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Deontic technology perceptions: a complementary view to instrumental perspectives on technology acceptance and use

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Received 5 August 2022
Revised 4 October 2022
Accepted 8 October 2022

Abstract

Purpose – For decades, organizational research has primarily considered instrumental technology perceptions (ITP) – emphasizing how technology impacts the personal interests of end users themselves – to understand technology acceptance. The authors offer a complementary paradigm by introducing deontic technology perceptions (DTP), defined as the degree to which individuals believe that the technology they use is beneficial to other individuals beyond themselves (e.g. beneficial to customers).

Design/methodology/approach – The authors collected quantitative survey-based data from three different hospitals located in the United States. On the basis of conservation of resources theory, the authors investigated whether both DTP and ITP were associated with improved work-related well-being.

Findings – Two pilot studies ($n = 161$ and $n = 311$ nurses) substantiated our DTP conceptualization. Our primary study ($n = 346$ nurses) found support for the association between DTP and improved work-related well-being. Evidence for the relationship between ITP and work-related well-being was mixed and the authors did not find a statistically significant interaction between DTP and ITP.

Originality/value – The authors build on decades of research on technology acceptance by complementing it with our deontic perspective. Our work demonstrates that technology users pay attention and react meaningfully to how their use of technology impacts not only themselves but also external parties like patients, customers and members of the general public.

Keywords Technology acceptance, Conservation of resources theory, Technology use, Deontic

Paper type Research paper

Introduction

For over three decades, a multidisciplinary body of research has been devoted to understanding how end users adopt and respond to new forms of technology. A variety of

Journal of Humanities and Applied Social Sciences
Vol. 5 No. 2, 2023
pp. 103-119
Emerald Publishing Limited
2632-279X
DOI 10.1108/JHASS-08-2022-0103

theoretical paradigms have been offered as attempts to explain these responses and facilitate the adoption of new technologies (e.g. Davis, 1989; Fishbein and Ajzen, 1975; Thompson *et al.*, 1991) with Venkatesh *et al.* (2003) reviewing 32 constructs across eight existing models to generate their Unified Theory of Acceptance and Use of Technology (UTAUT) model. Although their resulting model explained a significant amount of variance in behavioral intention and usage, they encouraged future research to identify additional causal antecedents underlying the cognitive phenomena that drive user attitudes and behaviors.

Technology perceptions are shaped by a variety of factors including gender; hedonic motivation; dispositional factors including self-efficacy, personal innovativeness and mastery; social influence processes; and organizational training (Gefen and Straub, 1997; O'Driscoll *et al.*, 2010; Sykes *et al.*, 2009; van der Heijden, 2004). These extant factors share a common lens in that the research questions under investigation focus on *how the technology affects the personal interests of the individual user*. A variety of constructs and terms have been offered to assess this idea, including perceived usefulness, ease of use, extrinsic and intrinsic motivation, affect toward use, social factors, facilitating conditions and voluntariness (Davis, 1989; Davis *et al.*, 1992; Moore and Benbasat, 1991; Thompson *et al.*, 1991; Venkatesh *et al.*, 2003). In sum, the literature on technology acceptance and usage has been dominated by an *inward* focus.

We seek to advance this literature in an organizational context by providing a complementary, *outward-focused* perspective that addresses how users perceive that their use of technologies at work affects *others*, particularly those outside the organization like customers or the general public. We differentiate between instrumental (inward-focused) and deontic (outward-focused) motives for human behavior and apply them to technology acceptance. The instrumental perspective holds that behavior may be explained by self-interested, inward-focused motives that are rooted in individuals' basic needs for control (Folger, 2001). In contrast, the deontic perspective proposes that human behavior is driven by individuals' desire for human dignity, morality and an inherent concern for the well-being of others (Rupp *et al.*, 2006). Yet with a historically predominant focus on inward-focused motives (e.g. ease of use), we propose that the technology acceptance literature to date has not fully explored how outward-focused perceptions impact user behavior. Applying these concepts, we argue that a more complete understanding of technology acceptance and usage can be developed by the study of outward-focused (deontic) technology perceptions of users.

Thus, the purpose of this paper is to conceptually develop and empirically explore deontic technology perceptions (DTP) as a complement to instrumental technology perceptions (ITP) for understanding technology use. We define DTP as the degree to which individuals believe that the technology they use at work is beneficial to other individuals beyond themselves and other members within the organization. These are contrasted with ITP, which represent the dominant paradigm and address how technology affects the users themselves. Beyond recognizing the potential overlap (i.e. use simultaneously benefitting oneself and others), our central thesis is that employees' underlying reasons for technology use are both inwardly *and outwardly* focused. Based on conservation of resources (COR) theory (Hobfoll, 1989), we anticipate that both are likely to enhance work-related well-being. Given the introductory nature of the concept, our work concludes with a future research agenda discussed in the context of the limitations associated with our study.

