

Towards a Unified Understanding of Digital Nudging by Addressing its Analog Roots

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Abstract

Nudging has become a well-renowned concept in policy making throughout the previous decade. Based on insights from behavioral economics (BE) and psychology, nudges are defined as intentional and targeted interventions to modify the choice architecture and alter individuals' behavior to a desired direction. As digital choice environments increasingly influence individuals' lives, a discourse on digital nudging has begun within the information systems (IS) community.

With a transdisciplinary bridge-building approach, we address the current state of digital nudging and argue that a more thorough foundation and definition of digital nudging can render itself useful for integrating the extensive research on choice architectures and nudging present in BE.

In this article, we summarize, transfer and discuss the current state of digital nudging's conceptualization in BE and IS. Furthermore, we propose an extended definition of digital nudging and introduce Blended Environments Framework as integrated views of analog and digital realms.

Keywords: Digital Nudging, Behavioral Economics, Digital Choice Environments, Information Systems Research, Blended Environments

Introduction

With the continued rise of digitalization's presence within a person's daily life, Information Systems (IS) are more frequently used and more decisions are made utilizing IS decision support mediums. In addition to decisions increasingly supported by IS, digitally-supported decisions' significance and scope likewise rise. Furthermore, additional decision support is required due to the fact more information can be accessed, with the possibility to cause effects like information overload or subsequent IS-usage paralysis when using IS in their intended way. The IS community itself has become interested in the links between BE and IS (Goes 2013), e.g. to strengthen the comprehension of different phenomena such as gamification, recommendation systems, or preference building effects.

Contradicting predictions derived from the economic theory of the "homo economicus", individuals do not act entirely rational all the time. Rather, each action of an individual is embedded within an exogenously defined and omnipresent decision environment and context. The respective configuration

and specific display of such a “choice architecture” likely influences the way how individuals behave and what decisions are made (Barton and Grüne-Yanoff 2015; Johnson et al. 2012; Münscher et al. 2016; Szaszi et al. 2018; Thaler et al. 2013; Thaler and Sunstein 2008). Research evidence from Behavioral Economics (BE) has highlighted that apparently insignificant and small modifications of these choice architectures can exert a strong impact on individuals’ decision-making (Münscher et al. 2016; Thaler 2016). These modifications include “seemingly irrelevant factors” (Thaler 2016) such as framing descriptions, default rules, or position effects (Thaler 2016). With these empirical insights in mind, a refined subset of behavior change techniques has been developed: Nudges. These approach contrast with other choice-limiting interventions such as mandates, fines or bans as it aims to be less intrusive and maintaining the freedom of choice. Due to individuals’ autonomy is still impaired by nudges, the concepts advent has been accompanied by an intense debate regarding the principal ethical soundness of nudging interventions (Bovens 2009; White 2013).

Recently, IS scholars generally started to recognize the potential of nudging for digital choice environments. This has led to the introduction of digital nudging (Hummel et al. 2018; Meske and Potthoff 2017; Mirsch et al. 2017; Schneider et al. 2018a; Weinmann et al. 2016). Nudging has been applied in various online contexts, e.g. privacy and security-related behaviors (Acquisti et al. 2015), e-commerce and product recommendations (Wang et al. 2018) or crowdfunding (Li et al. 2018). However, in this paper, we argue that the concept of nudging not be readily transferred to digital choice environments. On the one hand, nudging is rooted in a policy setting context, whereas the majority of behaviorally-informed instruments, as well as their underlying systematic cognitive boundaries, do focus on the “analog world”. As a consequence, these instruments cannot simply be copied and applied in digital choice environments (Benartzi et al. 2017). On the other hand, the rising amount of digitalization inherent in society leads to higher usage of digital decision support systems (DSS), including devices such as smartphones. This innovative and digital context necessitates an increased consideration since the digital context may alter the display and specific structure of choice architectures (Barton and Grüne-Yanoff 2015; Johnson et al. 2012; Münscher et al. 2016; Szaszi et al. 2018; Thaler et al. 2013; Thaler and Sunstein 2008).

Current research has mainly focused on summarizing the findings of nudging research in economics (Barton and Grüne-Yanoff 2015; Hansen 2016; Oliver 2015; Szaszi et al. 2018) and to propose general procedures and frameworks. However, a real “update” of the nudge approach is absent for digital choice environments. To date, digital nudging is understood as “the use of user-interface design elements to guide people’s behavior in digital choice environments” (Weinmann et al. 2016). Although the concept has already been researched and established in economics for decades (Hansen 2016), available definitions for digital nudging specifically can profit from additional demarcation power, leading to a definition more precise for today’s standards.

