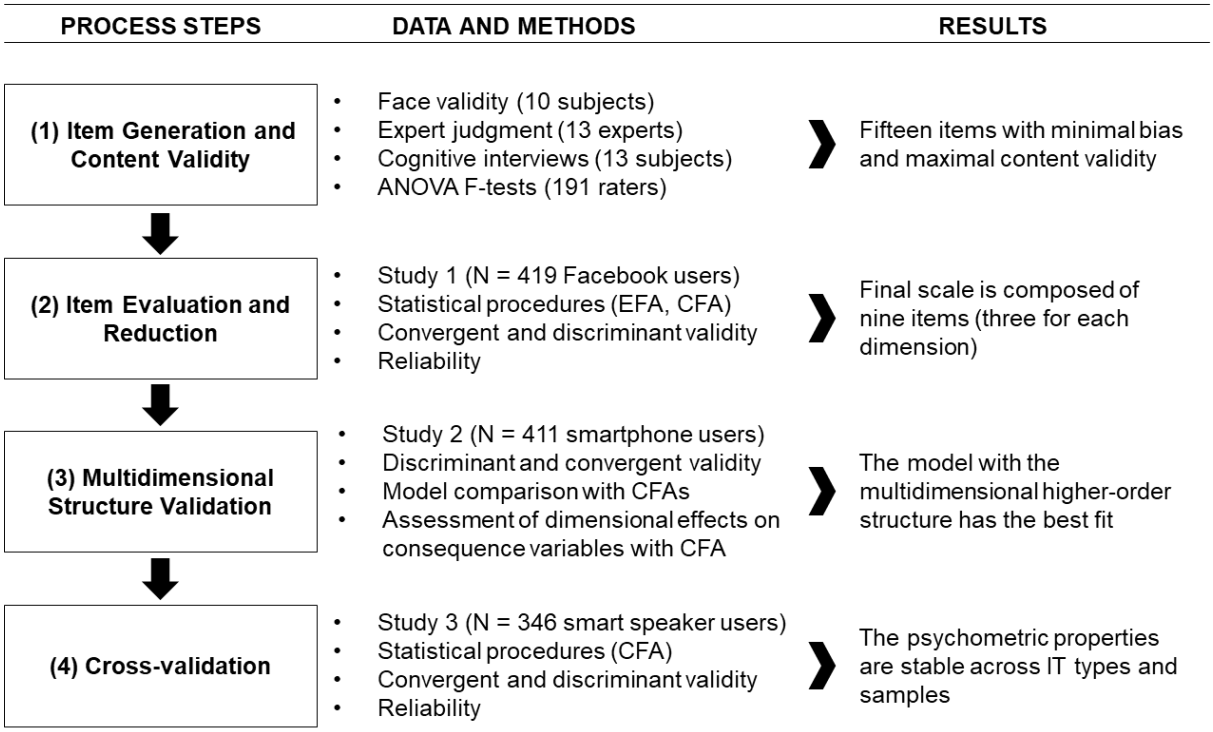

Figure 3. Overview of the Scale Development Process and Tests of Effects
Notes: N: sample size, ANOVA: analysis of variance, EFA: exploratory factor analysis, CFA: confirmatory factor analysis.

4.2 Sample and Participants

To test our hypotheses, we rely on observations from Study 1, 2 and 3 and analyze those using covariance-based SEM in Stata 15. Each study draws on a different sample and evaluates user perceptions on three distinct ITs (social media, smartphone, and smart speaker, respectively). Study 1 respondents were recruited via the crowdsourcing platform Prolific Academic (Peer et al. 2017) and all of them were required to own a Facebook account before taking the survey. For Study 2 and 3, we used the market research agency Qualtrics to identify smartphone (Study 2) and smart speaker (Study 3) owners. In Study 2 and 3, we enforced demographic criteria so that the final sample has similar demographic properties as the general US population. Participants were financially compensated for participating in the study. The data collection took place between Spring 2018 and Spring 2019.

4.3 Questionnaire Design and Measurement

The constructs in the model were operationalized using a combination of the scale we develop in this paper and existing scales. The sources and manifest items for the scale used in the model are reported in Appendix B. In line with our hypotheses, we included in the model the PFA construct and three user perceptions: perceived utilitarian value (PUV), perceived hedonic value (PHV) and perceived ease of use (EOU). PFA dimensions are captured through perceived functional vagueness (PFV), perceived functional inconsistency (PFI) and perceived functional unpredictability (PFU). We used existing measures of general consumer IT adoption from Venkatesh et al. (2012) to operationalize these constructs. All items are measured using a five-point fully labelled format and we took steps in the design of the questionnaire to minimize common method effects using a mix of procedural and statistical remedies (Podsakoff et al. 2012). For example, we separated psychologically the measures of predictor and criterion variables, and we used the CFA marker technique (Williams et al. 2010) to control for method variance in *post hoc* results. We also made sure that careless responses would not adversely impact our results by implementing questions meant to check the attention of respondents (Oppen-

heimer et al. 2009). We disregarded observations from respondents who failed to spot the attention checks.

