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THE DINU-MODEL – A PROCESS MODEL FOR THE DESIGN OF NUDGES

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THE DINU-MODEL – A PROCESS MODEL FOR THE DESIGN OF NUDGES

Research in Progress

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Abstract

The sociotechnical paradigm legitimates our discipline and serves as core identity of IS. In this study, we want to focus on IS-induced human behavior by introducing a process model for nudging in IS. In behavioral economics, the concept of nudging has been proposed, which makes use of human cognitive processes and can direct people to an intended behavior. In computer science, the concept of persuasion has evolved with similar goals. Both concepts, nudging and persuasion, can contribute to IS research and may help to explain and steer user behavior in information systems. We aim for an integration of both concepts into one digital nudging process model, making it usable and accessible. We analyzed literature on nudging and persuasion and derived different steps, requirements, and nudging elements. The developed process model aims at enabling researchers and practitioners to design nudges in e.g. software systems but may also contribute to other areas like IT governance. Though the evaluation part of our study has not yet been completed, we present the current state of the process model enabling more research in this area.

Keywords: Digital Nudging, Nudge, Persuasion, Behavior, Change

1 Introduction

The Information Systems (IS) discipline is a research field, which draws upon challenges and problems originating in organizations using information technology. Much of the discipline and its theories are based on the sociotechnical paradigm, indicating the need to analyze human and technical factors in the organizational context (Sarker et al., 2013). The sociotechnical paradigm legitimates our discipline in comparison to computer science and serves as core identity of IS (Benbasat and Zmud, 2003). In this study, we want to focus on the humans' role in IS research and design by introducing a process model for 'nudging' in IS. In 2009, behavioral economics Thaler and Sunstein have proposed nudging as a concept of influencing human behavior, which is based on social-psychological and cognitive theories. They define nudging as "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, 2009, p. 6). However, nudging goes beyond identifying patterns of behavior. It also constitutes a new view on influencing people's behavior for their own good. The founding fathers of nudging and of the related libertarian paternalism, which is a liberty preserving form of paternalism, show how nudges can be useful in many parts of human life to overcome biases and flawed thinking (Thaler and Sunstein, 2003). Recently, the concept of nudging has also been introduced in a *Business & Information Systems Engineering* catchword as *digital nudging* revealing a

high potential for IS research and society e.g. in the fields of e-health, e-commerce or business process management (Weinmann et al., 2016).

In computer science, the concepts of *persuasion* and *persuasive technology* evolved around the turn of the millennium and were mainly coined by B. J. Fogg (2003). He defined persuasion as “an attempt to change attitudes or behaviors or both (without using coercion or deception)” (Fogg, 2003, p. 15). As previous studies suggest, both nudging and persuasion are comparable as they aim at influencing people to perform a target behavior (Oinas-Kukkonen, 2013). However, the concepts have been developed individually in different disciplines with partially different goals. Nudging has its roots in economics and aims at preserving liberty whereas persuasion does not strictly prescribe what is allowed and what not, and focuses on a technically enabled influence. We question whether nudging can learn from persuasion and vice versa, and whether it can in combination provide the highest value for designers of decision situations. In information systems, decision situations include first and foremost user interfaces of software or web pages (Weinmann et al., 2016). However, nudging can also contribute to further areas of information systems research e.g. IT adoption and governance (Larosiliere et al., 2015; Stieglitz et al., 2013). We use the term *digital nudging* to emphasize on the digital environment. Digital nudging and our paper may help to (1) explain certain behavior patterns in information systems and (2) provide solutions for unfavorable behavior. Following the call of Weinmann et al. (2016, p. 435) to “engage in research on digital nudging”, we argue that both concepts, nudging and persuasion, need to be compared and integrated thoroughly. Up to now, there exists no overview of the diverse nudging elements, including guidance when and how to use those. In persuasion, models have been developed that better operationalize the target of changing behavior but with less design options as in nudging (Fogg, 2009). We want to close this gap by developing an application-oriented “digital nudging process model” (DINU Model) based on a systematic literature review and evaluated and improved with experts. Thereby, behavior change elements from both streams that are applicable in a digital environment and that meet nudging’s strict conditions are presented and processed for the design of digital nudges. The article is guided by the research question: *How can nudging and persuasion be combined to enable a digital nudging process model for behavior change in information systems?*

This paper is structured as follows. In section 2, we start with the theoretical background of nudging and persuasion. In section 3, we describe our research method in detail. Based on the literature analysis the process model is developed in section 4. The paper ends with a conclusion and outlook to further research in section 5.