Theory and hypotheses

Instrumental technology perceptions

From a management standpoint, technology has been viewed in terms of providing utility and practical rewards associated with efficiency through optimizing processes and minimizing costs (c.f., Agarwal and Karahanna, 2000). Primary theoretical paradigms addressing technology use have taken an instrumental perspective by focusing on the attitudes, perceptions and behaviors of the end user (i.e. the employee). The well-known Technology Acceptance Model (TAM) identified perceived usefulness and perceived ease of use as the primary determinants of whether a user would accept the technology (Davis, 1989). The TAM-2, proposed by Venkatesh and Davis (2000), integrated social influence and cognitive processes as predictors of user acceptance. The UTAUT suggested that performance and effort expectancies, social influence and facilitating conditions all predict behavioral intentions, which in turn predict use behavior (Venkatesh *et al.*, 2003).

The commonality across these models is that they all share this instrumental set of variables addressing how the technology is beneficial or detrimental to the end user. According to the TAM, for example, perceived usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" and 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). Semantically, these definitions make clear the self-interested nature of the focus while neither gives regard as to how using the technology would impact an external party beyond the user.

Social influence is "the degree to which an individual perceives that important others believe he or she should use the new system" (Venkatesh *et al.*, 2003, p. 451). These important others could be supervisors, leaders of the organization or champions of the technology within the organization. Although social influence accounts for others beyond the focal participant, it remains inwardly focused. First, social influence does not necessarily consider influences external to the organization (e.g. customers, patients or the general public). Second, and more importantly, social influence exerts its power from the instrumental perspective of the focal participant. For example, if a supervisor strongly encourages a subordinate to use a specific technology, the subordinate is likely to comply because of the potential personal rewards that can be gained (or avoidance of punishment) by appeasing the supervisor. This may include gaining favor with the supervisor to receive informal benefits or more tangible rewards in the form of higher performance evaluations or salary increases. Similarly, if coworkers discourage the use of a specific technology, a team member is unlikely to use the technology to avoid ostracism and to remain in favorable standing with the group.

Beyond the seminal models discussed above, numerous empirical studies have identified many influences as barriers and facilitators of end-user perceptions and behaviors. These include the current use of an incumbent technology system, embeddedness within one's social network, the compatibility of the technology, impediments created by the work environment, the complexity of the task associated with the technology, and the interface design (e.g. Ahuja and Thatcher, 2005; Bhattacherjee and Sanford, 2006; Kamis *et al.*, 2008; Karahanna *et al.*, 2006; Polites and Karahanna, 2012; Sykes *et al.*, 2009). Like perceived usefulness, ease of use and social influence – and the remaining 32 constructs reviewed by Venkatesh *et al.* (2003) – these all retain an internal focus.

Deontic technology perceptions

Despite the evident absence of a deontic perspective of technology acceptance and use in the management literature, overlapping models and theory from the consumer-focused literature lends some support for this notion. The UTAUT-2 emerged from the UTAUT and was developed to apply to the consumer context (Venkatesh *et al.*, 2012). Additional constructs have been considered in the consumer realm – including intrinsic and pleasurable rewards (i.e. hedonism), price value and habit (van der Heijden, 2004) – which also hold an instrumental focus. However, we identified three studies that began to consider a deontic perspective.

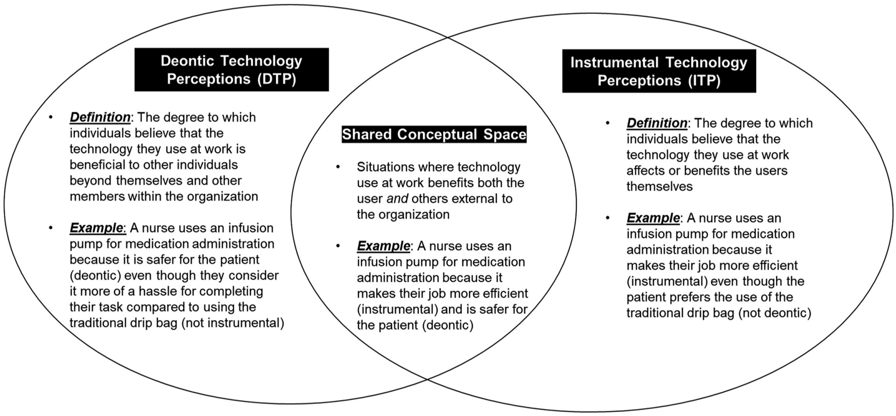
First, a study from the tourism management industry found that travelers may be willing to use social media to post about their vacations as an effort to better inform other future travelers about their experiences (Munar and Jacobsen, 2014). Second, Joo and Lee (2014) examined the benefits of eco-driving (self-benefit versus benefits to the environment) by using an experimental design to test how drivers' affective states interacted with the message (egoistic versus altruistic) received from the in-vehicle voice technology. Although they anticipated a deontic-based finding in that the usage of a car's eco-friendly features could be perceived as beneficial to the environment when drivers felt more altruistic, they did not obtain empirical support for this assertion. Third, Salome *et al.* (2013) provide evidence for the deontic-based perspective in finding that entrepreneurs involved in creating artificial settings for lifestyle sports not only focus on integrating technology to allow their operation to run effectively (instrumental) but also aim to remain environmentally friendly. Taken together, the consumer literature provides a small modicum of evidence that a deontic perspective exists in terms of consumer acceptance and use of technology. In other words, vacationers, drivers and entrepreneurs consider how the technology they are using benefits external referents (e.g. other vacationers and the environment).

