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Digital Nudging: A Systematic Literature Review, Taxonomy, and Future Research Directions

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Abstract

The expanding realm of digital nudging presents significant challenges for current research, due to its growing volume and diversity. This necessitates a unified framework for understanding and integrating the vast literature. In response, our study introduces a comprehensive taxonomy of digital nudging, developed through the analysis of 88 peer-reviewed publications. Our four-dimensional taxonomy includes five contexts, ten forms, two levels of intrusiveness, and three levels of user impact. This taxonomy serves as a foundational tool for coherent understanding, enabling the categorization, comparison, and synthesis of diverse studies. We also provide a consistent and precise definition of digital nudging, resolving semantic ambiguities and further clarifying the field. Our findings lay the groundwork for future research directions in digital nudging and offer practical guidelines for practitioners implementing nudges across various domains.

Keywords: Digital Nudging; Nudges; Taxonomy; Literature Review; Information Systems Design.

Introduction

Organizations strategically employ digital nudges to guide user decisions in line with their preferences. Among others, streaming services, such as Netflix, recommend movies based on user history with the objective to retain users in their ecosystem (Khoo, 2023; Terres et al., 2019). Another example are social networking services, such as Facebook or Twitter, prioritize data protection in the privacy settings. During the registration process they follow default privacy settings that allow or forbid data collection or content sharing permission (Bergram et al., 2020; Knijnenburg & Kobsa, 2014). These real-world examples from organizations demonstrate that digital nudging is omnipresent when interacting with information systems. These digital nudges create economic benefits for organizations and help users to interact more effectively with information systems. They are easy to implement and a broad spectrum of digital nudging applications has evolved in a variety of contexts.

However, this expanding landscape of digital nudging presents a significant challenge for research. Preliminary studies on digital nudging offer valuable insights into its potential applications and its capacity to enhance user decision-making (e.g., Mirsch et al., 2017; Schneider et al., 2018; Jesse & Jannach, 2021), but the literature on digital nudging is characterized by its expanding volume and heterogeneity. These characteristics make it difficult for researchers to position their findings within the broad realm of digital

nudging, necessary to develop theoretical contributions (Rai, 2017). Other research domains, such as IT governance (Wilkin & Chenhall, 2010), IT outsourcing (Blaskovich & Mintchik, 2011), cloud computing (Gill & Buyya, 2018), grappling with similar challenges have benefited from the development of a taxonomy. A taxonomy, defined as a structured classification system, aids in organizing and explaining diverse and complex research fields and help categorize, compare, and synthesize findings (Nickerson et al., 2013; Sabherwal & King, 1995). Taxonomies are particularly crucial when the field is marked by inconsistent terminology and heterogeneity. Taxonomies then provide a structure to the knowledge and enable to study the relationships among concepts and to hypothesize about these relationships (Glass & Vessey, 1995).

Consequently, within the research stream of digital nudging, the demand for a taxonomy arises from two imperatives. First, research outcomes must be generalized and situated within the broader context of existing literature to develop theoretical contributions (Rai, 2017). To date, the current state of the literature faces the challenge of inconsistent terminology, often describing similar digital nudges using different terms or, conversely, grouping distinct digital nudges under the broad category of digital nudging. This lack of granularity impedes a clear distinction between different digital nudges, leading to inaccurate generalizations of findings across the field. Consequently, nuanced insights and actionable conclusions become elusive. Hence, a taxonomy to structure findings is paramount. Second, a parallel challenge lies in defining digital nudging. Several definitions of digital nudging exist (e.g., Weinmann et al., 2016; Meske & Potthoff, 2017; Mirsch et al., 2017), but these are not uniformly aligned. While Meske & Potthoff (2017) emphasize the subtlety of guiding user behavior without constraining freedom of choice, Weinmann et al. (2016) do not specify the use of user-interface design elements. While Thaler and Sunstein (2008) highlight that nudges must always favor the user, digital nudging definitions do not universally incorporate this criterion. This semantic variability complicates scholarly discourse and practical application, as a consistent and precise definition is imperative for building a coherent foundation for research and practice. Combining a consistent and precise definition with a taxonomy of digital nudging enables researchers to categorize, differentiate, and provide clarity among the diversity of digital nudges and offers practical guidance for practitioners.

To provide a structure to the field of digital nudging and facilitate the integration of novel findings into the existing literature, this study aims to develop a taxonomy of digital nudging and resolve semantic ambiguities. This study ensures a shared conceptual understanding, anchoring research and practical applications on a solid foundation. The following research question guides this study:

> *What are the conceptually grounded and empirically validated characteristics that describe digital nudges?*

We follow established steps to develop a taxonomy (Nickerson et al., 2013). We draw from 88 academic journals and conference proceedings publications identified through a structured literature review (Wolfswinkel et al., 2013). After an iterative process, we identify four key dimensions that systematically characterize digital nudging: context, form, intrusiveness, and user impact. Finally, we demonstrate the taxonomy's applicability by evaluating it with research experts and practitioners regarding its usefulness, general applicability, and practical relevance.

Our contributions to research and theory are multifaceted. The taxonomy enables standardized and systematic classification of digital nudging studies and their findings, improving comparability, generalizability, and differentiation within the field. It provides a tool for directing future studies toward areas needing further investigation and addressing unanswered research questions. The taxonomy enables researchers to develop targeted interventions, enhancing our understanding of different digital nudges and their context-specific characteristics. By providing a consistent and precise definition of digital nudging, we contribute to a coherent foundation in the research stream of digital nudging. Finally, practitioners can use the taxonomy to guide the design and implementation of digital nudges in specific contexts.

Towards an Understanding of Digital Nudging

Nudging originates from psychological literature and draws on insights from behavioral economics. It has demonstrated success in various domains. For instance, in marketing, supermarkets strategically arrange shelves to encourage healthier food choices (Hoenink et al., 2020; Marchiori et al., 2017), while governments employ nudges to enhance vaccination rates and reduce disease transmission (Benartzi et al., 2017). In education, nudges help to encourage better school choices and improve student attendance, benefitting individuals and communities (Benhassine et al., 2015; Pugatch & Wilson, 2018). Adapting the potential of nudging, the IS research field has explored its application in digital environments, referred to as digital nudging (Weinmann et al., 2016). Digital functionalities, such as tracking users' clicking and browsing behavior, enable the personalization of

digital nudges (Benartzi & Lehrer, 2017). Among others, online marketing customizes product recommendations based on user data (Jesse & Jannach, 2021).

We note that there are varying definitions of digital nudging (see Table 1). Each of them focuses on common and distinct characteristics. While the Thaler and Sunstein (2008) initially define nudges to be in favor of the user, recent definitions (Weinmann et al., 2016; Meske & Potthoff, 2017; Mirsch et al., 2017) omit this criterion. Notably, recent definitions diverge in emphasis, with some underlining aspects like subtlety and freedom of choice (Meske and Potthoff, 2017), while others do not. We will adopt a consistent and precise definition to resolve semantic ambiguities. In the following, we propose a consistent and precise definition of digital nudging that combines key characteristics from existing definitions.

Findings agree that (digital) nudging alters user behavior in a predictable way (Thaler & Sunstein, 2008; Hausman & Welch, 2010; Weinmann et al., 2016; Meske & Potthoff, 2017; Mirsch et al., 2017). This is supplemented by freedom of choice without prohibiting or adding any options (Thaler & Sunstein, 2008; Hausman & Welch, 2010; Meske & Potthoff, 2017). Digital nudging does not make choices more costly in terms of time, trouble, social sanctions, and so forth (Hausman & Welch, 2010), and is easy and cheap to avoid (Thaler & Sunstein, 2008). Derived from these characteristics, we define digital nudging as an approach that predictably alters user behavior while preserving freedom of choice, avoiding increased costs, and remaining easy and inexpensive to avoid. It is important to note that digital nudging can have various effects on the user, both positive and negative.

Systematic Literature Review on Digital Nudging

Systematic Literature Review Method

We followed the grounded-theory-based literature review method (Wolfswinkel et al., 2013), consisting of five steps: define, search, select, analyze, and present (see Table 2). This methodology is helpful for a systematic review as it assures in-depth analyses of empirical facts and related insights (Wolfswinkel et al., 2013). This approach aids in identifying and comprehending the dimensions and characteristics of digital nudging necessary for developing a taxonomy.

In the define step, we outlined appropriate sources and criteria for including articles in our data set (Wolfswinkel et al., 2013). We considered academic journal publications and conference proceedings of multidisciplinary databases (AISeL, ScienceDirect, EbscoHost) to provide a comprehensive and structured overview of digital nudging in the literature and defined three criteria. First, we only considered articles that appeared after 2008, when the seminal publication by Thaler and Sunstein (2008) set the grounding for research on digital nudging. Second, we only included articles having qualitative or quantitative results. Third, we required the articles to focus on the digital format of nudging. The third criteria excluded a broad range of studies investigating analog nudges, such as signs next to dispensers to improve hand hygiene in hospitals (Caris et al., 2018) or labels on products to raise sustainability awareness (Vandenbroele et al., 2020), ensuring the selected articles are directly relevant to our research question.