5 Results

The structural model demonstrated satisfactory fit statistics in Study 1 (SRMR = .058, RMSEA = .060, CFI = .962, TLI = .956), Study 2 (SRMR = .023, RMSEA = .047, CFI = .984, TLI = .981), and Study 3 (SRMR = .029, RMSEA = .050, CFI = .977, TLI = .973). All indicator loadings were above .7, all AVEs were above .5, and all construct reliabilities (Cronbach alpha and composite reliability) were above .7. We found discriminant validity - checked with the Fornell-Larcker criterion - for all factors.

All path coefficients were significant at the 0.05 level except the direct effect of PFA on perceived utilitarian value and perceived hedonic value in Study 3, which was not significant (see Table 1). Thus, except for H2 and H3 in Study 3 about smart speakers, all hypotheses are supported. This result tends to show that PFA exerts a great deal of influence on user perception.

Accounting for the total effects of the focal construct shows that PFA is a significant predictor of ease of use (R^2 from 38% to 69%), utilitarian value (R^2 from 25% to 59%) and hedonic value (R^2 from 22% to 58%).

Hypo-theses	Structural paths	Study 1		Study 2		Study 3	
		Std. Coef.	p >|z|	Std. Coef.	p >|z|	Std. Coef.	p >|z|
/	PFA -> PFV	0.77	0.000	0.94	0.000	0.87	0.000
/	PFA -> PFI	0.91	0.000	0.91	0.000	0.95	0.000
/	PFA -> PFU	0.82	0.000	0.95	0.000	0.94	0.000
/	EOU -> PUV	0.72	0.000	0.89	0.000	0.65	0.000
/	EOU -> PHV	0.72	0.000	0.88	0.000	0.62	0.000
H1	PFA -> EOU	-0.83	0.000	-0.62	0.000	-0.63	0.000
H2	PFA -> PUV	0.30	0.012	0.23	0.000	0.08 (ns)	0.255
H3	PFA -> PHV	0.36	0.002	0.22	0.000	0.08 (ns)	0.230

Table 1. Structural Relationships Between Constructs

6 Discussion

6.1 Contribution to Research

This paper makes three contributions to IS research. First, we contribute efforts to theorize the nature of IT and propose that IT-related stimuli can be highly ambiguous. While former research has acknowledged that ambiguity is salient in IT-related contexts, the literature has concentrated on the equivocal nature of the information that can be extracted from IT (Daft et al. 1987; Lim and Benbasat 2000) or on the ability of IT to sustain divergent interpretations among distinct user groups (Berente et al. 2011; Doherty et al. 2006; Sahay and Robey 1996; Weick 1990). We add to the IS literature by theorizing the ambiguous nature of IT, especially when there exists great malleability in how the features they contain may be interpreted and used. We unpack the PFA construct to capture user perception that the function of an IT is unclear. Drawing on ambiguity research in psychology and marketing, we advance that this manifests in three ways: functional vagueness, functional inconsistency and functional unpredictability. This conceptualization echoes attempts to depict IT as *ambivalent* (Kallinikos et al. 2013)

and *dubious* (Ekbia 2009). It also expands Sun's observation that users are often uncertain about the purpose that an IT might serve, and we add to this by fleshing out which characteristics might contribute to this (Sun 2013; Sun and Fang 2010). By conceptualizing how ambiguity manifests at the micro-perceptual level of user perceptions, we hope to better understand attitudinal, affective and behavioral responses to IT-related stimuli (Zhang 2013).

To support this conceptualization, we propose an operationalization of the construct that follows state-of-the-art scale development and validation procedures, including procedures concerning multidimensional constructs (Edwards 2001; MacKenzie et al. 2011; Polites et al. 2012). Our second contribution therefore includes the development and validation of a scale. Measures are derived from the conceptual definition and the resulting measurement instrument is comprised of nine items. We took steps to minimize the extent of method effects that could stem from item wording by involving users of IT at the early stage of this project (Podsakoff et al. 2003). We have established the validity and reliability of the scale in a tightly controlled and highly predictable theoretical structure by testing the impact of the focal construct on core user perceptions. The psychometric properties of the scale were consistent across the three studies that were conducted. As a result of this scale development effort, we contribute to the IS discipline with a scale that scholars can confidently apply to a wide range of research endeavors. In that regard, we strongly encourage researchers to consider the potential of the construct beyond the framework of IT adoption that we used for validation purposes in this paper.