An extended discourse and a clear positioning of digital nudging allows for a joint understanding of what a digital nudge is and what it is not (Szaszi et al. 2018). We hereby strive to prevent this relatively new concept of digital nudging in the IS domain from becoming another concept “on its way from dilution to meaninglessness” (Badke-Schaub et al. 2010), e.g. in the advent of Design Thinking (ib.). This effort will ease the work of IS researchers and practitioners, as well as strengthen the important collaboration of IS researchers with behavioral economists (Goes 2013), as research within and between research communities commonly share the same understanding.

To the best of our knowledge, this article is the first to (1) offer a clear theoretical linkage to the analog roots of digital nudging, and (2) propose an integrative and more precise definition of digital nudging.

Our guiding questions are:

GQ1: How are analog and digital nudging currently conceptualized?

GQ2: How can an integrated digital nudging definition be derived based on previous research?

To address these guiding questions, our article is structured as follows:

Initially, for a deeper understanding, nudging in the field of behavioral economics (BE) is introduced. Afterward, we shed light on the most recent introduction of digital nudging in IS. In the synthesis section, we introduce the notion of Blended Environments for an advanced typification of digital

interventions and, thereafter, propose an extended definition of a digital nudge by integrating the literature.

Transdisciplinary Bridge-Building Approach

When we began our research, we have discovered two important research rationales: (1) In the domain of (behavioral) economics, where the concept of nudging and its roots are well established, researched, tested, and distinguished from other concepts (Hansen 2016; Oliver 2015). Therefore, a further exhaustive review on the topic would not likely lead to additional findings. (2) In IS, however, the recent adaptation of nudging as digital nudging leads to a sparse availability of present research articles (cf. (Mirsch et al. 2017; Schneider et al. 2018b; Weinmann et al. 2016)). In this paper, we aim at integrating and transferring the existing research from BE to the IS domain. Therefore, the approach of *transdisciplinary bridge-building* best characterizes our research goal. Similar to “bridging the gap between theories or disciplines” (Cooper 1988) and linguistic bridge-building, we analyze and transfer concepts from one research community A (here BE) to another research community B (here IS). Arguing in favor of a joint and overall perspective, we consider this approach an insightful and efficient approach to address our guiding questions. As a result, we adapted appropriate techniques from literature review: Taking pivotal and central theoretical and conceptual studies from domain A, summarizing and discussing key lines of thoughts and interpreting as well as transferring the obtained knowledge to research domain B.

Altogether, our research positioning can be situated to (1) summarize key theoretical contributions of prior BE research, (2) provide transdisciplinary bridge-building by synthesizing and integrating key thoughts of the BE domain in light of IS research, (3) proposing an integrated understanding by providing an espoused position, (4) focus on articles pivotal and central to the subject, (5) implemented around concepts and abstract ideas, and (6) target the audience of specialized scholars (cf. Cooper 1988). Selection-wise, only peer-reviewed sources have been considered within our main analysis.

The Theoretical Foundation of (Digital) Nudging

Human Behavior in the Mirror of (Behavioral) Economics and Psychology

Over the past century, scholars have been analyzing human decision making and its patterns, determinants, and peculiarities. This being said, two primary fields of research stand out: social and cognitive psychology. The first strand examines how an individual’s cognition, motivation, and behavior is affected by social influences, such as self-schemes, social preferences, social identity, and social norms. For instance, comprehensive empirical evidence has extensively illustrated that individuals do not act only in their self-interest, but are rather influenced by social preferences including reciprocity, fairness, or an aversion to injustice (Fehr and Gächter, 2002). In addition, their choices are affected by social norms. Furthermore, the decisions which they make are inherently affected by the implied or observed behaviors of other individuals (Demarque et al. 2015).

Focusing on details the processes of internal thought, the second cognitive psychology strand has been influenced by the ground-breaking work of Kahneman and Tversky. Several systematic patterns have been identified during the last decades which render human decisions irrational, among them heuristics and biases (Gigerenzer and Todd 1999; Kahneman et al. 1991; Kahneman and Tversky 1979; Loewenstein and Prelec 1992; Tversky and Kahneman 1974).

Heuristics are simple rules for information-processing that are systematically applied to surrogate complex decision-making problems by easier ones (Ross 2014; Sanjari et al. 2017). Typically, heuristics refer to intuitive and automatic judgments, but they can also be deliberately applied, especially when facing situations where only limited information is available. In several situations, these mental shortcuts conserve cognitive resources and allow decision-making in an accelerated and more efficient manner. Hence, under various circumstances using heuristics is no irrational endeavor at all, particularly in day-to-day decisions (Evans 2008; Hutchinson and Gigerenzer 2005). Nonetheless, in specific contexts, these heuristics may lead to predictable errors in decision-making as well as unreliable judgments. Such systematic patterns of perceptual distortion, misjudgments, or inconsistent as well as

illogical interpretations are defined as cognitive biases (Haselton et al. 2005; Tversky and Kahneman 1974).