Table 1. Pivotal Definitions of Digital Nudging

Reference	Pivotal Nudging Definitions
Thaler & Sunstein (2008)	Nudging is any aspect of the choice architecture that alters people's behavior predictably 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. A nudge tries to influence choices in a way that will make choosers better off.
Hausman & Welch (2010)	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.
Weinmann et al. (2016)	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 & Potthoff (2017)	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.
Mirsch et al. (2017)	Digital nudging is an approach based on insights from behavioral economics that applies user interface (UI) design elements to affect the choices of users in digital environments. UI design elements include graphic design, specific content, wording or small features.

Table 2. Grounded Theory Method for Systematic Literature Review

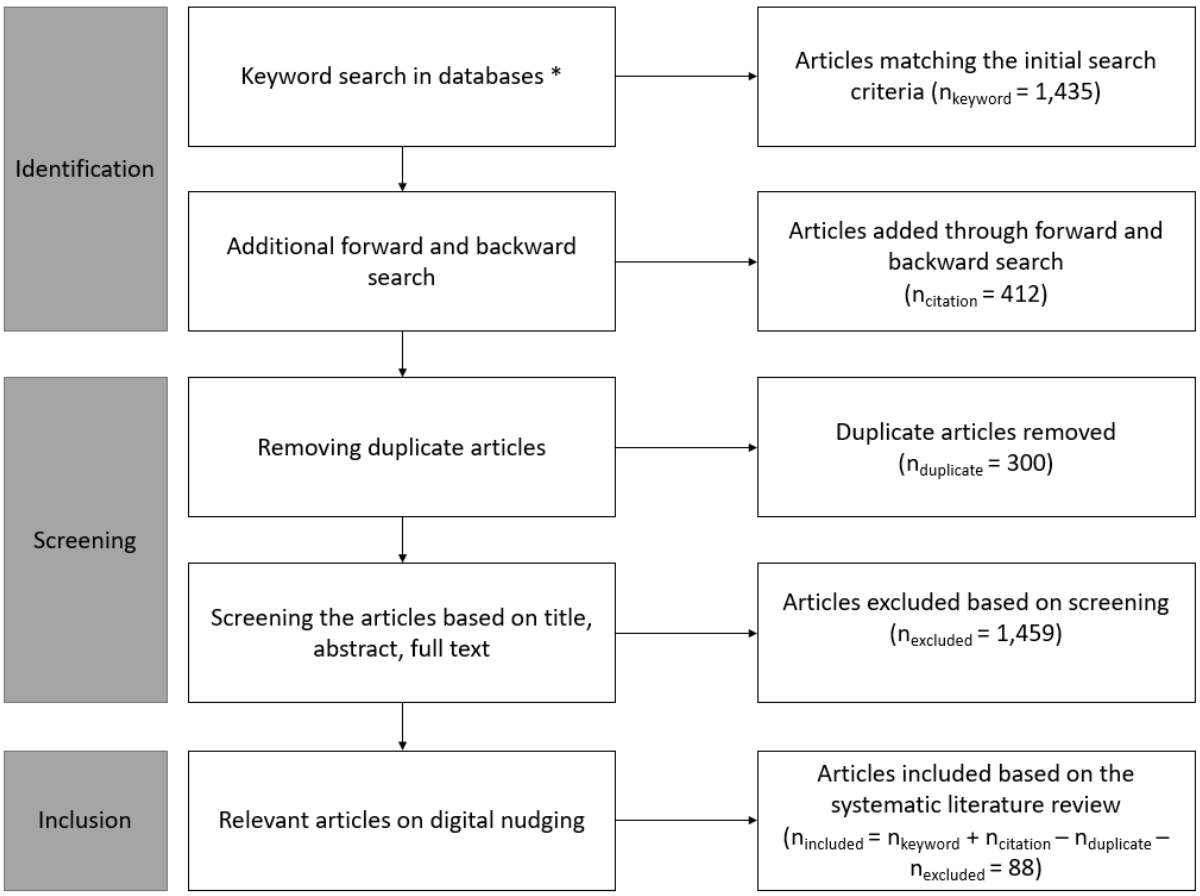
Step	Task	Application
1. Define	Define inclusion and exclusion criteria	Published literature about digital nudging, 2008 – 2022, including qualitative or quantitative results
	Define research disciplines	Multidisciplinary
	Determine appropriate sources	Academic journal publications and conference proceedings
	Define initial search terms	'Nudging', 'Nudge'
2. Search	Search execution	Search in electronic databases, including forward and backward search
3. Select	Sample refinement	A final sample of 88 articles
4. Analyze	Open coding	Identification of different forms, contexts, levels of intrusiveness, and varying user impact of digital nudging
	Axial coding	Identification of categories and subcategories
	Selective coding	Determination of relationships of categories to each other
5. Present	Structure content	Presentation of categories

In the search step, we applied these three search criteria and searched for the terms "nudge" and "nudging" in each database in title, abstract, or keywords. We intentionally avoided using the term "digital nudging" to prevent the inadvertent exclusion of articles addressing digital nudging but using alternative descriptors. This searching procedure resulted in 1,435 articles. We conducted an additional forward and backward search based on these articles to identify additional relevant articles, ultimately adding 412 articles to the relevant literature. These additional articles primarily originated from other disciplines, such as psychology (e.g., Guthrie et al., 2015) or medicine (e.g., Carter, 2015). In total, we identified a selection of 1,847 articles that meet our three criteria: published after 2008, employing qualitative or quantitative research methodologies, and centered around the digital form of nudging.

In the select step, we thoroughly screened the titles, abstracts, and full texts of the identified articles, retaining only those that met our literature search criteria. We removed studies for the following three reasons. First, we excluded duplicates and articles not published in journals or conferences. For instance, we found multiple instances of the same study across different databases, which we consolidated to avoid redundancy. Additionally, studies published in sources that did not meet academic quality standards, such as being peer-reviewed, were excluded to ensure the reliability of the included research. Secondly, despite our initial search criteria emphasizing the consideration of nudging in the digital context, during the article screening process, we identified additional studies with limited relevance, not necessarily related to digital forms of nudging in a digital context, or lacking specificity by encompassing various types of interventions that do not necessarily occur in the digital space. Third, we excluded articles that do not explore digital nudges with a specific focus on identifying one or more specific forms and contexts of their application. For instance, we removed studies primarily aimed at conceptualizing or defining digital nudging (e.g., Weinmann et al., 2016), providing design guidelines for digital nudges (Mirsch et al., 2018), or concentrating on ethical considerations regarding digital nudging (Schmid & Engelen, 2020). This step was crucial to ensure that the selected articles closely align with our research objectives of categorizing diverse types of digital nudging. As a result of this filtering process (see Table 3), we ended up with a final set of 88 articles deemed suitable for our analysis.

In the analyze step, we investigated the selected literature following open, axial, and selective coding (Strauss & Corbin, 1990). We generated and validated codes using the constant comparison method. We terminated coding at each stage when we reached theoretical saturation and could not elaborate further codes or relationships between existing codes within the dataset.

Table 3. Overview of the Literature Searching Process



* Initial search criteria: Search 'Nudging' or 'Nudge' in title, keywords, or abstract, in databases AISeL, ScienceDirect, EbscoHost, published after 2008, including qualitative or quantitative results.

We used open coding to break down, examine, compare, conceptualize, and categorize the data (Strauss & Corbin, 1990). During this phase, we identified various forms, contexts, levels of intrusiveness, and varying user impact of digital nudging in the analyzed literature. For example, we coded "increase the actual carbon-offset donation" (Székely et al., 2016, p. 2) or "increase employees' contributions to retirement saving accounts" (Gruene-Yanoff & Hertwig, 2016, p. 155) as contexts of digital nudging and "alternatives that are framed as gains" (Wang et al., 2014, p. 2368) or "have a default that increases sharing" (Knijnenburg & Kobsa, 2014, p. 15) as forms of digital nudging. Further, in our coding process, we observed distinctions between digital nudges in terms of their intrusiveness, exemplified by the strategies employed in studies such as "a correction message […] added to their news story" (Rich & Zaragoza, 2016, p. 4) to avoid implied misinformation and "the news website displayed an overlaying cookie consent request […] and only after the participant made a choice, the overlaying consent request disappeared and the news website was shown" (Graßl et al., 2021, p. 6). The former digital nudge offers additional information without actively involving the user's intent, while the latter presents a more intrusive approach, preventing users from accessing the website until they make a choice, thus adding the dimension of intrusiveness. We found further distinctions in terms of user impact. For example, articles exploring digital nudges designed to "phrase the agreement differently […] to increase the number of users who read the terms and privacy policy" (Bergram et al., 2020, p. 1), serve to increase privacy awareness, while articles focusing on increasing users' sharing tendency (Knijnenburg & Kobsa, 2014), have a rather negative impact on users' privacy, thus adding the dimension user impact. This open coding process resulted in a list of codes representing various forms, contexts, levels of intrusiveness, and user impact of digital nudging. A second author conducted an independent coding analysis of the extracted excerpts. A comparative process resulted in a raw intercoder agreement rate of 96.67 percent between the two authors, based on the axial coding results exemplified in Appendix Table A.1, illustrating the resulting

characteristics of the taxonomy. We reached a consensus on coding differences through a collective reevaluation and discussion of the codes among all authors.