The third contribution of this paper is to show that ambiguity influences user perceptions of IT attributes in both positive and negative ways. This contribution directly answers recent calls to explore new exogeneous mechanisms enabling or inhibiting IT acceptance (Venkatesh et al. 2016). Preliminary observations reveal interesting elements. First, a distinction must be made between perceptions concerning the effort required to use an IT and perceptions concerning the perceived value of an IT. We find that 30 percent to 70 percent of user cognitive effort to learn to use an IT can be attributed to functional ambiguity, which contrasts with former research pointing at objective usability as the primary source of cognitive effort (Venkatesh 2000). Our tentative explanation for this observation is that users deploy extensive mental resources trying to develop a conceptual understanding of IT by figuring out what features are available and how they relate to one another at a more abstract level (Griffith 1999; Sun 2012). Simultaneously, we find that the perceived value of an IT accrues from increased functional ambiguity. This counter-intuitive finding suggests that users expect to derive more value from IT - both pleasure and usefulness - the function of which is difficult to intuitively grasp. Nevertheless, these effects were not observed in the smart speaker study, suggesting that they may be contingent on other variables that are not directly tested in this model. This being said, we can conclude with sufficient confidence that PFA is a significant factor influencing user perceptions in a negative way. Connecting these results with extant research on post-adoptive usage, this study paves the way to a greater understanding why users can be reluctant to leverage IT requiring extensive individual sensemaking effort to deliver value (Berente et al. 2011; Griffith 1999; Hsieh et al. 2011).

6.2 Limitations and Future Research Directions

This conceptualization and operationalization of the ambiguous nature of IT lays the foundation for further research on malleable IT use. As with any study, our work contains some limitations, which may provide a starting point for further research.

First, we demonstrate that the scale applies to general consumer IT products used in a personal setting, with similar effects on user perceptions across classes of IT (i.e., software and hardware). However, we do not test if these effects hold for company products used in an organizational setting. Generally speaking, we suspect that ambiguity will be penalized more greatly by users in an organizational context simply because of the increased pressure to obtain work-related outcomes. If users are unable to quickly identify the purpose that an IT might serve, they may quickly turn it down rather than spend valuable cognitive resources and time to understand how to use it (Ahuja and Thatcher 2005). Studies in an organizational context should nevertheless be mindful about the nature of the activities or tasks

that users perform with IT as part of their organizational occupation, as research on task-technology fit indicates (Goodhue and Thompson 1995). Not all organizational settings call for clear and unambiguous technological solutions with centrally orchestrated usage dictated by organizational policies or managerial intentions. Instead, we expect users working in contexts characterized by unstructured and fast-changing activities to recognize the value of ambiguous solutions affording bottom-up use processes (Maruping and Magni 2015; Nan 2011). Therefore, this paper could spur interesting research projects in large-scale collaboration or innovation settings. Connected to the boundary conditions of this paper, we also encourage researchers to perform cross-national studies outside the US to establish stronger norms for the scale. Indeed, as noted by Spector (1992, p. 67): "In order to interpret the meaning of scores, it is helpful to know something about the distribution of scores in various populations. The scale of measurement for most constructs in the social sciences is arbitrary. The meaning of a score can only be determined in relation to some frame of reference." Since frames of reference may vary substantially across countries, additional validation in a European (or Asian) country is warranted.

Second, the structural relationships tested in this paper show that the direction of the direct and indirect effects of PFA on user perceptions differ, suggesting that "competitive effects" are at play (Zhao et al. 2010). This finding warrants deeper investigation, because although the observed dual effects are consistent with existing conceptualizations of ambiguity as a construct that simultaneously engenders positive and negative attitudinal reactions (McLain 1993), it is also possible that intervening variables are omitted in the model. Future research should thus seek to expend the proposed nomological network by assessing the impact of relevant user traits such as people's tolerance for uncertainty (Carleton et al. 2007; Grenier et al. 2005) or tolerance for ambiguity (Furnham and Marks 2013; Furnham and Ribchester 1995). Other omitted variables might include the appeal that people find in experimenting with IT (Agarwal and Prasad 1998), their beliefs of IT self-efficacy (Higgins and Compeau 1995) or how mindful they are about IT possibilities (Thatcher et al. 2018). One could reasonably hypothesize, for example, that highly innovative users view functional ambiguity as a desirable attribute of IT, which would positively rather than negatively alter their affective evaluation.