Yet despite the noted overlap between TAMs in the management and consumer literature (e.g. UTAUT and UTAUT-2), there is still a limited connection as to how DTP exists in the workplace. Within the management literature, studies focusing on justice and fairness bring attention to the deontic perspective. In this context, a critical element of this view "is that the recipient or target of the justice is external to the organization, distinct from the observers themselves or other parties (like coworkers) inside the organization" (Dunford *et al.*, 2015, p. 323). Marketing strategies and signals that organizations offer to the public and other external parties – in addition to the ways in which these individuals and entities are treated by the organization and its stakeholders – help shape employees' perceptions and attitudes about their organization, in addition to their subsequent behaviors (Hansen *et al.*, 2011; Rupp, 2011). Additionally, deontic models of justice argue that employees have felt a moral obligation or responsibility in responding to perceived injustice and mistreatment, whether it is toward them or toward another party (Rupp *et al.*, 2013; Skarlicki and Kulik, 2004).

Merging this perspective with our discussion above regarding technology acceptance and use, we argue that this deontic perspective for technology acceptance and use exists within organizational settings. In these scenarios, the recipient or target of the technology is external to the organization, distinct from the users themselves or other users (like coworkers) internal to the organization. We refer to this as *DTP*, defined as the degree to which individuals believe that the technology they use at work is beneficial to other individuals beyond themselves and other members within the organization. In contrast, we argue that *ITP* are distinct and defined as the degree to which individuals believe that the technology they use at work affects or benefits the users themselves. Because we recognize potential overlap – that is, technology use at work can benefit both the individual user and an external party simultaneously – we present this conceptualization in Figure 1 in the form of a Venn diagram. Since our study is based on a sample of nurses, we also provide relevant examples in Figure 1 specific to the healthcare context.

Study hypotheses

We integrate COR theory to develop our study hypotheses and investigate how ITP and DTP function in work-related settings. COR states that individuals are more likely to respond to stressful situations in a healthier and more productive manner when they possess "resources" (Hobfoll, 1989). Resources span a broad range of categories but – relevant to the purpose of our work – can refer to personal characteristics including positive attitudes and beliefs (Halbesleben *et al.*, 2014). Thus, DTP and ITP – that is, positive attitudes about



Note(s): While we consider deontic technology perceptions (DTP) and instrumental technology perceptions (ITP) as distinct, we recognize that overlap may exist (as shown in the "shared conceptual space" in the center of the diagram")

Figure 1. Conceptual overview of deontic and instrumental technology perceptions

technology – can function as personal resources at work. With the accumulation of three decades worth of research on COR theory, a widely replicated finding is the presence of *gain spirals* – aptly named where "initial resource gain begets future gain" (Chen *et al.*, 2015, p. 97). For example, the presence of personal resources enhances subsequent work engagement (Xanthopoulou *et al.*, 2009) while job resources enhance flow at work (Mäkikangas *et al.*, 2010). Moreover, perceived social support and trust among coworkers lead to increased citizenship behaviors directed toward those same individuals (Halbesleben and Wheeler, 2015).