Following the open coding, we used axial coding to develop different categories for digital nudging forms, contexts, levels of intrusiveness, and varying user impact based on the codes. For example, "increase the actual carbon-offset donation" (Székely et al., 2016, p. 2) as well as "increase employees' contributions to retirement saving accounts" (Gruene-Yanoff & Hertwig, 2016, p. 155) appeared to be digital nudges aiming to improve environmental and societal decisions and we, therefore, created societal-related as a context of digital nudging. Likewise, for the mentioned forms "alternatives that are framed as gains" (Wang et al., 2014, p. 2368) and "have a default that increases sharing" (Knijnenburg & Kobsa, 2014, p. 15), we created the categories framing and status quo bias as forms of digital nudging. We provide additional examples and details on the coding process in the Appendix (see Appendix Table A.1).

In summary, our analysis revealed various forms, contexts, levels of intrusiveness, and varying user impact of digital nudging within the analyzed literature. This lays the foundation for developing a precise taxonomy and deepening our understanding of the multifaceted aspects of digital nudging.

Digital Nudging in Existing Literature

This section summarizes the findings of our systematic literature review of digital nudging, representing the present step.

Contexts of Digital Nudging

We identified five contexts of digital nudging, sorted by occurrence frequency in the reviewed literature: societal-, health-, privacy-, revenue-, and work-related (Table 4). The term context in this classification refers to the specific area of application where a digital nudge is employed. As one article may investigate multiple contexts or forms of digital nudging, the sum of articles in Table 4 and Table 5 is higher than the total amount of articles (88). For instance, Stryja et al. (2017) explored the influence of status quo bias and priming on people's decision-making when choosing electric cars in an online rental car booking scenario. Since this article addresses both online booking and promotes sustainability, we assigned it to the two categories revenue-related and societal-related (see Appendix Table A.2).

Societal-related digital nudges aim to influence users' decision-making in alignment with societal and environmental objectives. Societal objectives encompass digital nudges that aim to raise awareness about retirement provision (e.g., Bertheim, 2018), improve users' saving habits (e.g., Kooreman & Prast, 2010), and simplify payment processes to support citizens (e.g., Schirrmacher et al., 2019). Environmental objectives include digital nudges designed to increase renewable energy choices (e.g., Momsen & Stoerk, 2014), foster sustainability in grocery deliveries (e.g., Auf der Landwehr et al., 2021), or increase CO2 offset payments for online flight bookings (e.g., Székely et al., 2016). These studies demonstrate the positive societal and environmental impact of societal-related digital nudges.

Table 4. Contexts of Digital Nudging

Context	Explanation	Examples	Articles
Societal-related	Societal-related digital nudges aim to make users' actions more beneficial to the environment and society.	Auf der Landwehr et al., 2021; Hausman & Welch, 2010; Kooreman & Prast, 2010; Momsen & Stoerk, 2014; Schirrmacher et al., 2019	28
Health-related	Health-related digital nudges aim to make users' actions more beneficial to their health.	Kattelmann et al., 2014; Luoto et al., 2014; Miller et al., 2016; Sengupta et al., 2020; Thorndike et al., 2012	28
Privacy-related	Privacy-related digital nudges aim to make users' actions more beneficial to their privacy.	Balebako & Cranor, 2014; Gerber et al., 2017; Tsai et al., 2011; Tsai et al., 2017; Zhang & Xu, 2016	20
Revenue-related	Revenue-related digital nudges aim to make users' actions more profitable from a business perspective.	Chang et al., 2016; Collier et al., 2020; Forwood et al., 2015; Schaer & Stanoevska-Slabeva, 2019	13
Work-related	Work-related digital nudges aim to make users' actions more beneficial to their work performance.	Bertsimas & O'Hair, 2013; Boskovic-Pavkovic et al., 2019; Nielsen, 2014; Thomas et al., 2013; Yevseyeva et al., 2014	10

Health-related digital nudges aim to encourage users to make healthier decisions, such as engaging in more physical activity or opting for nutritious food. Examples include digital nudges that improve public health prevention (e.g., Oullier & Sauneron, 2010), increase physical activity (e.g., Forberger et al., 2019), promote healthier food and beverage selections (e.g., Thorndike et al., 2012), improve eating habits (e.g., Kattelmann et al., 2014), or reduce the risk of virus diseases (e.g., Luoto et al., 2014). These studies underscore the effectiveness of health-related digital nudging in fostering healthier user behaviors.

Privacy-related digital nudges influence users' actions concerning their privacy, such as setting passwords or adjusting privacy settings. There exist digital nudges that promote data security during online transactions (e.g., Acquisti et al., 2015), reduce privacy disclosure (e.g., Wang et al., 2013), and increase privacy awareness in online social networks (e.g., Bergram et al., 2020). Some studies even encourage users to share more private data (e.g., Acquisti, 2009). Research on privacy-related digital nudges reveals their capacity to guide users to greater caution or openness regarding their private information.

Revenue-related digital nudges aim to increase the profitability of user actions from a business perspective. Unlike other contexts, revenue-related digital nudges often contradict Thaler and Sunstein's (2008) basic idea of nudges primarily benefiting the user. User interface providers typically implement digital nudges to influence the behavior of their users. In some cases, the user interface provider may also be the organization aiming to monetize users through their application use. In such cases, the provider implements digital nudges to encourage users to spend more money. Revenue-related digital nudges are often affected by this potential conflict of interest. In digital nudging research, revenue-related digital nudges were often studied to increase user purchases or spending (e.g., Demarque et al., 2015), boost the redemption of online rebates (e.g., Tasoff & Letzler, 2014), influence the amount users are willing to pay for a product (e.g., Collier et al., 2020), or reduce food waste to save money (e.g., Kallbekken & Sælen, 2013). These studies suggest that revenue-related digital nudging can increase willingness to pay in e-commerce settings but may also influence users' financially detrimental decisions.

Work-related digital nudges encourage users to improve their productivity or performance, often through reminders or by providing real-time feedback. These digital nudges target specific workplace behaviors or decisions, such as increasing users' commitment to online courses (e.g., Zaqoot & Oh, 2020) and reducing procrastination in academic settings (e.g., Rodriguez et al., 2019). Other studies show that digital nudges promote better task management among workers and increase users' likelihood of completing their tasks on time (e.g., Wang et al., 2018) or increase engagement within their workplace among users (e.g., Chen et al., 2019). These insights indicate that digital nudging is an effective tool for enhancing performance and productivity in work-related contexts.

Forms of Digital Nudging

We identified ten distinct forms of digital nudging (Table 5). In this classification, the term form refers to the specific techniques employed for implementing a digital nudge.

Framing influences users' choices by presenting certain options more appealingly among several alternatives (Mirsch et al., 2017). For example, a website promoting a subscription service might frame the offer to emphasize the benefits and discounts available to members rather than the subscription costs. Framing can make the decision to subscribe seem more attractive and increase the likelihood of conversion (Wang et al., 2013). Other examples are online booking systems that frame environmental-friendly transport preferences as a moral choice or a contribution to a public good (Hilton et al., 2014). The user chooses the environmental-friendly transport preference independently of financial incentives because it appears good and clean (Hilton et al., 2014). Another example is framing sustainable retirement provision plans in a more appealing way to increase users' awareness of retirement provision decisions (Bertheim, 2018).

Status quo bias describes users' tendency to stick with their current situation (Mirsch et al., 2017). It is explained by the fact that the potential disadvantages of leaving a current state weigh higher than the advantages associated with a change (Mirsch et al., 2017). This can manifest in various ways in IT and online interactions, such as users not changing default settings, not exploring new features, or not switching to a better service. An example can be seen in online privacy settings. Many internet users stick with the default settings pre-configured by the service providers, even if these settings do not align with their privacy preferences (Acquisti & Grossklags, 2005). Another example is pre-selecting the pro-environmental option as the default option. If users want to opt out of this pre-selection, they must spend extra effort (Henkel et al., 2019). Other examples are retirement provisions that set the default to the most sustainable choice (Bertheim, 2018).