Third, this paper presents three cross-sectional studies with datasets collected on three different samples. However, this design does not allow us to explore how dynamic changes in the focal construct influence user perceptions. Developing a dynamic perspective on the focal construct is particularly relevant because we can expect that usage behaviors, in terms of frequency as well as extent of use (Burton-Jones and Straub 2006), are likely to retrospectively influence users' conceptual understanding of IT. Specifically, one might expect ambiguity to diminish with experience as users unpack the black box of IT features and progressively become more cognizant about the IT (Nambisan et al. 1999; Sun 2012). Future research can address this limitation by using a more controllable research context where the researcher can observe and test for the feedback loop described above, or by setting up a longitudinal research program that accounts for construct-level changes over time.

6.3 Managerial Contributions

The results of this research demonstrate that functional ambiguity should not be disregarded because it can affect the way users interact with IT. The key implications of this stems from the finding that ambiguous perceptions of IT significantly alter user perceptions of IT.

First of all, IT vendors can make decisions that will influence the extent to which their user base experiences uncertainty when interacting with IT. As shown in this paper, greater degrees of ambiguity can have adverse effects on adoption as users tend to put a great penalty on the cognitive efforts that dealing with ambiguity induces. Thus, this paper is of practical interest because it sheds light on the downside of designing incomplete tools that are left for users to interpret and make sense of. This invites designers not only to focus on usability concerns as they are a well-known source of learning efforts, but also to consider high-level cognitive processes of meaning making and how these might impact the user experience. For IT vendors who monitor factors inhibiting acceptance and use of IT, be-

ing aware of the distinction between usability issues and conceptual issues of meaning making is critical. Being able to tease out the unique effects of increased functional ambiguity on user reports of cognitive effort should be beneficial to IT vendors.

The underlying question for practitioners lies in the actions they can take to mitigate the negative effects of ambiguity. The proposed conceptualization identifies three ways in which ambiguity can manifest, and each area calls for a different set of actions. First, ambiguity manifests in increased vagueness caused by the virtually unlimited possibilities that the IT offers. Providing users with a more guided experience at the early interaction stages might prove a relevant approach. One could consider a layered design whereby users progressively expand the boundaries of the IT. Designers could think of implementing typical use cases or prompting users to perform certain actions at various adoption stages. Second, ambiguity is likely to manifest as users realize that the same IT integrates features that are not typically found together. To mitigate this potential source of confusion, practitioners should stress the complementary nature of these features through integrative use cases. Third, the frequent emergence of radically new uses will likely confuse users as they must reconsider their initial interpretation of the IT. Properly managing the introduction of new features and offering adequate guidance on how to use those features is necessary to prevent feature fatigue whereby users are simply overwhelmed with the frequency of change. Written information on new feature releases, in-use visual aids, and more guided interventions would minimize these adverse effects.

7 Conclusion

We contribute to IS research by conceptualizing what we call functional ambiguity as well as developing and validating a new scale to operationalize the construct. We find consistent evidence of the impact of PFA on seminal user perceptions across three studies. This novel conceptualization of IT opens up new research areas that embrace the uncertainty and ambiguity associated to IT use, placing these aspects at the core of IT acceptance and use mechanics.

Appendix

Appendix A – Sample Characteristics

Demographic	Category	Study 1 (N = 419)		Study 2 (N = 411)		Study 3 (N = 346)	
Gender	Men	104	25%	181	44%	171	49%
	Women	315	75%	230	56%	175	51%
Age bracket	Under 18	0	0%	1	0%	0	0%
	18-24	67	16%	41	10%	44	13%
	25-34	147	35%	83	20%	69	20%
	35-44	100	24%	76	18%	60	17%
	45-54	69	16%	82	20%	61	18%
	55-64	31	7%	68	17%	53	15%
	65+	5	1%	60	15%	59	17%
Education	Less than High School	4	1%	15	4%	5	1%
	High School / GED	76	18%	109	27%	72	21%
	Some College	88	21%	103	25%	101	29%
	2-year College Degree	41	10%	52	13%	35	10%
	3-year College Degree	85	20%	96	23%	3	1%
	4-year College Degree	56	13%	26	6%	91	26%
	Master Degree	50	12%	4	1%	31	9%
	Doctoral Degree	9	2%	4	1%	4	1%
	Professional Degree (JD, MD)	10	2%	2	0%	4	1%