In line with COR and the notion of gain spirals, we anticipate that DTP and ITP will be positively associated with work-related well-being. Work-related well-being generally refers to a combination of positive (e.g. job satisfaction) and reduced negative (e.g. burnout) attitudinal and mental health states (Inceoglu *et al.*, 2018; Montano *et al.*, 2017; Ryff, 2019; Wiklund *et al.*, 2019). Specifically, we anticipate that DTP will create a gain spiral since helping others can be an energizing and more satisfying on-the-job experience. We also anticipate that ITP will create a gain spiral since quicker and more efficient task completion can also result in a satisfying on-the-job experience and conserve energy (i.e. protect resources) that can be used for other tasks. Connecting back to our conceptualization, our hypothesizing is consistent with the technology acceptance literature: although attitudes toward technology may not directly influence behavioral intention (Venkatesh *et al.*, 2003), they are likely to exert an influence on other attitudinal outcomes. In fact, attitudinal outcomes have "been identified as an important dependent variable, not only when the use of the system is mandated . . . but also as a general IS [information systems] success metric" (Brown *et al.*, 2014, p. 731). Accordingly, we suggest,

H1. (a) DTP and (b) ITP will be positively related to work-related well-being.

Again, consistent with the notion of gain spirals and because DTP and ITP represent two distinct resources, we anticipate that the positive effects on work-related well-being will be highest when both DTP and ITP are experienced positively (i.e. the shared conceptual space in Figure 1). Indeed, evidence suggests that the presence of multiple resources combined can yield more positive outcomes (van Woerkom *et al.*, 2016). Therefore, we hypothesize the following:

H2. The interaction between DTP and ITP will yield positive effects on work-related well-being. Specifically, work-related well-being will be highest when both DTP and ITP are high.

Methodology

Sample and procedure

We conducted two pilot studies to provide empirical substantiation for the DTP construct and one primary study to test our hypotheses. For the two pilot studies, we collected data from nurses across two hospitals in the United States. In the first study (n = 161), we conducted an exploratory factor analysis (EFA) examining the factor loadings for the survey items among our DTP, ITP and work-related well-being constructs. In the second study (n = 311), we conducted a confirmatory factor analysis (CFA). Because we consider this as important – yet supplemental – to the investigation at hand, we summarize the two pilot studies in Appendix.

Our primary study involved data from nurses at a different hospital facility in the United States using a Qualtrics-based survey (n = 346 nurses). Responses from the 346 nurses came from nine different units (e.g. intensive care unit; pediatrics; outpatient) which resulted in a nested data structure involving individual responses (Level 1) across units (Level 2). Therefore, we applied hierarchical linear modeling to test H1 and H2. Hierarchical linear modeling is ideal since it properly accounts for nested data when generating standard error terms (Raudenbush and Bryk, 2002). Although our hypotheses are focused on the individual level and unit-level effects or influences are beyond the scope of our investigation, ordinary least squares regression would be inappropriate since the generation of incorrect standard error terms (i.e. failure to account for nested data) could lead to inaccurate results.

Across all three studies, nurses used "smart" infusion pumps (i.e. "Safe Medication Administration through Technologies"; Dunford *et al.*, 2017) – the focal technology under consideration for our study – as part of their daily work activities.

Measures

Appendix provides the full set of items and stems for the DTP, ITP and work-related well-being measures. The three constructs were scored using a 5-point Likert scale.

DTP. In the justice literature, "third party reactions can be either positive or negative depending on the nature of external party justice (i.e. whether the organization is perceived as fair or unfair)" (Dunford *et al.*, 2015, p. 346). Previous research has shown that when a transgressor is unfair to a third party, individuals may give up their own resources to rectify the situation even when they are not the recipient of the transgression (Ellard and Skarlicki, 2002; Kray and Lind, 2002; Turillo *et al.*, 2002). Nurses were asked to assess the degree to which the safety features on smart pump devices assisted them in (a) setting up the correct infusion, (b) avoiding medication errors and (c) preventing adverse drug events (patient harm). All three items direct attention to patients (the external referent) in that the items focus on the patients' needs and experiences while care is administered to them. Higher scores on this scale suggested that nurses perceived the technology to be more (as opposed to less) beneficial *to patients*.

ITP. We created four items asking the degree to which the focal technology – safety features on smart pumps – (a) disrupts nurses' workflow, (b) makes it harder to work with other systems, software or technologies, (c) makes work more stressful and (d) contributes to an excessive workload. These four items focused specifically on how the safety features were disruptive *to nurses*, with higher scores suggesting that nurses perceived the technology to be less (as opposed to more) beneficial *to themselves*. These items were then reverse-scored, with higher measures reflecting higher ITP.

Work-related well-being. Given the stress imposed from the introduction of various technologies, we created a four-item scale where nurses were asked the degree to which they were (a) satisfied with their jobs, (b) often think of quitting their job, (c) fully trust their employer and (d) feel burned out from work. The items assessing thoughts about quitting one's job and burnout were reverse-scored so that higher scores on this scale represented higher levels of work-related well-being. This is consistent with previous approaches that use a compilation of job-related attitudes to assess work-related well-being (e.g. Ryff, 2019; Wiklund *et al.*, 2019).