Table 5. Forms of Digital Nudging

Form	Explanation	Examples	Articles
Framing	Framing influences users by designing specific choices more appealingly (Mirsch et al., 2017).	Gruene-Yanoff & Hertwig, 2016; Guthrie et al., 2015; Hilton et al., 2014; Wang et al., 2013	54
Status quo bias	The status quo influences users by highlighting the disadvantages of leaving the current state more prominent than the advantages associated with a change (Mirsch et al., 2017).	Avineri, 2012; Forwood et al., 2015; Schirrmacher et al., 2019; Stryja et al., 2017	29
Social norms	Social norms influence users by giving information about the behavior of other users, provoking herd behavior (Mirsch et al., 2017).	Chang et al., 2016; Kooreman & Prast, 2010; Laskowski, 2015; Auf der Landwehr et al., 2021	21
Messenger effects	Messenger effects influence users through messages the users receive, e.g., warning symbols or reminder messages (Mirsch et al., 2017).	Altmann & Traxler, 2014; Czap et al., 2015; Tsai et al., 2017; Zhang et al., 2014	18
Priming	Priming influences users by preparing them for the situation where a decision takes place, e.g., by visualizing the consequences of a decision (Mirsch et al., 2017).	Henkel et al., 2019; Knijnenburg & Kobsa, 2014; Momsen & Stoerk, 2014; Wang et al., 2013	17
Loss aversion	Loss aversion influences users using the bias that individuals weigh losses and disadvantages that may result from a decision more heavily than gains and benefits (Mirsch et al., 2017).	Bertsimas & O'Hair, 2013; Bull, 2012; Jones et al., 2015; Oelander & Thøgersen, 2014	14
Hyperbolic discounting	Hyperbolic discounting influences users using the bias that individuals value the present more than the future, even though future effects may be better (Mirsch et al., 2017).	Grand, 2008; Ratner et al., 2008; Wang et al., 2013; Woodend et al., 2015	10
Anchoring	Anchoring influences users using the bias that individuals tend to assess or estimate choices concerning individual starting points, and therefore different starting points lead to different results (Mirsch et al., 2017).	Bergram et al., 2020; Kretzer & Maedche, 2018; Oullier & Sauneron, 2010; Székely et al., 2016	10
Simplification	Simplification influences users by reducing the complexity of choice options (Mirsch et al., 2017).	Boskovic-Pavkovic et al., 2019; Gerber et al., 2017; Rodriguez et al., 2019; Thomas et al., 2013	7
Decoupling	Decoupling influences users by separating the costs of a choice from its consumption (Mirsch et al., 2017).	Avineri, 2012; Czap et al., 2015; Kattelmann et al., 2014; Yevseyeva et al., 2014	6

Social norms refer to how the behavior of others influences users. In the context of IT and online interactions, this can manifest in various ways, such as social media activity, online reviews, and ratings (Mirsch et al., 2017). For example, if a product or service has many positive reviews and ratings, it is more likely to attract new customers than if it has fewer or mostly negative reviews. One example of this bias in action can be seen in e-commerce platforms, where the number of purchases or positive reviews for a product can influence other users to buy the same product (Demarque et al., 2015). When a product is labeled as a best seller or has many positive reviews, it can increase its perceived value, leading more users to purchase it.

Messenger effects describe influencing users with messages while making a decision (Mirsch et al., 2017). Messenger effects can include email notifications, text messages, or through an app or website. An example is an online calendar system, where users can set reminders for upcoming events or tasks and receive corresponding messages. These messages can be delivered via email or push notification on the users' devices, making it more likely that they will remember to attend or complete the task (Mirsch et al., 2017). Likewise, messenger effects influence attitudes and privacy disclosure by showing the user who can see certain posts or private data through privacy notice dialogs (Wang et al., 2013).

Priming influences users by preparing a certain situation where a decision takes place, e.g., by

visualizing the consequences of a decision to the user (Mirsch et al., 2017). Examples are rental car booking websites that provide illustrative information and positive associations, such as the environmental benefits of certain options, such as electric cars. This priming nudge decreases the resistance of users to switch toward sustainable innovations (Stryja et al., 2017).

Loss aversion occurs when the costs of losing something are perceived as higher than the benefits (Mirsch et al., 2017). Examples are online banking websites increasing customers' debt repayment behavior by loss framing annual running costs (Jones et al., 2015).

Hyperbolic discounting describes the phenomenon that individuals value the present more than the future, even though future benefits may be better (Mirsch et al., 2017). Examples are online retirement plan providers that create time-limited offerings to engage people in dealing with their retirement plans (Gruene-Yanoff & Hertwig, 2016).

Anchoring occurs because users tend to estimate choices concerning individual starting points. These different starting points lead to different results. User interfaces can use this effect and offer specific starting points to users. Examples are airlines increasing customers' CO2 offset payments for online flight bookings by proposing higher anchors in default payments (Székely et al., 2016).

Simplification influences users' decisions by simplifying certain options (Mirsch et al., 2017). Simplification decreases high energy consumption by presenting information more straightforwardly and in a way that fits the user's information processing capabilities. Simplifications can ease decision-making processes through simplified feedback on energy consumption, such as informative energy bills, metering, or displays (Momsen & Stoerk, 2014).

Decoupling influences users by disconnecting the cost of a choice from its actual consumption (Mirsch et al., 2017). Decoupling enhances consumer welfare by decoupling the costs of a decision from the positive impacts to make the user choose independently of the costs (Ratner et al., 2008). Likewise, selling websites use decoupling to increase revenue and offer financing and deferred payment to decouple the purchase from the actual payment and make a purchase more likely (Mirsch et al., 2017).

Intrusiveness of Digital Nudging

We also identified two levels of intrusiveness (Table 6). The term intrusiveness pertains to the degree of interference or imposition that a digital nudge exerts on users' decision-making process.

Low-intrusive digital nudges are designed to influence user behavior in a subtle and non-obtrusive manner. They aim to gently steer users towards making choices while respecting their freedom of choice and autonomy. Examples of low-intrusive digital nudges include push notifications on the phone reminding users to drink more water throughout the day (e.g., Haile et al., 2020). Further, e-commerce platforms often employ low-intrusive digital nudges by displaying related products or items frequently bought together. When a user is viewing a product, these subtle recommendations encourage additional purchases without forcefully directing the user's choice.

High intrusive digital nudges are more forceful in their approach, often exerting a noticeable and coercive influence on users' decision-making process. These digital nudges are designed to guide users towards specific choices or behaviors actively, often without providing them with much room for alternative actions. One example is an intrusive pop-up message that blocks the user's screen until they make a choice (e.g., Okeke et al., 2018). For instance, when visiting a website, a pop-up message asks the user to subscribe to a newsletter. In this case, the pop-up message is high-intrusive because it interrupts the user's browsing experience and forces them to make a decision before they can continue using the website. Due to their high intrusiveness, such digital nudges are often investigated in the field of ethics (e.g., Lembcke et al., 2019; Meske & Amojo, 2020; Schmidt & Engelen, 2020).

Table 6. Intrusiveness of Digital Nudging

Intrusiveness	Explanation	Examples	Articles
Low	Low-intrusive digital nudges subtly guide users' decision-making process without overtly disrupting their autonomy.	Haile et al., 2020; Székely et al., 2016; Tasoff & Letzler, 2014	67
High	High-intrusive digital nudges strongly and potentially coercively influence users' decision-making process.	Balebako & Cranor, 2014; Hilton et al., 2014; Okeke et al., 2018	21

Table 7. User Impact of Digital Nudging

User Impact	Explanation	Examples	Articles
Positive	Digital nudges with positive user impact aim to influence user behavior to promote users' goals, preferences, or well-being. They are designed to bring positive changes.	Shah & Adusumalli, 2020	54
Neutral	Digital nudges with neutral user impact have no significant impact on user's goals, preferences, or well-being.	Djurica & Figl, 2017	21
Negative	Digital nudges with negative user impact aim to influence user behavior to harm users' goals, preferences, or well-being. They are designed to bring negative changes.	Auf der Landwehr et al., 2021	13

User Impact of Digital Nudging

We identified three levels of user impact of digital nudges (Table 7). The term *user impact* pertains to the effect that a digital nudge exerts on the users themselves, regarding their goals, preferences, or well-being.

Digital nudges with a *positive user impact* aim to promote users' goals, preferences, or well-being. They may include helpful information, support, or simplify complex situations. For example, a health app that employs digital nudging to promote healthier habits by rewarding users for achieving daily exercise and nutrition goals showcases a positive user impact (e.g., Shah & Adusumalli, 2020).

Digital nudges with a *neutral user impact* have no significant impact on users' goals, preferences, or well-being. They are typically informational or organizational. Digital nudges with neutral user impact can still have a positive or negative impact on participants other than the user, such as organizations or the environment. For example, grocery deliveries that promote an environmentally friendly choice neither exert a positive nor negative but neutral impact on the user, while it might benefit the environment (e.g., Auf der Landwehr et al., 2021).