Table A.1. Demographic Attributes of the Respondents

Appendix B – Manifest Items for Constructs

Constructs, Dimensions, and Items	
Perceived Functional Vagueness *(new development)*	
PFV1	I have difficulties understanding all the things <the IT> can do.
PFV2	I only have a vague perception of all the functionalities of <the IT>.
PFV3	I cannot figure out all that can be done using <the IT>.
Perceived Functional Inconsistency *(new development)*	
PFI1	The great diversity of uses offered by <the IT> confuses me.
PFI2	I am confused by the very different ways in which <the IT> can be used.
PFI3	I cannot get my mind around the disparate functionalities of <the IT>.
Perceived Functional Unpredictability *(new development)*	
PFU1	I cannot wrap my head around the new ways of using <the IT>.
PFU2	I tend to be confused when I hear about the new ways of using <the IT>.
PFU3	I have difficulties getting a grasp of the new ways of using <the IT>.
Perceived Utilitarian Value *(from Venkatesh et al. (2012))*	
PUV1	I find <the IT> useful in my daily life.
PUV2	I think that <the IT> is a valuable tool.
PUV3	Using <the IT> helps me accomplish things more quickly.
PUV4	Using <the IT> improves my efficiency.
Perceived Ease of Use *(from Venkatesh et al. (2012))*	
EOU1	Learning how to use <the IT> is easy for me.
EOU2	My interaction with <the IT> is clear and understandable.
EOU3	I find <the IT> easy to use.
EOU4	It is easy for me to become skillful at using <the IT>.
Perceived Hedonic Value *(from Venkatesh et al. (2012))*	
PHV1	I believe that using <the IT> is enjoyable.
PHV2	I have fun using <the IT>.
PHV3	The actual process of using <the IT> is entertaining.

Table B.1. Manifest Items for Constructs

References

Agarwal, R., and Prasad, J. 1998. "A Conceptual and Operational Definition of Personal Innovativeness in the Domain of Information Technology," *Information Systems Research* (9:2), pp. 204–215.

Agarwal, R., and Venkatesh, V. 2002. "Assessing a Firm's Web Presence: A Heuristic Evaluation Procedure for the Measurement of Usability," *Information Systems Research* (13:2), pp. 168–186.

Ahuja, M. K., and Thatcher, J. B. 2005. "Moving beyond Intentions and toward the Theory of Trying: Effects of Work Environment and Gender on Post-Adoption Information Technology Use," *MIS Quarterly* (29:3), pp. 427–459.

Barki, H., Titah, R., and Boffo, C. 2007. "Information System Use-Related Activity: An Expanded Behavioral Conceptualization of Individual-Level Information System Use," *Information Systems Research* (18:2), pp. 173–192.

Berente, N., Hansen, S., Pike, J. C., and Bateman, P. J. 2011. "Arguing the Value of Virtual Worlds: Patterns of Discursive Sensemaking of an Innovative Technology," *MIS Quarterly*, pp. 685–709.

Budner, S. 1962. "Intolerance of Ambiguity as a Personality Variable.," *Journal of Personality* (30), pp. 29–50.

Burton-Jones, A., and Straub, D. W. 2006. "Reconceptualizing System Usage: An Approach and Empirical Test," *Information Systems Research* (17:3), pp. 228–246.

Carleton, R. N., Norton, M. A. P. J., and Asmundson, G. J. G. 2007. "Fearing the Unknown: A Short Version of the Intolerance of Uncertainty Scale," *Journal of Anxiety Disorders* (21:1), pp. 105–117.

Constantinides, P., Henfridsson, O., and Parker, G. G. 2018. "Introduction—Platforms and Infrastructures in the Digital Age," *Information Systems Research*, pp. 1–20.

Daft, R. L., Lengel, R. H., and Trevino, L. K. 1987. "Message Equivocality, Media Selection, and Manager Performance: Implications for Information Systems," *MIS Quarterly*, pp. 355–366.

Daft, R. L., and Macintosh, N. B. 1981. "A Tentative Exploration into the Amount and Equivocality of Information Processing in Organizational Work Units," *Administrative Science Quarterly*, pp. 207–224.

Davidson, E. J. 2002. "Technology Frames and Framing: A Socio-Cognitive Investigation of Requirements Determination," *MIS Quarterly* (26:4), pp. 329–358.

Davis, F. D. 1989. "Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology," *MIS Quarterly* (13:3), pp. 319–340.

Doherty, N. F., Coombs, C. R., and Loan-Clarke, J. 2006. "A Re-Conceptualization of the Interpretive Flexibility of Information Technologies: Redressing the Balance between the Social and the Technical," *European Journal of Information Systems* (15:6), pp. 569–582.

Edwards, J. R. 2001. "Multidimensional Constructs in Organizational Behavior Research: An Integrative Analytical Framework," *Organizational Research Methods* (4:2), pp. 144–192.

Ekbia, H. R. 2009. "Digital Artifacts as Quasi-Objects: Qualification, Mediation, and Materiality," *Journal of the American Society for Information Science and Technology* (60:12), pp. 2554–2566.