Widespread in psychology, intuitive, automatic and affective modes of human decision-making are explained in a dual process model (Kahneman 2011; Lades 2014; Stanovich and West 2000). Cognitive processes can therein be separated into two different but interacting systems: An mostly intuitive, automatic, emotion-driven, and quickly operating system, titled “System 1”, as well as a reflective, logically calculating, but slower processing system, titled “System 2” (Kahneman 2011; Lades 2014). Which system is involved in a decision is determined by the task, the specific context, and the person's cognitive abilities. Usually, this process is unconscious, which is an important prerequisite for the effectiveness of nudging mechanisms. The boundaries between both systems remain fluid as they run in parallel and frequently interact with each other. Under certain conditions, individuals respond systematically, affectively and unconsciously to physical, verbal, emotional or social stimuli and other “seemingly irrelevant factors” (Thaler 2016), including accounting, framing descriptions, default rules, and positioning effects (Thaler 2016).

In sum, contradicting the economic paradigm of rational choice, these empirical insights show a more realistic picture of human behavior: Humans hold limited cognitive resources while simultaneously their judgments and decisions are influenced by emotions, social norms, the use of mental shortcuts (heuristics), biases, as well as through the context of the decision itself (Heukelom 2014).

Nonetheless, these systematic and predictable deviations from rational behavior took decades to be integrated into a more behaviorally- and empirically-informed policy approach (Dolan et al. 2012; Lunn 2014; OECD 2017; Reisch and Zhao 2017; Sunstein 2011). The development of empirically based, less intrusive and choice-preserving intervention mechanisms for behavioral change has been a pivotal part of this process: termed as *nudges* (Reisch and Zhao 2017; Thaler and Sunstein 2003, 2008).

Definition of Nudging

The definition of Sunstein and Thaler (2008) provides a place to begin the subsequent discussion: “A nudge [...] is any aspect of the choice architecture that alters people’s behavior in a predictable way without forbidding any options or significantly changing their economic incentives” (Thaler and Sunstein 2008). Therein, any nudge-intervention has to be easily avoidable (e.g. by one easy mouse click). From the perspective of BE, all decision-making processes are embedded in some kind of “choice architectures”. This exogenously defined and omnipresent physical or informational environment influences how individuals behave and what decisions they make (Johnson et al. 2012; Lehner et al. 2016; Thaler and Sunstein 2008).

According to Barton and Grüne-Yanoff (2015), this standard definition has a dualistic character: Whatever an individual’s perspective may be, a nudge can be interpreted either as a non-intentional aspect of the choice architecture (Mills 2015) or as a purposefully and deliberately implemented intervention tool (Guala and Mittone 2015). In order to bring this dispute to a close, Sunstein argues that a clear distinction should be made between the basic idea of choice architectures on the one hand, and a nudge as a deliberate, targeted and intentional intervention to modify a choice architecture on the other hand (Sunstein 2015a). A concise overview of the various choice architecture techniques can be found in Münscher et al. (2016).

Nevertheless, for a very clear and selective distinction, even this differentiation is too vague: “almost everything that affects behavior has been renamed a nudge, which renders this concept meaningless” (Gigerenzer 2015). Moreover, even the payoff function of a rational agent cannot exclusively be determined by economic incentives (Hansen and Jespersen 2013). Hence the core of the definition needs to be further refined (Barton and Grüne-Yanoff 2015). To this end, Hausman and Welch (2010) propose to extend the definition for all other kinds of incentives: “Nudges are ways of influencing choice without limiting the choice set or making alternatives appreciably more costly in terms of time, trouble, social sanctions, and so forth” (Hausman and Welch 2010). However, a clear linkage with the underlying cognitive processes is still missing, although these processes remain key components in understanding and developing nudging interventions.

In order to harmonize existing definitions and their theoretical foundations, Hansen (2016) has compiled an enhanced definition that underscores the importance of BE principles: “A nudge is a function of (I) [sic] any attempt at influencing people’s judgment, choice, or behavior in a predictable way, that is (1) made possible because of cognitive boundaries, biases, routines, and habits in individual and social decision-making posing barriers for people to perform rationally in their own self-declared interests, and which (2) works by making use of those boundaries, biases, routines, and habits as integral parts of such attempts [...]” (Hansen 2016).