Digital nudges with a *negative user impact* aim to harm users' goals, preferences, or well-being. They may include misleading information, unwanted distractions, or manipulative patterns. Examples are manipulative notifications during online shopping, urging customers to purchase an expensive item by suggesting a limited-time offer (e.g., Djurica & Figl, 2017). Such a digital nudge can put the user under pressure and foster rash decisions, leading to negative user impact.

Developing a Taxonomy of Digital Nudging

Building upon the systematic literature review findings, we develop a taxonomy of digital nudging by identifying the dimensions and characteristics of digital nudging through an iterative process. We incorporate each finding from the literature review regarding how digital nudges differ in context, form, intrusiveness, and user impact into the taxonomy as dimension, with corresponding subtypes as characteristics (Nickerson et al., 2013). A taxonomy categorizes objects based on common characteristics, ensuring that each object exhibits precisely one characteristic in each dimension. The taxonomy development process comprises seven iterative steps guided by objective and subjective ending conditions (see Appendix Table A.3). We provide additional detail on the iterations below (see Table 8).

First iteration. We conducted a conceptual-to-empirical approach to develop the taxonomy of digital nudging. Conceptual-to-empirical is a deductive approach in which the taxonomy's dimensions are conceptualized first, and the dimensions' characteristics are identified afterward (Nickerson et al., 2013). The literature review on digital nudging presented in this paper (see Section 3.2) assesses the status quo of research on digital nudging. We find that existing research investigates digital nudging in five different contexts. To incorporate these different contexts into our taxonomy, we added the dimension 'context' with the characteristics 'societal-related', 'health-related', 'privacy-related', 'revenue-related', and 'work-related'.

*Second iteration***.** We identified ten different forms of digital nudging in the existing literature. To include these varying forms within our taxonomy, we added the dimension 'form' with the characteristics 'framing', 'status quo bias', 'social norms', 'messenger effects', 'priming', 'loss aversion', 'hyperbolic discounting', 'anchoring', 'simplification', and 'decoupling'.

Table 8. Iterative Development of the Taxonomy of Digital Nudging

Iteration	T_i = {Dimension$_i$ [Characteristic$_i$, Characteristic$_{ii}$]}	Added dimension	Ending condition
1	T_1 = {Context [societal-related, health-related, privacy-related, revenue-related, work-related]}	Context	Subjective: ✓ Objective: x
2	T_2 = {Context [societal-related, health-related, privacy-related, revenue-related, work-related]; Form [Framing, Status quo bias, Social norms, Messenger effects, Priming, Loss aversion, Hyperbolic discounting, Anchoring, Simplification, Decoupling]}	Form	Subjective: ✓ Objective: x
3	T_3 = {Context [societal-related, health-related, privacy-related, revenue-related, work-related]; Form [Framing, Status quo bias, Social norms, Messenger effects, Priming, Loss aversion, Hyperbolic discounting, Anchoring, Simplification, Decoupling]; Intrusiveness [High, Low]}	Intrusiveness	Subjective: ✓ Objective: x
4	T_4 = {Context [societal-related, health-related, privacy-related, revenue-related, work-related]; Form [Framing, Status quo bias, Social norms, Messenger effects, Priming, Loss aversion, Hyperbolic discounting, Anchoring, Simplification, Decoupling]; Intrusiveness [High, Low]; User Impact [Positive, Neutral, Negative]}	User Impact	Subjective: ✓ Objective: x
5	T_5 = {Context [societal-related, health-related, privacy-related, revenue-related, work-related]; Form [Framing, Status quo bias, Social norms, Messenger effects, Priming, Loss aversion, Hyperbolic discounting, Anchoring, Simplification, Decoupling]; Intrusiveness [High, Low]; User Impact [Positive, Neutral, Negative]}	/	Subjective: ✓ Objective: ✓

Table 9. Taxonomy of Digital Nudging

Dimension	Characteristics				
Context	Societal-related	Health-related	Privacy-related	Revenue-related	Work-related
Form	Framing	Status quo bias	Social norms	Messenger effects	Priming
	Loss aversion	Hyperbolic discounting	Anchoring	Simplification	Decoupling
Intrusiveness	Low		High		
User Impact	Positive	Neutral	Negative		

Third iteration. Our literature review shows that digital nudges differ in their intrusiveness. While some digital nudges are gentle, others are intrusive and assertive (Mirsch et al., 2017). To respect this in our taxonomy, we added the dimension 'intrusiveness' with the characteristics 'high' and 'low'.

Fourth iteration. Contrary to the initial definition of nudging by Thaler and Sunstein (2008), we identified digital nudges not acting in users' favor. Building on the results of our literature review, we added the dimension 'user impact' with the characteristics 'positive', 'neutral', and 'negative'.

Fifth iteration. Since there were no additional findings from our literature review relevant to extending the taxonomy, we added no further dimensions and characteristics. We meet all subjective and objective ending conditions (see Appendix Table A.3). In total, our taxonomy comprises four dimensions and 20 characteristics, providing a structured framework for classifying digital nudging (see Table 9).

Taxonomy Evaluation and Demonstration of Application

We assessed the taxonomy of digital nudging regarding its usefulness, general applicability, and practical relevance through expert evaluation. We invited 14 experts, seven with theoretical knowledge of digital nudging and seven with practical experience in digital nudging and user interface design, to categorize three real-world digital nudges using the taxonomy. For the evaluation, we chose digital nudges from a car rental website (Europcar), a flight booking website (AirFrance), and a social media platform (Facebook), as we expect them to differ in their categorization (Table 10).

Table 10. Description of Evaluated Digital Nudges

Case	Description
Europcar	Europcar designs environmentally friendly transportation options, e.g., electric cars, as a moral choice and a contribution to the public, as customers cause less harmful CO2 emissions with this option. Europcar uses more appealing formulations for environmentally friendly transportation options. The user can still choose a different option, and the desired option would neither positively nor negatively impact the user.
Facebook	In a beta version, Facebook locked the "post" button before posting a photo or text, and a message popped up showing the user who could see the post and corresponding private data and what other people could do with this data. If the user continues, another message pops up aiming to protect the user's privacy and asks the user if they want to share private data with these people. The user is interrupted several times by messages through the digital nudge and has to expend considerable effort to share the post. However, the digital nudge positively impacts the user's privacy.
AirFrance	AirFrance allows customers to pay CO2 offsets for flights during the booking process. This money is entirely used to compensate for the negative impact of the flight on the environment. Each customer can determine the number of CO2 offsets they want to pay. During this process, AirFrance offers high starting points for payment to nudge customers to choose higher balances than they initially intended. The CO2 offsets are voluntary and can easily be skipped during booking. Because the user probably puts more money into CO2 offsets than planned, they experience a negative financial impact.

Table 11. Application Demonstration of Developed Taxonomy

Dimension	Characteristics				
Context	Societal-related 31.8 %	Health-related 31.8 %	Privacy-related 22.7 %	Revenue-related 14.8 %	Work-related 11.4 %
Form	Framing 61.4 %	Status quo bias 33.0 %	Social norms 23.9 %	Messenger effects 20.5 %	Priming 19.3 %
	Loss aversion 15.9 %	Hyperbolic discounting 11.4 %	Anchoring 11.4 %	Simplification 8.0 %	Decoupling 6.8 %
Intrusiveness	Low 76.1 %			High 23.9%	
User Impact	Positive 61.4 %		Neutral 23.8 %		Negative 14.8 %

Key: Europcar Facebook AirFrance

Values indicate the distribution of digital nudges from the literature review per characteristic.

Note: Values per dimension can exceed 100 %, since one article can investigate several characteristics.

The evaluation results affirm the taxonomy's usefulness and ease of use (see Appendix Table A.4). It met the experts' expectations (mean = 6.3, SD = 0.48, Likert scale from 1 = strongly disagree to 7 = strongly agree) and demonstrated comprehensiveness (mean = 6.0, SD = 0.81), extensiveness (mean = 6.2, SD = 0.79), robustness (mean = 5.5, SD = 0.85) and extendibility (mean = 6.3, SD = 0.72). Moreover, it proved relevant for practitioners, aiding in selecting suitable digital nudges from an existing portfolio (mean = 6.6, SD = 0.52). It inspires the development of digital nudges for specific objectives (mean = 6.7, SD = 0.67). The experts' high agreement in classification (Europcar 82.1 %, Facebook 89.3 %, AirFrance 73.2 %) underscores the taxonomy's consistent characterization of digital nudges.

To demonstrate the taxonomy's practical applicability and capability to classify digital nudges, we applied it to categorize all 88 articles from the literature review. Table 11 presents the frequency of each characteristic across all digital nudges and visually illustrates the categorization of the three exemplary digital nudges.