Control variables. We included *age* and *years of experience with smart pumps* as control variables in our analyses since the technology acceptance literature suggests that both are factors in the degree to which users are amenable to the benefits of technology (Venkatesh *et al.*, 2003). Because organizational experiences and one's position in the organization can strongly influence and shape work-related perceptions, we also included *tenure* (i.e. the number of years spent working as a nurse in their current hospital) and *area size* (i.e. the number of responses from each unit within the organization) as control variables (Perrigino *et al.*, 2021).

Finally, we included available job *resources* as a control variable based on COR theory. COR proposes that organizations may provide "resource caravans" – that is, resources that are shared among and available across employees (Hobfoll, 2011). Since we reasoned that the presence of other job resources likely affects work-related well-being, we included this as a control to assess the effects of DTP and ITP more rigorously. We created a two-item measure to assess resources using the items "I have sufficient access to resources for troubleshooting smart pump related problems" and "I have adequate opportunities for giving feedback regarding smart pumps". Higher scores reflected stronger individual perceptions that additional technology-related job resources were available.

Results

Table 1 displays the means, standard deviations, reliabilities and correlations of the variables. All scale variables demonstrated sufficient reliability ($\alpha > 0.70$). Closer inspection of Table 1 reveals preliminary support for first hypothesis, which stated that DTP (H1a; $r = 0.18$, $p < 0.01$) and ITP (H1b; $r = 0.13$, $p < 0.05$) would be positively associated with work-related well-being. We also note that our CFA results offer similar support (Appendix).

	M	SD	1	2	3	4	5	6	7	8
1. Area size	38.44	43.66	–							
2. Age	36.81	11.86	−0.06	–						
3. Experience	10.79	10.36	−0.15**	0.89**	–					
4. Tenure	7.81	8.09	−0.03	0.69**	0.79**	–				
5. Resources	3.09	0.88	−0.09	0.06	0.06	0.04	(0.75)			
6. ITP	4.17	0.67	0.05	−0.19**	−0.24**	−0.20**	0.17**	(0.90)		
7. DTP	3.56	0.80	0.03	0.01	0.00	−0.03	0.22**	0.31**	(0.84)	
8. WRWB	3.69	0.69	−0.12*	−0.04	0.01	0.00	0.32**	0.13*	0.18**	(0.73)

Note(s): $^{**}p < 0.01$; $^{*}p < 0.05$; reliabilities (α) are displayed in parentheses along the diagonal; ITP = Instrumental Technology Perceptions; DTP = Deontic Technology Perceptions; WRWB = Work-Related Well-Being; $n = 346$

Table 1. Means, standard deviations, reliabilities and correlations

We used hierarchical linear modeling to more rigorously assess H1 and H2 and present these results in Table 2. Model 1 presents the null model which indicates – based on the ICC(1) value – that only around 5% of the explainable variance in work-related well-being is due to the nested data. Model 2 presents the control variable-only model. Consistent with our supposition that other work-related resources might improve work-related well-being, our resources variable was statistically significant ($B = 0.24$, $p < 0.001$). Age was marginally significant ($B = -0.01$, $p < 0.10$), indicating a trend toward older nurses experiencing lower work-related well-being compared to younger nurses. Notably, the reduced −2 Log Likelihood, AIC and BIC information criteria indicated that this model was a better fit compared to the null model (which was also confirmed through a Chi-square difference test).

Model 3 includes DTP and ITP as predictors. Consistent with H1a, DTP was positively associated with work-related well-being ($B = 0.10$, $p < 0.05$). However, H1b was not supported since the positive association between ITP and work-related well-being did not reach statistical significance ($B = 0.04$, $p > 0.05$). Interestingly, the information criteria suggested that the previous model was a better fit to the data compared to this model even though DTP was a statistically significant predictor. As indicated by the ΔR^2 statistic, the inclusion of the DTP and ITP predictors explained an additional 2% of variance in work-related well-being with the R^2 statistic increasing from 0.10 to 0.12 ($p < 0.10$).

Finally, we included an interaction term (ITP*DTP) in Model 4 to assess H2 and determine whether a gain spiral was present (i.e. more positive work-related well-being when both ITP and DTP are higher). This hypothesis was not supported, as (1) the interaction term was not statistically significant, and (2) the information criteria indicated that the data was a worse fit for this model. For parsimony, we do not include Model 4 results in Table 2.