The Ethical Dimension of Nudging

A central component of ethical criticism regarding the nudging approach in the academic and public realm is the fact that nudge interventions employ behavioral insights to influence people’s behavior (Felsen et al. 2013; Hansen 2016). A widespread and fundamental assertion is that nudges would only work if they un- and/or subconsciously manipulated people’s decisions, which would be irreconcilable with the fundamental principles of modern democracies (Bovens 2009; Hansen and Jespersen 2013; Vallgård 2012).

In fact, behavioral interventions, triggering automated and affective-cognitive processes (e.g. heuristics) in order to directly alter people’s behaviors, constitute the core of the nudging-approach (Barton and Grüne-Yanoff 2015; Hansen and Jespersen 2013). Thereby, nudging interventions are intended to unconsciously influence individuals’ behavior by exploiting biases (biasing) or using a second bias to (over)compensate the effects of another bias (re-biasing) (Michalek et al. 2016; Soman and Liu 2011). Yet, as Michalek et al. (2016) emphasize, nudges do not necessarily address these subconscious judgment processes directly (nondeliberative faculties). Instead, nudges can also indirectly induce a change in behavior, e.g. by stimulating reflective decision-making processes. By correcting or eliminating cognitive biases or “monitoring errors” of system 2, these tools “debias” people’s judgments in a conscious manner (Barton and Grüne-Yanoff 2015; Hansen and Jespersen 2013; Michalek et al. 2016).

Regardless of that individual’s response to this borderline controversy, the debate accentuates that political, cultural, and ethical strings attached to and influencing nudge-interventions have always been present (Hagman et al. 2015). Thaler and Sunstein reply to such criticisms by first outlining some respective ethical principles when employing the usage of nudges: “To count as a mere nudge, an intervention has to preserve freedom of choice” (Thaler and Sunstein 2008), ably interpreted as the absence of obstacles, barriers or constraints (Thaler and Sunstein 2003, 2008). All the same, it remains controversial at which extent this criterion becomes fulfilled in order to reason a nudge ethically sound (e.g. Veetil 2011): The decisive argument is even “if [a] choice architecture does not block or significantly burden choices, it might still interfere with a person’s ability to discern and consider options and act according to her own preferences, i.e., it might interfere with her autonomy” (Blumenthal-Barby 2013).

Nudges may additionally impose a “lack of transparency by clouding the availability of options accessible at the moment of the decision and thereby endanger informed and free choice” (Clavien 2018), thereby manifesting an additional opposition to nudges. Accordingly, maintaining and preserving the freedom of choice of nudgees is important. Nudgees must be able to easily discern when and where they are subject to being nudged (type-transparency), to grasp the nudger’s goal setting and motivation for an intervention is, as well as to understand how and why the nudge is working (token-transparency) (Barton and Grüne-Yanoff 2015; Bovens 2009). This consideration necessitates to argue in favor of certain public regulations that ensure the legitimate use of nudging interventions: “We should create rules of engagement that reduce fraud and other abuses, that promote healthy competition, that restrict interest-group power, and that create incentives to make it more likely that [nudging, the authors] architects will serve the public interest” (Thaler and Sunstein, 2008). In coordination with the transparency rule, nudges must be clearly identifiable by nudgees (Sunstein, 2015c).

An additional ethical aspect, and nonetheless important to concerns is the question of the circumstances where nudging is to be deemed legitimate or not (Hagman et al. 2015; Hansen and Jespersen 2013). Nudges can be oriented towards three, not necessarily mutually exclusive, goals (Clavien 2018; Hagman et al. 2015): (1) individual and selfish goals of the nudger (e.g. personal profit or benefit), (2)

social / pro-social goals (e.g. gender equality, public welfare) and (3) nudgee-driven / pro-self goals (e.g. exercising more if a respective attitude towards exercising has already been formed). However, according to Thaler and Sunstein (2008), the ethical justification is absent, especially for the first goal (selfish): “[...] we show that in many cases, individuals make pretty bad decisions – decisions they would not have made if they had paid full attention and possessed complete information, unlimited cognitive abilities, and complete self-control” (Thaler and Sunstein 2003). Thus, so-called “pro-self nudges” (Hagman et al. 2015) are considered legitimate interventions, for maximizing the private welfare of an individual (Hagman et al. 2015).