Furnham, A., and Marks, J. 2013. "Tolerance of Ambiguity: A Review of the Recent Literature," *Psychology* (04:09), pp. 717–728.

Furnham, A., and Ribchester, T. 1995. "Tolerance of Ambiguity: A Review of the Concept, Its Measurement and Applications," *Current Psychology* (14:3), pp. 179–199.

Garud, R., Jain, S., and Tuertscher, P. 2008. "Incomplete by Design and Designing for Incompleteness," *Organization Studies* (29:3), pp. 351–371.

Goode, M. R., Dahl, D. W., and Moreau, C. P. 2013. "Innovation Aesthetics: The Relationship between Category Cues, Categorization Certainty, and Newness Perceptions," *Journal of Product Innovation Management* (30:2), pp. 192–208.

Goodhue, D. L., and Thompson, R. L. 1995. "Task-Technology Fit and Individual Performance," *MIS Quarterly* (19:2), p. 213.

Grenier, S., Barrette, A.-M., and Ladouceur, R. 2005. "Intolerance of Uncertainty and Intolerance of Ambiguity: Similarities and Differences," *Personality and Individual Differences* (39:3), pp. 593–600.

Griffith, T. L. 1999. "Technology Features as Triggers for Sensemaking," *Academy of Management Review* (24:3), pp. 472–488.

Van Der Heijden, H. 2004. "User Acceptance of Hedonic Information Systems," *MIS Quarterly* (28:4), pp. 695–704.

Higgins, C. A., and Compeau, D. R. 1995. "Computer Self-Efficacy: Development of a Measure and Initial Test," *MIS Quarterly* (19:2), pp. 189–211.

Hinkin, T. R., and Tracey, J. B. 1999. "An Analysis of Variance Approach to Content Validation," *Organizational Research Methods* (2:2), pp. 175–186.

Hoch, S. J. 2002. "Product Experience Is Seductive," *Journal of Consumer Research* (29:3), pp. 448–454.

Hsieh, J. J. P.-A., Rai, A., and Xu, S. X. 2011. "Extracting Business Value from IT: A Sensemaking Perspective of Post-Adoptive Use," *Management Science* (57:11), pp. 2018–2039.

Jarvis, C. B., Mackenzie, S. B., and Podsakoff, P. M. 2003. "A Critical Review of Construct Indicators and Measurement Model Misspecication in Marketing and Consumer Research," *Journal of Consumer Research* (30:2), pp. 199–218.

Jasperson, S., Carter, P. E., and Zmud, R. W. 2005. "A Comprehensive Conceptualization of Post-Adaptive Behaviors Associated with Information Technology Enabled Work Systems," *MIS Quarterly* (29:3), pp. 525–557.

Jen-Hwa Hu, P., Han-fen, H., and Xiao, F. 2017. "Examining the Mediating Roles of Cognitive Load and Performance Outcomes in User Satisfaction with a Website: A Field Quasi-Experiment.," *MIS Quarterly* (41:3), pp. 975–988.

Kallinikos, J., Aaltonen, A., and Marton, A. 2013. "The Ambivalent Ontology of Digital Artifacts," *MIS Quarterly* (37:2), pp. 357–370.

Karr-Wisniewski, P., and Lu, Y. 2010. "When More Is Too Much: Operationalizing Technology Overload and Exploring Its Impact on Knowledge Worker Productivity," *Computers in Human Behavior* (26:5), pp. 1061–1072.

Krohne, H. W. 1989. "The Concept of Coping Modes: Relating Cognitive Person Variables to Actual Coping Behavior," *Advances in Behaviour Research and Therapy* (11:4), pp. 235–248.

Lakoff, G. 2008. *Women, Fire, and Dangerous Things: What Categories Reveal about the Mind*, University of Chicago press.

Lakshmanan, A., and Krishnan, H. S. 2011. "The Aha! Experience: Insight and Discontinuous Learning in Product Usage," *Journal of Marketing* (75:6), pp. 105–123.

Lim, K. H., and Benbasat, I. 2000. "The Effect of Multimedia on Perceived Equivocality and Perceived Usefulness of Information Systems," *Mis Quarterly* (24:3), pp. 449–471.

MacKenzie, S. B., Podsakoff, P. M., and Podsakoff, N. P. 2011. "Construct Measurement and Validation Procedures in MIS and Behavioral Research: Integrating New and Existing Techniques.," *MIS Quarterly* (35:2), pp. 293–334.

Maruping, L. M., and Magni, M. 2015. "Motivating Employees to Explore Collaboration Technology in Team Contexts," *MIS Quarterly* (39:1), pp. 1–16.

McLain, D. L. 1993. "The MSTAT-I: A New Measure of an Individual's Tolerance for Ambiguity," *Educational and Psychological Measurement* (53:1), pp. 183–189.