Table 2.
Multilevel model hypothesis testing

	Model 1			Model 2			Model 3		
	B	SE	*p*	*B*	SE	*p*	*B*	SE	*p*
Fixed effects									
Intercept	3.72	0.07	***	3.36	0.23	***	2.92	0.32	***
Area size				0.00	0.00		0.00	0.00	
Age				−0.01	0.01	t	−0.01	0.01	t
Experience				0.01	0.01		0.01	0.01	
Tenure				0.00	0.01		0.00	0.01	
Resources				0.24	0.04	***	0.22	0.04	***
ITP							0.04	0.06	
DTP							0.10	0.05	*
Random effects									
Residual	0.46	0.04	***	0.40	0.03	***	0.39	0.03	***
Intercept	0.02	0.02	**	0.02	0.02	**	0.02	0.02	
ICC(1)	0.05			0.04			0.05		
Information criteria									
−2 Log Likelihood	718.85			673.06			675.37		
$\Delta\chi^2$				45.79	***		−2.31		
AIC	722.85			677.06			679.37		
BIC	730.53			684.61			686.90		
R^2				0.11			0.12		t
ΔR^2				0			0.02		

Note(s): ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; $p < 0.10$; ITP = Instrumental Technology Perceptions; DTP = Deontic Technology Perceptions; Outcome = Work-related well-being; $n = 346$

Discussion

Our primary objective was to introduce DTP, focusing on how technology users perceive technology to be beneficial (or detrimental) to others beyond themselves and other members within the organization. In line with this objective, we not only distinguished DTP from ITP but also found evidence that DTP was positively associated with work-related well-being. Below we discuss the strengths, limitations and implications for research that stem from these findings.

Theoretical implications

Our study makes several important theoretical contributions to the literature. First, our study suggests that employees pay attention to and react meaningfully to perceptions of how *others* are influenced by information technologies. This is a significant addition to the dominant paradigm in the technology acceptance literature which focuses on perceptions of how users themselves are influenced by technology. We argue that accounting for both instrumental and deontic perspectives is necessary for a more complete understanding of technology acceptance and problem-solving, with a focus on both first-person and third-party perceptions.

Second, our study contributes to the development of future theory by offering insights for formal measurement development-related efforts aimed at more precisely assessing both DTP and ITP. Although our items were developed for a healthcare sample, they can be adapted to any industry, technology or target, including situations where researchers would like to understand how information technologies impact customers or members of the general public. Instead of addressing smart pump safety features, items can address other technologies relevant and specific to an organization including those related to the growing areas of cloud computing, artificial intelligence and Big Data. Third, our study advances the literature by exploring the connection between technology and well-being in the healthcare industry, addressing calls for greater industry-specific management and information systems research. Given that Chiasson and Davidson (2005) found only 5.6% of industry-specific studies in the management and information systems literature were devoted to healthcare, we advocate for further healthcare-focused studies adopting this technology-oriented focus.

Practical implications

In addition to theoretical implications, our study makes important practical contributions to the literature. Organizations may benefit significantly by undertaking efforts (e.g. surveys and interviews) to understand employees' DTP involving patients, customers and other parties external to the organization. These initiatives may improve the likelihood that employees will respond favorably to technologies. Organizational leaders must ensure that users within the organization accept the technology, are trained properly, and use the technology as intended as opposed to working around it (Dunford and Perrigino, 2018). When considering issues of technology replacement and implementation, Chief Technology Officers should solicit input not only from the end users but also seek feedback from the recipients which could be through focus groups or customer satisfaction surveys. Moreover, given how the occupational stress and well-being literature highlights how negative perceptions of technology can lead to adverse outcomes (Day *et al.*, 2010) – combined with our findings that DTP is positively associated with work-related well-being – organizations must recognize and leverage the potential benefits as to how the deontic perspective has a positive influence on broader health and well-being (e.g. psychosomatic implications).

Limitations and future research

Our study has certain limitations that give rise to future research directions. One of the weaknesses has to do with our sample of nurses and the fact that the sample was predominantly female. While this is representative of the nursing population at large, gender differences in technology acceptance and use have long been recognized (Ahuja and Thatcher, 2005; Gefen and Straub, 1997; Venkatesh and Morris, 2000). Moreover, employees in nursing and healthcare tend to be more altruistic and other-oriented compared to employees in other industries (Perrigino *et al.*, 2020). Thus, future research should further explore DTP among more gender-balanced samples and its prevalence across different industries. Juxtaposed with our work, studies can attempt to replicate our findings involving technology in male-dominated industries (e.g. engineering).