Comparing the occurrence of the taxonomy characteristics across the 88 articles of our literature review, the form *Framing* is the most prevalent, occurring in 61.4% of the data set. Digital nudges are predominantly applied in *societal-related* (31.8 %) and *health-related* (31.8 %) contexts, with *privacy-related* (22.7 %) digital nudges also being relatively common. Most digital nudges (76.1 %) employ low intrusiveness in influencing user choices. Concerning user impact, a significant proportion of digital nudges have a *positive*

user impact (61.0 %), some are *neutral* (24.2 %), and a few yield *negative* user impacts (14.8 %). As one article can investigate several characteristics, the values per dimension can exceed 100 %. For instance, Figl & Lehrer (2020) investigate how the presentation of certain options (framing) and the establishment of defaults (status quo bias) impact users' decision-making regarding their privacy settings (privacy-related). Therefore, we assigned this article to the form-dimension for both *Framing* and *Status quo bias* characteristics, accounting for its classification under multiple characteristics.

In summary, our expert evaluation has confirmed the taxonomy's effectiveness, usability, and relevance in categorizing digital nudges. Its robustness and versatility make it a valuable tool for researchers and practitioners. The following section discusses the taxonomy's implications and contributions to theory and practice and provide future research directions.

Discussion

This study develops a taxonomy of digital nudging, addressing semantic ambiguities within the field. This taxonomy provides a structure to the expanding and heterogeneous field of digital nudging literature, facilitating the incorporation of novel findings into existing knowledge. Through systematic categorization, the taxonomy enables researchers to draw meaningful insights and practical conclusions. By resolving semantic ambiguities, it promotes a shared understanding among researchers and practitioners. This taxonomy offers solution to the challenge of organizing and comprehending the diverse field of digital nudging. In the following, we delve into its theoretical contributions, outline future research directions, and discuss its practical implications.

Theoretical Contributions

Based on 88 peer-reviewed publications, we developed a taxonomy of digital nudging. This taxonomy classifies digital nudges based on key dimensions. The taxonomy aligns with the characteristics of a type I theory approach (Gregor, 2006). In general, the taxonomy represents a complete and exhaustive classification tool that encompasses the full spectrum of digital nudges. In specific, these characteristics are valuable for emerging research fields (Fawcett & Downs, 1986) and equip researchers and practitioners with a structured tool to understand and navigate the intricate field of digital nudging. For instance, by categorizing digital nudges based on their specific dimensions, such as context, form, intrusiveness, and user impact, the taxonomy provides clarity and precision in defining and discussing digital nudges. The developed taxonomy contributes to the field by streamlining the systematic classification of digital nudges across diverse contexts and settings, facilitating comparability, generalizability, and differentiation within the field. This classification ensures that research outcomes can be effectively compared and applied across diverse contexts, enhancing the overall cohesiveness and applicability of digital nudges, their mechanisms (e.g., Jesse & Jannach, 2021), effectiveness (e.g., Hummel & Maedche, 2019), and ethical implications (e.g., Lembcke et al., 2019). By incorporating its dimensions and characteristics, the taxonomy empowers researchers to develop precisely targeted digital nudges. It facilitates a more profound understanding of various types of digital nudges and their context-specific characteristics. This, in turn, facilitates the design and implementation of more effective digital nudges tailored to specific situations and user preferences (e.g., Meske & Potthoff, 2017). Ultimately, these advancements expand our knowledge of the field and enhance its practical applications, bringing us closer to realizing the full potential of digital nudging.

By zooming into the taxonomy, it allows classifying digital nudges along four dimensions: context, form, intrusiveness, and user impact. These four dimensions are mentioned in earlier peer-reviewed articles and comprehensively describe and explain digital nudges. We define the four dimensions accordingly and identify specific characteristics for each dimension. Overall, these dimensions and characteristics offer research oversight and categorization so that we contribute to research by providing a nuanced theoretical depth and a more profound theoretical perspective on digital nudging. In detail, we offer four dimensions and 20 characteristics describing and explaining digital nudging. We focus on each separate dimension in the following.

We identify five broad contexts. This context describes whether the digital nudge pertains to societal-, health-, privacy-, revenue-, or work-related goals. For example, a nudge aimed at increasing privacy awareness of online social network users may differ from one aimed at promoting healthy eating habits among users. By recognizing each context's unique needs and characteristics during the design process of digital nudges, our taxonomy contributes to a deeper understanding of their application. Examining the context-based categorization aids in identifying the most suitable target audience and goal for each digital nudge, optimizing their design, and enhancing their impact in specific situations (Meske & Potthoff, 2017; Mirsch et al., 2018). In essence, this context-based categorization enriches the field's theoretical foundations and practical applications. Thereby, by identifying the five different contexts of digital nudging, we contribute by explaining that digital nudges can be

differentiated based on their context, which makes them distinct in terms of area of application and subsequently impacts the goals of the digital nudge.

We identify ten forms of digital nudging. The form describes specific techniques employed for implementing a digital nudge. This form of a digital nudge influences its effectiveness (Hummel & Maedche, 2019). For example, messenger effects may excel at conveying information succinctly, while framing may be more effective at evoking emotions and catching the user's attention. Simplification, on the other hand, may prove less effective in altering users' behavior (Hummel & Maedche, 2019). Such classification enables a deeper understanding of the various forms of digital nudges and their effectiveness in achieving specific behavior changes, facilitating communication among researchers, and enabling the systematic generalization of results across these ten forms. Thereby, with identifying the ten unique forms of digital nudging, we contribute by illustrating that digital nudges can be distinguished by their form, more specifically by their underlying techniques.

We identify two levels of intrusiveness of digital nudges. Intrusiveness describes the degree of interference or imposition a digital nudge exerts on users' decision-making process. Subtle digital nudges are less likely to be perceived as annoying and may prove more effective in driving long-term behavior change, whereas intrusive nudges may prompt immediate but potentially less lasting changes (Dalecke & Karlsen, 2020). Recognizing this distinction allows for tailored digital nudge designs that address individual user needs and are perceived as valuable and acceptable, thus increasing user experience. With identifying the two levels of intrusiveness, we contribute by highlighting that digital nudges vary in their interference on users' decisions, depending on their design and imposition on the user interaction process.

We identify three levels of user impact. User impact describes the effect that a digital nudge exerts on users themselves regarding their goals, preferences, or well-being, which can be positive, neutral, and negative. The identification of negative user impact challenges the conventional definition by Thaler and Sunstein (2008) by acknowledging that digital nudges can have negative effects on users. This user impact has ethical implications (Lembcke et al., 2019), as digital nudges can be used to manipulate user decision-making or affect autonomy and privacy (Meske & Amojo, 2020). The ability to categorize digital nudges based on their user impact is crucial when developing digital nudges (Meske & Potthoff, 2017; Mirsch et al., 2018), as it helps to understand and select digital nudging techniques (Mirsch et al., 2018) and design and evaluate digital nudges (Meske & Potthoff, 2017). Our classification of digital nudges highlights the importance of considering user impact when studying or designing digital nudges, providing a valuable contribution to the theoretical understanding of digital nudging and its ethical considerations. With identifying three levels of user impact, we contribute by showing that digital nudges can be differentiated by their impact on the user, which makes them distinct in terms of their effect on users' goals, preferences, or well-being, especially relevant for research on ethical implications. Recognizing the varying impact of digital nudging on the user also allows for a more refined and tailored approach in designing digital nudges.

Future Research

This study opens numerous future research directions. In the subsequent, we provide six research focuses with corresponding research questions, summarized in Table 12.

We recommend broadening the existent characteristics of forms and contexts to uncover additional, as-yet-untapped potentials within the field of digital nudging. Identifying novel forms and contexts will reveal innovative ways to apply digital nudges. Exploring uncharted contexts can shed light on untouched areas where digital nudging could make a significant impact. For instance, we know from analog nudging that a context of nudging is strengthening one's self-control and resisting temptations to overcome addictive behavior such as smoking (Thaler & Sunstein, 2008). These insights might be helpful in the digital health context, among others, to use digital nudges to overcome IT addiction. While research on overcoming IT addiction has shown that some addicts terminate the use of IT on their own, others require external support (Maier, 2020). Research could investigate how digital nudges can provide external support for individuals to strengthen their self-control and overcome IT addiction.

Expanding the repertoire of forms allows for a more diverse breadth of nudge techniques, potentially unlocking new strategies for behavior change across various domains. In this vein, further research might identify forms of digital nudging that help to overcome further work-related challenges when using IS at work, such as technostress (Ayyagari et al., 2011) or job burnout (Pflügner et al., 2023) on an individual level and how digital nudging can thereby increase productivity and performance on an organizational level. Such research is necessary because organizations often have to implement costly measures to overcome these challenges (Valta et al., 2021), and digital nudging is a cost-effective alternative with a high reach (Weinmann et al., 2016).