Metcalfe, J., and Shimamura, A. P. 1994. *Metacognition: Knowing about Knowing*, The MIT Press.

Meyers-Levy, J., and Tybout, A. M. 1989. "Schema Congruity as a Basis for Product Evaluation," *Journal of Consumer Research* (16:1), pp. 39–54.

Nambisan, S., Agarwal, R., and Tanniru, M. 1999. "Organizational Mechanisms for Enhancing User Innovation in Information Technology," *MIS Quarterly* (23:3), pp. 365–395.

Nan, N. 2011. "Capturing Bottom-up Information Technology Use Processes: A Complex Adaptive Systems Model," *MIS Quarterly*, pp. 505–532.

Nardon, L., and Aten, K. 2012. "Valuing Virtual Worlds : The Role of Categorization in Technology Assessment Valuing Virtual Worlds : The Role of Categorization in Technology Assessment," *Journal of the Association for Information Systems* (13), pp. 772–796.

Norton, R. W. 1975. "Measurement of Ambiguity Tolerance," *Journal of Personality Assessment* (39:6), pp. 607–619.

Noseworthy, T. J., Wang, J., and Islam, T. 2012. "How Context Shapes Category Inferences and Attribute Preference for New Ambiguous Products," *Journal of Consumer Psychology* (22:4), pp. 529–544.

Oppenheimer, D. M. 2008. "The Secret Life of Fluency," *Trends in Cognitive Sciences* (12:6), pp. 237–241.

Oppenheimer, D. M., Meyvis, T., and Davidenko, N. 2009. "Instructional Manipulation Checks: Detecting Satisficing to Increase Statistical Power," *Journal of Experimental Social Psychology* (45:4), pp. 867–872.

Orlikowski, W. J., and Gash, D. C. 1994. "Technological Frames: Making Sense of Information Technology in Organizations," *ACM Transactions on Information Systems* (12:2), pp. 174–207.

Palmer, J. W. 2002. "Web Site Usability, Design, and Performance Metrics," *Information Systems Research* (13:2), pp. 151–167.

Peer, E., Brandimarte, L., Samat, S., Acquisti, A., Brandimarte, L., and Acquisti, A. 2017. "Beyond the Turk: Alternative Platforms for Crowdsourcing Behavioral Research," *Journal of Experimental Social Psychology* (70), pp. 153–163.

Petty, R. E., and Cacioppo, J. T. 1986. "The Elaboration Likelihood Model of Persuasion," *Advances in Experimental Social Psychology* (19), pp. 123–205.

Podsakoff, P. M., MacKenzie, S. B., Lee, J.-Y., and Podsakoff, N. P. 2003. "Common Method Biases in Behavioral Research: A Critical Review of the Literature and Recommended Remedies.," *The Journal of Applied Psychology* (88:5), pp. 879–903.

Podsakoff, P. M., Mackenzie, S. B., and Podsakoff, N. P. 2016. "Recommendations for Creating Better Concept Definitions in the Organizational, Behavioral, and Social Sciences," *Organizational Research Methods* (19:2), pp. 159–203.

Podsakoff, P. M., MacKenzie, S. B., and Podsakoff, N. P. 2012. "Sources of Method Bias in Social Science Research and Recommendations on How to Control It," *Annual Review of Psychology* (63:1), pp. 539–569.

Polites, G. L., Roberts, N., and Thatcher, J. 2012. "Conceptualizing Models Using Multidimensional Constructs: A Review and Guidelines for Their Use," *European Journal of Information Systems* (21:1), pp. 22–48.

Rajagopal, P. 2005. "Consumer Categorization and Evaluation of Ambiguous Products."

Richter, A., and Riemer, K. 2013. "Malleable End-User Software," *Business & Information Systems Engineering* (5:3), pp. 195–197.

Rust, R. T., Thompson, D. V., and Hamilton, R. W. 2006. "Defeating Feature Fatigue.," *Harvard Business Review* (84:2), pp. 37–47.

Sahay, S., and Robey, D. 1996. "Organizational Context, Social Interpretation, and the Implementation and Consequences of Geographic Information Systems," *Accounting, Management and Information Technologies* (6:4), pp. 255–282.

Schmitz, K. W., Teng, J. T. C., and Webb, K. J. 2016. "Capturing the Complexity of Malleable IT Use: Adaptive Structuration Theory for Individuals Availability," *MIS Quarterly* (40:3), pp. 663–686.

Smithson, M. 1999. "Conflict Aversion: Preference for Ambiguity vs Conflict in Sources and Evidence," *Organizational Behavior and Human Decision Processes* (79:3), pp. 179–198.