Another limitation of our study is the use of self-report data (Podsakoff *et al.*, 2003). Considering this limitation, it is important to recognize that "perceptions about technology" is a subjective construct. Previous arguments have been made that for such "inherently subjective constructs . . . the focal person is probably the most accurate source of information regarding his or her desires, perceptions, and attitudes" (Rothbard *et al.*, 2005, p. 254; see also Perrigino and Jenkins, 2022). Because "a large proportion of information systems research is concerned with developing and testing models pertaining to complex cognition" (Becker *et al.*, 2013, p. 665), future research may build on these self-report measures by exploring multisource options, including coworker ratings as to how the focal participant views the technology (and examining the strength of the correlations between these self- and other-ratings). Additionally, future research may integrate DTP with multilevel perspectives at the team level where team members may share common beliefs or "climates" related to how the technology impacts third parties. Based on existing theory and research on emotional contagion (Barsade, 2002; Pugh, 2001), turnover contagion (Felps *et al.*, 2009) and burnout contagion (Bakker and Schaufeli, 2000), "workaround contagion" effects can be explored to determine if individuals' attitudes about how technology affects themselves and external referents are transmittable in the sense that these attitudes aggregate to the team level.

The context of the study perhaps limits the generalizability of the findings in that the focal technology – usage and attitudes regarding smart infusion pumps – is very specific to the healthcare population, which is only a small subset of the working population at large. Nonetheless, most previous studies assessing technology acceptance and use have taken a similar empirical approach to support their overarching theoretical arguments. For example, Davis's (1989) seminal work focused on the usage of e-mail while van der Heijden's (2004) influential work on hedonic information systems assessed user reactions to a Dutch movie website. The nuanced focus of each of these studies did not take away from advancing the field's general understanding of technology acceptance, use and hedonic information systems. Analogously, despite the focus here on smart pump technology, the specific empirical focus should not detract from future studies attempting to advance research on deontic perspectives of technology.

Finally, we encourage future research to consider both antecedents and a wider set of outcomes. Although our study focused as much on establishing the conceptualization of DTP as it did on its effects, there are ample opportunities to assess more nuanced outcomes. For example, studies might consider separate effects on work-related well-being between its hedonic (i.e. happiness and pleasure) and eudaimonic (i.e. self-realization and meaning) forms (Ryan and Deci, 2001). Regarding antecedents, other-orientation and self-interest may be stronger predictors of DTP and ITP, respectively (De Dreu and Nauta, 2009). These examples are a few of the many possibilities to investigate, as our DTP and ITP constructs can be positioned within the various TAMs that already consider many antecedents and outcomes.

Conclusion

Our work introduced DTP – the degree to which individuals believe that the technology they use at work is beneficial to other individuals beyond themselves and other members within the organization – and found a positive association with work-related well-being. In addition, we proposed an agenda for future research to further integrate the concept into the broad knowledge base of technology acceptance and use that has been established over the last few decades. The construct appears to hold the potential to explain additional variance in end-user perceptions and use, above and beyond the existing instrumental perspectives that have dominated the literature to date.

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Appendix

Overview and summary of pilot studies

In line with our conceptualizations, we generated three items to assess DTP, four items to assess ITP and four items to assess work-related well-being (Table A1). Our first pilot study used an EFA to make a preliminary determination as to whether a three-factor structure was optimal for the 11 items, with each item loading onto its anticipated factor. Our second pilot study used a more rigorous CFA to again confirm the three-factor structure (e.g. Hinkin, 1998).

First pilot study: exploratory factor analysis (EFA)

We collected data from 161 nurses employed at a hospital located in the United States using a Qualtrics-based survey. All three measures demonstrated good reliability (DTP, $\alpha = 0.83$; ITP, $\alpha = 0.89$; work-related well-being, $\alpha = 0.75$). Table A2 displays the eigenvalues associated with the EFA results. Typically, eigenvalues greater than 1.0 indicate the presence of a distinct construct or factor. As anticipated, three of the eigenvalues were above the 1.0 threshold. Moreover, principal components analysis using a promax rotation indicated that the respective items for DTP, ITP and work-related well-being each loaded onto their respective factors. In other words, the three DTP items loaded onto a single factor together, the four ITP items loaded onto a single factor together and the four work-related well-being items loaded onto a single factor together. These results are displayed in Table A3. Finally, the correlation matrix generated by the EFA indicated correlations of $r = 0.40$ between DTP and ITP, $r = 0.23$ between ITP and work-related well-being and $r = 0.22$ between DTP and work-related well-being.