Table 12. Future Research Agenda

Research focus	Possible Research Questions
Contexts of digital nudging	What further contexts can digital nudging address? How can digital nudging be applied in the digital health context?
Forms of digital nudging	What other forms of digital nudging can be found? How are these forms different from existing forms? How can organizations make use of these forms of digital nudging? Which forms of digital nudging reduce negative consequences of IS use, such as technostress or job burnout?
Intrusiveness of digital nudging	How can digital nudges be designed more / less intrusive? What factors influence whether digital nudges are perceived as intrusive or not?
User impact of digital nudging	Where are the boundaries between digital nudging and dark patterns and persuasion?
Effectiveness of digital nudging	Which digital nudges are most effective? Are digital nudges with high or low intrusiveness more effective? What factors influence the effectiveness of digital nudges? What is the effectiveness of digital nudging over time?
Target groups of digital nudging	Which target groups can be nudged in addition to the user? How can organizations or governments benefit from digital nudging?

While the initial idea of Sunstein and Thaler (2008) implies that digital nudges have a positive user impact, our results show that several digital nudges also have a negative user impact. For example, organizations use digital nudges in online shopping environments in revenue-related contexts to encourage users to spend more money (Demarque et al., 2015). The benefits of such digital nudges no longer lie with the user but with the selling organization. We recommend future research to focus on the ethical perspective of digital nudging and draw boundaries from digital nudging to manipulative elements, dark patterns, or persuasion.

Our results show that digital nudges differ in terms of their intrusiveness. While digital nudges, such as a more appealing framing of a specific option, are easily avoidable, other digital nudges, such as messages the user cannot easily remove, are difficult to avoid. Literature and practice have explored digital nudges with varying levels of intrusiveness, yet we don't understand the factors that influence whether users perceive digital nudges as intrusive or subtle. Differences might lie in the ability of users to cope with the use of information systems (Valta et al., 2022b). We recommend future research to identify factors influencing whether digital nudges are perceived intrusive.

Previous research indicates that digital nudges vary in effectiveness (Hummel & Maedche, 2019). However, it remains to be investigated why specific digital nudges have a more substantial impact on the user and whether digital nudges with high or low intrusiveness are more effective (Hummel & Maedche, 2019). In general, research and practice require an understanding of what factors influence the effectiveness of digital nudges, and especially about its consequences over time (Maier et al., 2023). This understanding is vital for selecting suitable digital nudges tailored to specific situations. The disparities in effectiveness could be rooted in the dimensions we identified in our study, namely, context, form, intrusiveness, and user impact. We recommend future research to identify factors that influence the effectiveness of digital nudging.

While our findings show that research focused on the user as a private customer when investigating digital nudging, we recommend future research to study digital nudges that take an organizational, societal, or political perspective. For example, organizations invested around 10 percent of their revenues in marketing in 2023, primarily using digital media (Statista.com, 2023). Organizations spend much time phrasing advertising slogans and want to frame their product optimally. Despite this fact and many studies on revenue-related contexts and framing, we see that only a few studies focus on other target groups than the user. To offer organizations more affordable solutions and evaluate and optimize the effectiveness of organizations' online marketing campaigns, we recommend future research to focus on identifying and developing additional forms that support organizations.

Practical Implications

Our study also offers practical implications. Digital nudging has gained increasing attention for enhancing information system effectiveness and user-friendliness, enabling subtle influence over user behavior. Digital nudges empower designers to gently steer users toward specific actions or choices, which is particularly valuable when encouraging decisions like opting into privacy settings or selecting environmentally friendly or health-conscious options. Our research presents a taxonomy of digital nudging,

offering a valuable resource for managers and user interface designers to understand and implement these techniques effectively. Broadly speaking, our study highlights the need for managers and user interface designers to be more aware of the types of digital nudges that influence user behavior and decision-making.

Our evaluation demonstrates the practical utility of this taxonomy for user interface designers. It offers a comprehensive overview of available digital nudges and their applications, aiding designers in the initial brainstorming phase. For designers with defined goals, the taxonomy is a resource for crafting effective digital nudges. Designers can systematically shape their digital nudges by using its dimensions, particularly form, intrusiveness, and user impact.

Furthermore, our results provide managers with insights into user needs and motivations. By testing various aspects of digital nudges as per the taxonomy, managers can uncover what motivates and influences user behavior, enhancing user experience and overall user satisfaction. Leveraging this taxonomy, organizations can develop user interfaces that drive business success and foster a more effective and satisfying user interaction.

Limitations

While our literature review covers major IS journals and conferences, and we chose the search term and procedure precisely, there remain some limitations to our findings. The search string that we defined limits the search results to publications in English. There might be articles relevant to this topic not included in our literature review because these articles address digital nudging but do not use the term nudge. Further, we focused on academic peer-reviewed sources, omitting other formats, such as books, scientific forums, or internet articles. These articles might investigate different forms or contexts affecting the taxonomy's results.

In addition, this study is limited due to the methodological approach. We narrowed our taxonomy to the most relevant dimensions and characteristics of digital nudging. We confirmed the applicability of our taxonomy and expected it to hold across different contexts generally. However, we encourage future research to apply the taxonomy to other IS contexts and extend it if needed, considering context-specific dimensions and characteristics. We are also aware that the perception of digital nudges varies among users, making their classification within our taxonomy potentially ambiguous. For instance, a specific digital nudge, such as a pop-up message informing the user about potential outcomes of a particular decision, might be perceived as intrusive by one user while being perceived as easily avoidable and less invasive by another user.

Conclusion

Motivated by the need to structure existing knowledge in the field of digital nudging, we developed a taxonomy that organizes the expanding and heterogeneous field of digital nudging to address the challenges posed by its evolving nature. This taxonomy, encompassing context, form, intrusiveness, and user impact, is a robust, broadly applicable, and practically relevant tool for future research. It enhances understanding in the field, providing a foundation for researchers to build upon. Our findings identify several future research directions, encouraging researchers to deepen our understanding of digital nudges' effects on user behavior and how to design effective, tailored digital nudges. This approach helps managers and user interface designers create digital nudges that support users in making decisions that align with their goals and improve the overall digital experience. Ultimately, it contributes to more effective information systems and a better digital user experience.

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Appendix

Table A.1. Coding Examples of Reviewed Articles

Reference	Excerpt	Open Coding	Axial Coding
Székely et al. (2016), p.2	"increase the actual carbon-offset donation"	Carbon-offset donation	Context: societal-related
Gruene-Yanoff & Hertwig (2016), p. 155	"increase employees' contributions to retirement saving accounts"	Retirement provision	Context: societal related
Wang et al. (2014), p. 2368	"alternatives that are framed as gains"	Framing	Form: framing
Knijnenburg & Kobsa (2014), p. 15	"have a default that increases sharing"	Having a default	Form: status quo bias
Graßl et al. (2021), p. 6	"Each news website displayed an overlaying cookie consent request when being visited (while the rest of the website was dimmed at first), offering two choice possibilities: allow the website and other third parties to collect data and to track user's web behaviour (privacy-unfriendly), versus not allowing such data collection and web tracking (privacy-friendly). After the participant made a choice, the overlaying consent request disappeared and the news website was shown."	Force the user to make a decision, otherwise unable to read the website	Intrusiveness: high
Rich & Zaragoza (2016), p. 4	"a correction message was added to their news story"	Provide additional information	Intrusiveness: low

Table A.2. Classification of Reviewed Literature among Context and Form

Context Form	Societal-related	Health-related	Privacy-related	Revenue-related	Work-related
Framing	Alemanno & Spina (2014); Auf der Landwehr et al. (2021); Avineri (2012); Bertheim (2018); Bull (2012); Chang et al. (2016); Chen et al. (2018); Czap et al. (2015); Forwood et al. (2015); Gruene-Yanoff & Hertwig (2016); Hausman & Welch (2010); Hilton et al. (2014); Kattelmann et al. (2014); Kooreman & Prast (2010); Lehner et al. (2016); Luoto et al. (2014); Momsen & Stoerk (2014); Ölander & Thøgersen (2014); Qizilbash (2012)	Altmann & Traxler (2014); Baskin et al. (2016); Borovoy & Roberto (2015); Cioffi et al. (2015); Guthrie et al. (2015); Haile et al. (2020); Hausman & Welch (2010); Holland (2015); Kattelmann et al. (2014); Kooreman & Prast (2010); Levy et al. (2012); Luoto et al. (2014); Miller et al. (2016); Mohan et al. (2013); Oullier & Sauneron (2010); Qizilbash (2012); Thorndike et al. (2012); Woodend et al. (2015)	Barev et al. (2021); Bergram et al. (2020); Buchmann & Haki (2021); Figl & Lehrer (2020); Gerber et al. (2017); Knijnenburg et al. (2013); Tsai et al. (2011); Tsai et al. (2017); Wang et al. (2013); Wang et al. (2014); Wang et al. (2018); Zhang & Xu (2016)	Chang et al. (2016); Djurica & Figl (2017); French (2011); Schär & Stanoevska-Slabeva (2019); Schirrmacher et al. (2019)	Boskovic-Pavkovic et al. (2019); Bull (2012); Knijnenburg et al. (2013); Nielsen (2014); Rodruguez et al. (2019); Thomas et al. (2013); Zaqoot & Oh (2020)
Status quo bias	Alemanno & Spina (2014); Avineri	Baskin et al. (2016); Borovoy & Roberto	Bergram et al. (2020); Figl &	Chang et al. (2016); Collier et al. (2020);	Knijnenburg et al. (2013); Rodriguez