With respect to the pro-self perspective, several authors noted that the application of such legitimation strategies lacks sufficient knowledge, making it presumably impossible for the nudger to identify the preferences of the individual (Barton and Grüne-Yanoff 2015; Rebonato 2014). Moreover, if one is to ignore this criticism, creating one single intervention that fits all heterogeneous preferences within a large population remains a difficult challenge. Due to such heterogeneity, there will always be nudges that dissuade some individuals from their own genuine and true preferences (Barton and Grüne-Yanoff 2015). With this criticism in mind, the pro-self nudge has to originate from ethically acceptable, yet justifiable goals (Ismaili M'hamdi et al. 2017), allowing individuals to avoid “decisions they would not have made if they had paid full attention and possessed complete information, unlimited cognitive abilities, and complete self-control” (Hagman et al. 2015).

With regard to the pro-social perspective, nudges can be justified in cases where, from a societal point of view, the coordination of resources by a free market is perceived as inefficient. Such market failures can be associated with “behavioral market failures” like cognitive bias, or time-inconsistence preferences (Bhargava and Loewenstein 2015) as well as with standard economic reasoning like externalities or information asymmetries, as well as.

A categorization such as this provides valuable implications for the differentiation of nudging from other and seemingly similar behavior change techniques as, for instance, used in marketing as well as for the normative debate accompanying nudging.

The Rise of Digital Nudging

Nudging in Digital Decision Environments

When attempting to understand, develop, and implement the nudges, the key lies in the psychological determinants of human decision-making. This foundation has exhibited substantial empirical results, first of which have demonstrated how digital choice environments prompt a more automatic and intuitive mode of thinking (system 1), due to the raised visibility and the purer store of available information (Benartzi and Lehrer 2015). Additionally, research revealed information-rich digital environments directly result in choice overloads, and declining time spans of sustained attention, so that individuals spend less time with in-depth and concentrated reading while reading on digital screens (Liu 2005). Neuroscientists have determined that in particular, younger people are prone to “gravitate toward ‘shallow’ [digital, the authors] information processing behaviors characterized by rapid attention shifting and reduced deliberation. They engage in increased multitasking behaviors that are linked to increased distractibility and poor executive control abilities” (Loh and Kanai 2016).

Such attention-limiting circumstances make individuals more vulnerable to judgmental errors during the processing of digital information. This affects both digital-specific phenomena, like the so-called “display-biases” (Benartzi and Lehrer 2015), as well as more “traditional biases” (e.g. anchoring or priming effects). As a consequence, the mere visual salience of options (Milosavljevic et al. 2012) or their arrangement (Christenfeld 1995) have the possibility of affecting decision-making (Benartzi and Lehrer 2015). For instance, there is a greater chance an individual is noticed options or information if and when they are displayed right in the middle of the screen (“middle bias”). Even if this phenomenon likewise occurs in the “analog world”, it is of particular interest when it is pronounced in a modern digital space, due to the high visibility of screens (Benartzi and Lehrer 2015; Reutskaja et al. 2011).

Aside from these challenges, IS offer many innovative tools and functions potentially able to increase the effectiveness of nudging interventions. These include, among others, filter options, intelligent

tracking and targeting methods or feedback tools, recommender systems, as well as a broad spectrum of techniques for personalization and individualization (Mirsch et al. 2017). Unlike the analog (physical) world, digital environments offer higher degrees of freedom for designers of digital nudges. While one cannot easily move or reshape real-world objects as streets, trees or the like (the physical world exists “as it is”), designers and developers typically have a multitude of choices to change the design of an IS, even without a great deal of financial effort. In addition, the ability to turn something from its current state into a preferred something (Simon 1981) is made easier in digital environments (e.g. via digital prototyping). Therefore, testing and then implementing digital nudges can be considered easier and faster than the equivalent within analog nudging.

The Recent Advent of Digital Nudging in IS research

As afore-mentioned, nudging has recently received increasing attention in the IS domain. At present, digital nudging has been defined as “the use of user-interface design elements to guide people’s behavior in digital choice environments” (Weinmann et al. 2016). Hereby, digital choice environments are conceptualized as user interfaces “that require people to make judgments or decisions” (ib.). These broad definitions lead to the following questions: What are the characteristics specific to a (digital) nudge? How does digital nudging relate to other IS research strands, in particular, behavior change support systems (BCSS) or persuasive technology (PT)?