Deontic technology perceptions (DTP)
In most hospitals today, certain formal procedures and technologies are put in place to help nurses . . .
1. Assist the nurse in setting up the correct infusion
2. Assist the nurse in avoiding medication errors
3. Assist in preventing adverse drug events (patient harm)

Instrumental technology perceptions (ITP)
Rate the following items as to the degree to which the smart pump safety procedures . . .
1. Disrupt nurses' workflow (reverse-coded)
2. Make it harder to work with other systems, software or technologies (reverse-coded)
3. Make work more stressful (reverse-coded)
4. Contribute to an excessive workload (reverse-coded)

Work-related well-being
1. I am satisfied with my job
2. I often think of quitting my job (reverse-coded)
3. I fully trust my employer
4. I feel burned out from work (reverse-coded)

Note(s): All three variables were rated using a 5-point Likert scale. The DTP and ITP variable scale choices were 1 = not at all, 2 = very little, 3 = a moderate amount, 4 = a great amount and 5 = an extensive amount. The work-related well-being scale choices were 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree

Table A1. Items for DTP, ITP and work-related well-being scales

Component	Total	Eigenvalues % of variance	Cumulative %	Rotation sums of squared loadings Total
1	4.15	37.72	37.72	3.55
2	1.98	18.03	55.76	2.61
3	1.52	13.80	69.56	2.87
4	0.76	6.91	76.46	
5	0.59	5.40	81.86	
6	0.53	4.83	86.69	
7	0.40	3.61	90.31	
8	0.35	3.18	93.43	
9	0.32	2.89	96.38	
10	0.27	2.41	98.79	
11	0.13	1.21	100.00	

Table A2. Exploratory factor analysis – total variance explained

Item	Pattern matrix component 1	2	3	Structure matrix component 1	2	3
DTP1	−0.01	0.00	*0.85*	0.33	0.18	*0.84*
DTP2	0.06	0.00	*0.86*	0.41	0.20	*0.89*
DTP3	−0.03	0.00	*0.87*	0.32	0.18	*0.86*
ITP1	*0.80*	0.00	−0.03	*0.79*	0.18	0.28
ITP2	*0.83*	−0.03	0.08	*0.86*	0.18	0.41
ITP3	*0.92*	0.01	−0.01	*0.92*	0.23	0.36
ITP4	*0.93*	0.02	−0.02	*0.92*	0.23	0.35
WRWB1	0.02	*0.82*	−0.12	0.16	*0.80*	0.06
WRWB2	0.04	*0.81*	0.05	0.25	*0.83*	0.24
WRWB3	0.05	*0.65*	−0.02	0.19	*0.66*	0.14
WRWB4	−0.11	*0.76*	0.11	0.11	*0.76*	0.23

Note(s): DTP = Deontic Technology Perceptions; ITP = Instrumental Technology Perceptions; WRWB = Work-Related Well-Being. Numbers in italic reflect on to which of the three components each item loaded

Table A3. Exploratory factor analysis – principal components extraction (with promax rotation)

Second pilot study: confirmatory factor analysis (CFA)

We collected data from 311 nurses employed at a hospital located in the United States using a Qualtrics-based survey and a CFA with this data. The CFA allowed for a more rigorous test of assessing the factorial validity of our three constructs and, particularly, in distinguishing between ITP and DTP. Consistent with the first pilot study, we used the same 11 items and anticipated a three-factor structure. Once again, all three measures demonstrated good reliability (DTP, $\alpha = 0.84$; ITP, $\alpha = 0.91$; work-related well-being, $\alpha = 0.76$).

We used the χ^2 statistic, Tucker–Lewis index (TLI), comparative fit index (CFI) and root mean square error of approximation (RMSEA) to assess model fit. A three-factor solution provided an excellent fit to the data (χ^2 [41] = 48.309, $p > 0.05$; RMSEA = 0.024; CFI = 0.996; TLI = 0.994). A two-factor solution in which DTP and ITP loaded onto a single factor provided a poor fit to the data (χ^2 [43] = 345.463, $p < 0.001$; RMSEA = 0.154; CFI = 0.815; TLI = 0.763), as did a model where all items loaded onto a single factor (χ^2 [44] = 629.532, $p < 0.001$; RMSEA = 0.211; CFI = 0.642; TLI = 0.552). A Chi-square difference test indicated that the three-factor solution was a better fit to the data compared to both the two-factor solution ($\Delta\chi^2 = 297.15$, df = 2, $p < 0.001$) and a one-factor solution ($\Delta\chi^2 = 581.22$, df = 3, $p < 0.001$) since the statistically significant p-value indicated that the larger (i.e. three-factor) model with fewer degrees of freedom should be retained. The covariance between DTP and ITP was $r = 0.50$, $p < 0.001$, while the covariance between DTP and work-related well-being was $r = 0.20$, $p < 0.01$ (providing preliminary support for H1a) and the covariance between ITP and work-related well-being was $r = 0.34$, $p < 0.001$ (providing preliminary support for H1b). Taken together, the two pilot studies help substantiate our conceptualization in Figure 1 that DTP and ITP are two distinct perspectives with a smaller degree of overlap.

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