Spector, P. E. 1992. "A Consideration of the Validity and Meaning of Self-Report Measures of Job Conditions," *International Review of Industrial and Organizational Psychology* (7), pp. 123–151.

Sun, H. 2012. "Understanding User Revisions When Using Information System Features: Adaptive System Use and Triggers," *MIS Quarterly* (36:2), pp. 453–478.

Sun, H. 2013. "A Longitudinal Study of Herd Behavior in the Adoption and Continued Use of Technology," *MIS Quarterly* (37:4), pp. 1013–1041.

Sun, H., and Fang, Y. 2010. "Toward a Model of Mindful Acceptance of Technology," in *Proceedings of the 31st International Conference on Information Systems*, pp. 12–15.

Sun, H., Fang, Y., and Zou, H. (Melody). 2016. "Choosing a Fit Technology: Understanding Mindfulness in Technology Adoption and Continuance," *Journal of the Association for Information Systems* (17:6), pp. 377–412.

Thatcher, J. B., Wright, R. T., Sun, H., Zagenczyk, T. J., and Klein, R. 2018. "Mindfulness in Information Technology Use: Definitions, Distinctions, and a New Measure," *MIS Quarterly* (42:3), pp. 831–847.

Thong, J. Y. L., Hong, W., and Tam, K.-Y. 2002. "Understanding User Acceptance of Digital Libraries: What Are the Roles of Interface Characteristics, Organizational Context, and Individual Differences?," *International Journal of Human-Computer Studies* (57:3), pp. 215–242.

Uekermann, F., Herrmann, A., Wentzel, D., and Landwehr, J. R. 2010. "The Influence of Stimulus Ambiguity on Category and Attitude Formation," *Review of Managerial Science* (4:1), pp. 33–52.

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), pp. 342–365.

Venkatesh, V., Brown, S., Maruping, L., and Bala, H. 2008. "Predicting Different Conceptualizations of System Use: The Competing Roles of Behavioral Intention, Facilitating Conditions, and Beha-

vioral Expectation," *MIS Quarterly* (32:3), pp. 483–502.

Venkatesh, V., and Ramesh, V. 2006. "Web and Wireless Site Usability: Understanding Differences and Modeling Use," *MIS Quarterly*, pp. 181–206.

Venkatesh, V., Thong, J. Y. L., and Xu, X. 2012. "Consumer Acceptance and Use of Information Technology: Extending the Unified Theory of Acceptance and Use of Technology," *MIS Quarterly* (36:1), pp. 157–178.

Venkatesh, V., Thong, J. Y. L., and Xu, X. 2016. "Unified Theory of Acceptance and Use of Technology: A Synthesis and the Road Ahead," *Journal of the Association for Information Systems* (17:5), pp. 328–376.

Weick, K. E. 1990. "Technology as Equivoque: Sensemaking in New Technologies.," in *The Jossey-Bass Management Series. Technology and Organizations*, P. S. Goodman and L. S. Sproull (eds.), San Francisco: Jossey-Bass.

Whittlesea, B. W. A. 1993. "Illusions of Familiarity.," *Journal of Experimental Psychology: Learning, Memory, and Cognition* (19:6), p. 1235.

Williams, L. J., Edwards, J. R., and Vandenberg, R. J. 2003. "Recent Advances in Causal Modeling Methods for Organizational and Management Research," *Journal of Management* (29:6), pp. 903–936.

Williams, L. J., Hartman, N., and Cavazotte, F. 2010. "Method Variance and Marker Variables: A Review and Comprehensive CFA Marker Technique," *Organizational Research Methods* (13:3), pp. 477–514.

Winkielman, P., Schwarz, N., Fazendeiro, T. A., and Reber, R. 2003. "The Hedonic Marking of Processing Fluency: Implications for Evaluative Judgment," in *The Psychology of Evaluation: Affective Processes in Cognition and Emotion.*, J. Musch and K. C. Klauer (eds.), pp. 189–217.

Yi, Y. 1993. "The Determinants of Consumer Satisfaction: The Moderating Role of Ambiguity," *Advances in Consumer Research* (20:1), pp. 502–506.

Yoon, C. 2018. "Assumptions That Led to the Failure of Google Glass," *Medium*.

Zhang, P. 2013. "The Affective Response Model: A Theoretical Framework of Affective Concepts and Their Relationships in the ICT Context," *MIS Quarterly* (37:1), pp. 247–274.

Zhao, X., Lynch, J. G., Chen, Q., Lynch Jr., J. G., and Chen, Q. 2010. "Reconsidering Baron and Kenny: Myths and Truths about Mediation Analysis," *Journal of Consumer Research* (37:2), pp. 197–206.