Altering user behaviors constitutes a part of PT and BCSS research as well. Similar to digital nudging, the definitions of PT and BCSS are rather broad: PT is defined as “any interactive computer system designed to change people’s attitudes or behaviors” (Fogg 2003) and BCSS as IS “designed to form, alter or reinforce attitudes, behaviors or an act of complying without using coercion or deception” (Oinas-Kukkonen 2013). Comparing the three definitions for digital nudging, PT, and BCSS, there seems to be no clear demarcation present. As a consequence, nudging may be seen as a subclass or part of both PT and BCSS (Schneider et al. 2018a). However, PT and BCSS intervention mechanisms are by no means a subclass of digital nudging as the vague definition of digital nudging (Weinmann et al. 2016) may indicate. Congruent with Meske and Potthoff (2017), we argue that a general digital intervention mechanism becomes a nudge by fulfilling the definitory and especially ethical strings attached to a nudging intervention mechanism rooted in the BE domain. By adhering to both definitory and ethical standards, we argue for digital nudging to be the digital representation of nudges as understood in BE. Thus, only a subset of PT/BCSS intervention mechanisms do meet the necessary requirements to qualify as nudges.

In sum, more clarification and a digital nudging definition with demarcation power is needed. Accordingly, the following chapter integrates the BE and IS strands of (digital) nudging to derive a coherent and elaborate definition of digital nudges, taking into account the augmented interactions in analog, blended or digital environments.

Towards an Integrated and BE-Informed Conceptualization of Digital Nudging

As mentioned above, the transfer of the nudge approach to digital choice environments is still in its infancy. What is missing is a conceptual “upgrade” for the “new” digital choice environments, including an integrative theoretical foundation. In this section, we use accumulated knowledge to address some of these requirements. In this chapter, we discuss (1) an extension of digital nudge approach from analog to digital and blended environments and (2) an integrative and more precise definition of digital nudging.

Integrating the Digital Environment

Behavior changes usually necessitate multiple cues (e.g. nudges) to become persistent (Petty 2013). Digital nudges thus can support these behavior changes, e.g. through motivating users to frequently interact with digital applications. Accordingly, digital nudges are likely to appear at multiple points of time. The concept of interacting with users at multiple (touch) points over time is conceptualized as customer journey research (Lemon and Verhoef 2016). Therefore, we propose that for a full exploitation of the potential of digital nudging, the whole journey a user takes while utilizing an IS should be taken

into consideration. Future research should analyze how different choice architecture techniques can be combined and applied simultaneously, in order to address multiple touchpoints in the user interaction over time. This offers both a chance and a risk, since most digital nudges do not incur any cost significant for the service provider (e.g. notifying users through a mobile app is possible nearly at no charge). One consequence may be customers or users becoming or feeling over-nudged. Even more, digital choice designers have higher degrees of freedom as they can theoretically modify every single element of a digital artifact like a website or app.

Moreover, the current literature is largely focused on a (pure) analog or (pure) digital “user journey”. However, every interaction in a digital environment is embedded and rooted in an analog environment (in the most basic form, the place a user is physically at while interacting with the digital environment). Since people can and do behave differently in digital and analog environments (Benartzi and Lehrer 2015), we argue there are Blended Environments where both worlds interact (intendedly) or interfere (unintendedly) with each other. Following the argument of de Guinea and Markus (2009), using digital nudges IS “itself – at the device or the feature level – may also serve as an extraordinarily powerful environmental cue” (ib., p. 441). For our conceptualization, we adapted the term of Blended Environments from the associated education literature. In this domain, “blended” is connoted with any means on the spectrum between analog and digital learning environments (Garrison and Kanuka 2004). In specific circumstances, the outcome domains can be interlinked in a similar way to an analog behavior, or induce a digital action or vice versa.