Context Form	Societal-related	Health-related	Privacy-related	Revenue-related	Work-related
	(2012); Bertheim (2018); Forwood et al. (2015); Gruene-Yanoff & Hertwig (2016); Henkel et al. (2019); Hilton et al. (2014); Kallbekken & Sælen (2013); Kooreman & Prast (2010); Lehner et al. (2016); Momsen & Stoerk (2014); Qizilbash (2012); Stryja et al. (2017); Ölander & Thøgersen (2014)	(2015); Holland (2015); Kallbekken & Sælen (2013); Kooreman & Prast (2010); Laskowski (2015); Libotte et al. (2014); Marteau et al. (2011); Oullier & Saueron (2010); Qizilbash (2012); Van Dalen & Henkens (2014); Woodend et al. (2015)	Lehrer (2020); Knijnenburg & Kobsa (2014); Lehmann et al. (2016); Monteleone (2015); Tsai et al. (2017); Tscherisch (2015); Wang et al. (2013)	Djurica & Figl (2017); Forwood et al. (2015); French (2011); Schär & Stanoevska-Slabeva (2019); Schirrmacher et al. (2019); Stryja et al. (2017)	et al. (2019); Yevseyeva et al. (2014)
Social norms	Avineri (2012); Forwood et al. (2015); Kallbekken & Sælen (2013); Kooreman & Prast (2010); Lehner et al. (2016); Ölander & Thøgersen (2014); Auf der Landwehr et al. (2021); Qizibash (2012); Zhang et al. (2014)	Baskin et al. (2016); Holland (2015); Kooreman & Prast (2010); Kretzer & Maedche (2018); Laskowski (2015); Monteleone (2015); Qizibash (2012); Van Dalen & Henkens (2014); Woodend et al. (2015)	Barev et al. (2021); Gerber et al. (2017); Monteleone (2015); Zhang & Xu (2016)	Demarque et al. (2015); Djurica & Figl (2017); Forwood et al. (2015); Kallbekken & Sælen (2013); Kordyaka & Hribersek (2019); Schär & Stanoevska-Slabeva (2019); Zhang et al. (2014)	Yevseyeva et al. (2014)
Messenger effects	Czap et al. (2015); Kretzer & Maedche (2018); Thomas et al. (2013)	Jacobsen (2015); Marteau et al. (2011); Oullier & Sauneron (2010); Sengupta et al. (2020); Sunstein (2018)	Balebako & Cranor (2014); Gerber et al. (2017); Knijnenburg et al. (2013); Tsai et al. (2011); Tsai et al. (2017); Wang et al. (2013); Wang et al. (2014)	Schirrmacher et al. (2019)	Knijnenburg et al. (2013); Rodriguez et al. (2019); Thomas et al. (2013)
Priming	Auf der Landwehr et al. (2021); Chang et al. (2016); Chen et al. (2018); Henkel et al. (2019); Jacobsen (2015); Momsen & Stoerk (2014); Stryja et al. (2017); Zhang et al. (2014)	Bockstedt et al. (2013)	Balebako & Cranor (2014); Tschersich (2015); Tsai et al. (2017); Wang et al. (2013); Wang et al. (2014)	Chang et al. (2016); Schär & Stanoevska-Slabeva (2019); Stryja et al. (2017); Zhang et al. (2014)	Knijnenburg & Kobsa (2014); Marteau et al. (2011)
Loss aversion	Alemanno & Spina (2014); Auf der Landwehr et al. (2021); Avineri (2012); Bertsimas & O'Hair (2013); Bull (2012); Hilton et al. (2014); Jung & Jeong (2011);		Gerber et al. (2017)	Jones et al. (2015); Schär & Stanoevska-Slabeva (2019); Tasoff & Letzler (2014)	Bertsimas & O'Hair (2013); Yevseyeva et al. (2014)

Context Form	Societal-related	Health-related	Privacy-related	Revenue-related	Work-related
	Kretzer & Maedche (2018); Ölander & Thøgersen (2014)				
Hyperbolic discounting	Auf der Landwehr et al. (2021); Gruene-Yanoff & Hertwig (2016); Ratner et al. (2008); Thomas et al. (2013); Zhang et al. (2014)	Grand (2008); Woodend et al. (2015)	Wang et al. (2014); Wang et al. (2013)	Ratner et al. (2008); Zhang et al. (2014)	Thomas et al. (2013); Yevseyeva et al. (2014)
Anchoring	Auf der Landwehr et al. (2021); Cioffi et al. (2015); Jung & Jeong (2011); Ölander & Thøgersen (2014); Székely et al. (2016)	Oullier & Sauneron (2010)	Bergram et al. (2020); Tschersich (2015)	French (2011); Schär & Stanoevska-Slabeva (2019)	
Simplification	Kretzer & Maedche (2018); Momsen & Stoerk (2014); Thomas et al. (2013)	Oullier & Sauneron (2010)	Balebako & Cranor (2014); Thomas et al. (2013)		Boskovic-Pavkovic et al. (2019); Rodriguez et al. (2019); Thomas et al. (2013)
Decoupling	Aineri (2012); Auf der Landwehr et al. (2021); Czap et al. (2015); Kattelmann et al. (2014); Ratner et al. (2008)	Kattelmann et al. (2014)		Ratner et al. (2008)	Yevseyeva et al. (2014)

Table A.3. Ending Conditions of the Taxonomy of Digital Nudging

	Ending Conditions	Description	Application in this Study
Objective	No new dimensions or characteristics were merged or split in the last iteration.	-	✓
	No new dimensions or characteristics were added in the last iteration.	-	✓
	Every dimension is unique and not repeated.	-	✓
Subjective	The taxonomy of digital nudging is concise.	Focus on the most relevant dimensions and characteristics.	The Taxonomy of digital nudging is based on four dimensions and 20 characteristics.
	The taxonomy of digital nudging is robust.	Objects can be clearly distinguished from each other based on dimensions and characteristics.	The Taxonomy of digital nudging allows for a clear differentiation of digital nudges, confirmed by 14 experts (seven practitioners and seven researchers) during a demonstration of the application.
	The taxonomy of digital nudging is comprehensive.	The taxonomy is developed conceptually and tested.	14 experts (seven practitioners and seven researchers) confirmed the comprehensiveness of the taxonomy of digital nudging.

Table A.4. Questions to Evaluate the Taxonomy of Digital Nudging

Construct	Item	Mean	SD
Perceived Usefulness (Davis, 1989)	The taxonomy of digital nudging enables me to classify digital nudges more quickly.	6.2	0.63
	Using the taxonomy of digital nudging enhances my effectiveness in classifying digital nudges.	6.0	0.94
	Using the taxonomy of digital nudging makes it easier to classify digital nudges.	6.6	0.70
	The taxonomy of digital nudging is helpful for classifying digital nudges.	6.5	0.71
Perceived Ease of Use (Davis, 1989)	Learning how to use the taxonomy of digital nudging was easy for me.	5.6	1.73
	It is easy to assign a characteristic to a digital nudge.	4.8	1.14
	The description of the taxonomy of digital nudging is clear and understandable.	5.8	0.79
	The taxonomy of digital nudging is flexible in applying it to different digital nudges.	6.2	0.92
	It was easy for me to become skillful in using the taxonomy of digital nudging.	5.9	0.99
	The taxonomy of digital nudging is easy to use.	5.4	0.84
Expectation (Nickerson et al., 2013)	The taxonomy of digital nudging fulfills my expectations.	6.3	0.48
Comprehensiveness (Nickerson et al., 2013)	The taxonomy of digital nudging enables a complete description of digital nudges using the same set of dimensions.	6.0	0.81
Extensiveness (Nickerson et al., 2013)	The taxonomy of digital nudging is sufficiently extensive.	6.2	0.79
Robustness (Nickerson et al., 2013)	Digital nudges can be clearly distinguished from each other based on the dimensions and characteristics of the taxonomy of digital nudging.	5.5	0.85
Extendibility (Nickerson et al., 2013)	The taxonomy of digital nudging would allow for the inclusion of additional dimensions and characteristics when new types of objects appear in the future.	6.3	0.72
Practical Relevance	As a user interface designer, the taxonomy of digital nudging would support me in selecting appropriate digital nudges for my goals from an existing portfolio.	6.6	0.52
	As a user interface designer, the taxonomy of digital nudging would inspire me to develop appropriate digital nudges.	6.7	0.67
	The taxonomy of digital nudging enables me to classify digital nudges more quickly.	6.2	0.63
Answered on a 7-point Likert scale from 1 = strongly agree to 7 = strongly			