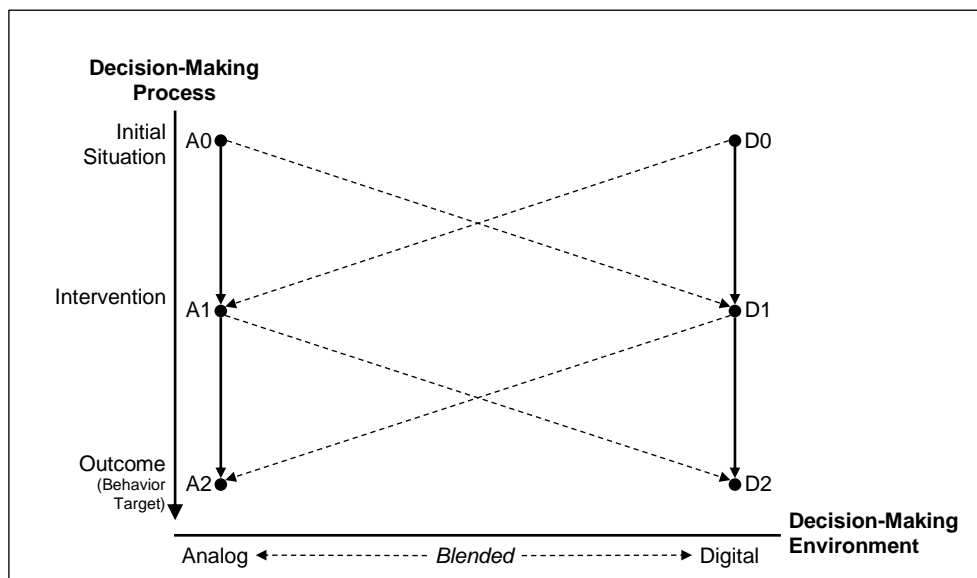


Figure 1. Blended Environments Framework for Interventions

For example, imagine a fitness app utilizing nudging mechanisms to motivate users to cross the attitude-behavior gap of going to the gym. When the app sends users a notification on their smartphones in order to nudge their behavior, users may be in an analog environment (with smartphones vibrating in their pockets), represented by the analog starting point A0 in Figure 1. Alternatively, users may be in a digital environment (e.g. a popup overlays the app that users are currently viewing on their smartphones), represented by the digital starting point D0 in Figure 1. Regardless of the previous user environment (as characterized by the attention focus of the user), the core nudging intervention takes place in a digital environment (D1), i.e. the notification of the app. Thus, users with a previously analog attention focus may be induced to shift their attention to the digital environment (path A0 to D1). However, the intended and targeted behavior by the digital fitness app is not digital again but the physical act of doing sports, represented by the path D1 to A2. Therefore, the digital nudge aims to induce analog behavior (A2), although additional nudges may be utilized to bind users to the app as well. Out of this interaction between analog and digital goal settings, the efficiency of digital nudging may be strengthened, e.g. through regularly using the app (D2) and more frequently visiting the gym (A2) alike.

To develop the full picture of digital nudging, future research should consider the targeted outcome behavior domain as well. In particular, the characteristics of Blended Environments as specific touch points for altering users' behaviors offer several opportunities for the IS decision support research.

Integrative Definition of Digital Nudging

Author	Pivotal Nudging Definition
Thaler and Sunstein (2008), p. 6	A nudge [...] is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives. To count as a mere nudge, the intervention must be easy and cheap to avoid. Nudges are not mandates.
Thaler and Sunstein (2008), p. 5	[A nudge, the authors] tries to influence choices in a way that will make choosers better off, as judged by themselves.
Hausman and Welch (2010), p. 126	Nudges are ways of influencing choice without limiting the choice set or making alternatives appreciably more costly in terms of time, trouble, social sanctions, and so forth.
Barton and Grüne-Yanoff (2015), p. 343	A nudge is defined here as an intervention on the choice architecture that is predictably behaviour-steering, but preserves the choice set and is (at least) substantially non-controlling, and does not significantly change the economic incentives.
Barton and Grüne-Yanoff (2015), p. 347	[...] to be avoidable, nudges should not only be type-transparent (the general existence of such nudges is made transparent to the nudgee), but also token-transparent (each specific intervention is made transparent to the nudgee).
Sunstein (2015a), p. 511	Nudges are interventions that steer people in particular directions but that also allow them to go their own way. [...] To qualify as a nudge, an intervention must not impose significant material incentives.
Sunstein (2015b), p. 416	A nudge might preserve freedom of choice, but it might manipulate people and be objectionable for that reason. [...] transparency and accountability are indispensable safeguards, and both nudges and choice architecture should be transparent.
Hansen (2016), p. 174	A nudge is a function of (I) [sic] any attempt at influencing people's judgment, choice or behaviour in a predictable way, that is (1) made possible because of cognitive boundaries, biases, routines, and habits in individual and social decision-making posing barriers for people to perform rationally in their own self-declared interests, and which (2) works by making use of those boundaries, biases, routines, and habits as integral parts of such attempts. Thus a nudge amongst other things works independently of: (i) forbidding or adding any rationally relevant choice options, (ii) changing incentives, whether regarded in terms of time, trouble, social sanctions, economic and so forth, or (iii) the provision of factual information and rational argumentation.
Author	Pivotal Digital Nudging Definition
Weinmann et al. (2016), p. 433	Digital nudging is the use of user-interface design elements to guide people's behavior in digital choice environments. Digital choice environments are user interfaces – such as web-based forms and ERP screens – that require people to make judgments or decisions.
Meske and Potthoff (2017, p. 2589), p. 2589	Digital nudging is a subtle form of using design, information, and interaction elements to guide user behavior in digital environments, without restricting the individual's freedom of choice.

Table 1. Pivotal Definitions of (Digital) Nudging

The review revealed that the concept of nudging is already anchored in the IS domain but has not been explicitly stated as such. For example, persuasive technology may provide a rational superclass in which (digital) nudging can reside. Digital nudging might be positioned as one subclass of cues utilized by persuasive technology. A digital nudge is hereby a cue that users are externally exposed to (as compared to internal cues, e.g. the already prevailing attitudes of users). Within the class of external cues, we propose to further differentiate between intended and unintended cues, highlighting the fact that a nudge is designed to evoke a specific behavior change. With intended meaning hereby, the purpose of a cue is to specifically address the desired action. Ultimately, nudges have to be differentiated from monetary or forceful cues.

However, the current understanding of digital nudging as proposed by Weinmann et al. (2016) or even Meske and Potthoff (2017) offers only a vague description of these and other core elements of nudge interventions: For instance, the pro-self / pro-social intention and the necessary intervention transparency for individuals' being nudged are missing and demonstrate clear definitory shortcomings. This makes the differentiation of digital nudging from other behavioral change techniques, as well as a constructive integration of similar IS concepts like persuasive technology, even harder. Therefore, an

integrative and stricter definition could support the accumulation of evidence from different fields of research (Goes 2013; Szaszi et al. 2018).

Integrating and building on our review (see Table 1), we propose the following extended definition of a digital nudge taking the specialties of digital and blended environments into account:

A digital nudge is any intended and goal-oriented intervention element (e.g. design, information or interaction elements) in digital or blended environments attempting to influence people's judgment, choice, or behavior in a predictable way, that

- (1) is made possible because of and works by making use of cognitive boundaries, biases, routines, and habits in individual and social decision-making,
- (2) works by making use of those cognitive boundaries, biases, routines, and habits as integral parts of such attempts,
- (3) preserves the full freedom of choice without forbidding or adding any rationally relevant choice options,
- (4) does not limit the choice set or making alternatives appreciably costlier in terms of time, trouble, social sanctions, and so forth,
- (5) nudges must be able to easily recognize when and where they are subject to being nudged (type-transparency), as well as what the nudger's goals of this intervention are, in addition to how and why the nudge is working (token-transparency) and
- (6) increases the private welfare of the nudged individual (pro-self) or the social welfare in general (pro social).

A digital nudge is hereby differentiated from similar techniques used in marketing or theoretical concepts, such as like dark patterns defined as "instances where designers use their knowledge of human behavior (e.g. psychology) and the desires of end users to implement deceptive functionality that is not in the user's best interest" (Gray et al. 2018).

Future research can base upon our results, e.g. deriving at practical implementation strategies for digital nudging. Hereby, more light shall be shed on the ethical strings attached to digital nudging, i.a. elaborating on potential conflicts of interest between commercial, pro-social or pro-self goal settings.

Conclusion

With a transdisciplinary bridge-building approach, we have addressed the current state of digital nudging conceptualization in order to integrate the existing body of knowledge. However, the research on digital nudging is still sparse and lacks an extended theoretical link to its BE roots. At the same time, most behaviorally-informed instruments and their underlying systematic cognitive boundaries are focused on the "analog world" and cannot simply be embodied in digital choice environments. As a result, there had been a lack of a proper definition for digital, which we thoroughly addressed within this article. In sum, this article offers three main contributions:

First, our proposed definition offers a precise and value-adding definition in order to avoid confusion about what exactly is to be regarded as a (digital) nudge. It integrates a decade-long discourse on nudging in the BE domain and transfers the conceptual key elements from BE to the IS research. We hereby provide a starting point to foster interdisciplinary nudging research between both BE and IS disciplines (Goes 2013). Furthermore, our integrated definition allows the research of underlying processes of digital nudging in more detail (Münscher et al. 2016) as well as to integrate further research strands and approaches, e.g. design science. In this context, future research may shed light on the appropriate and ethical design principles of digital nudges. In line, how personality traits or user characteristics influence the effectiveness of digital nudges may be analyzed in detail.

Second, the key to understanding, developing and implementing (digital) nudges lies in the foundational psychological determinants of human decision-making. As different constructs do or may exert different impacts on individuals in digital or in analog decision-making environments, researchers shall aim at adapting and updating the more and more intervention mechanisms from analog to digital environments. A thorough understanding as to why and how digital nudges operate is essential since

empirical evidence suggests that interventions are more effective if they are based on a thorough theoretical framework (Szaszi et al. 2018).

Third, since digital nudges are likely targeting multiple user-interaction touch points in digital or blended environments over time, the sole and mere analysis of single nudging interventions – as prevalent in traditional economics – might not render the full picture. Alongside the nudging mechanism, we argue for taking the users' journey, initial situation and the targeted outcome behavior domain into account – both analog and digital. This ultimately leads to the notion of Blended Environments in which digital nudges operate.

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