2 Theoretical Background

In 2009, Thaler and Sunstein’s book “Nudge” made a starting point for the concept of nudging as a subject of research in behavioral economics. Their concept builds on the assumption that decisions are made in choice architectures that are designed by choice architects (Thaler and Sunstein, 2009). They argue that no design of a choice architecture is neutral as it always influences people in some way. Consequently, the concept of nudging assumes that the choice architecture can be altered in a way that makes a desired output or decision more likely. The behavior is predictable due to cognitive biases that the choice architect can use. In this context, Daniel Kahneman speaks of system 1, which operates automatically, unconsciously and unreflectively, and system 2 that evaluates consequences in detail but requires much more cognitive capacity (Kahneman, 2011). Nudges make either use of the unreflective thinking, or trigger the reflective system for decisions that were otherwise made unconsciously (Thaler and Sunstein, 2009). It is further stated that the alteration of the choice architecture is justifiable only if it is to the decision-makers own good and only if it remains a free decision without any coercion. Thaler and Sunstein (2003) call this concept *libertarian paternalism*, a liberty-preserving soft form of paternalism. In this sense nudging is understood as “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, 2009, p. 6). However,

researchers challenged the lack of intentionality (Hansen and Jespersen, 2013) and the missing goal, i.e. to benefit the decision-maker (Hausman and Welch, 2010). Even though literature on nudging often names the government and policy-makers as those who can design and use nudges (e.g. in crisis situations: Mirbabaie et al., 2014; Stieglitz et al., 2017), companies may also integrate the idea of libertarian paternalism into their marketing ethics by putting their customers’ or employees’ wellbeing first (Goldin, 2015; Grüne-Yanoff and Hertwig, 2016; Meske et al., 2016; Room, 2016).

In IS and computer science, and especially in the field of human-computer interaction (HCI), the idea of persuasion is not completely new. Research with a focus on using design elements to influence behavior began around the turn of the millennium. Two famous approaches were selected to gain insight into persuasion: the Fogg Behavioral Model (FBM) (Fogg, 2009) and the Persuasive Systems Design (Oinas-Kukkonen and Harjumaa, 2009). In their sense, persuasion is a form of human communication that is aimed at influencing autonomous judgements and actions of others. Fogg defined “persuasive technology as any interactive computing system designed to change people’s attitudes or behaviors.” (Fogg, 2003, p. 1) The similarity to nudging is also evident in the exclusion of coercion or deception (Fogg, 2003, p. 15). Still, persuasive technology is often understood as IT artefacts exclusively designed to change behavior (e.g. software visualizing accelerated aging for smokers). It does not primarily address the implementation of persuasive elements in established information systems e.g. to enhance privacy or increase interaction. In Table 1, we exemplarily structured the understandings of nudging and persuasive technology to see similarities and differences.

Term	Artefact	Realm	Action	Aim	Target	Predictability	Limitation	Source
Nudging 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, 2009)
Persuasive technology is	any interactive computing system		designed	to change	people's attitudes or behaviors		without using coercion or deception	(Fogg, 2003)

Table 1. Similarities and differences between nudging’s and persuasion’s understanding

Nevertheless, Fogg has provided a model that goes beyond nudging in terms of operationalization. The FBM foresees three requirements that have to occur simultaneously to facilitate behavior change in the targeted audience: motivational state, the ability of a person to perform the targeted behavior, and the presence of an effective trigger (Fogg, 2009). These aspects of persuasion have not yet been considered in nudging as current nudging tools do not consider the timing of a nudge, the decision-maker’s motivation or her ability to attend to the nudge. On the other hand, the emergence of nudging has given rise to debates about ethics since it may constitute a subtle form of manipulation depending on the kind of nudge (Campbell et al., 2014; Hansen and Jespersen, 2013). This differentiates nudging from persuasion which does not really know such debates. Although the ethical discussions has not yet achieved a consensus, we follow Thomas et al. (2013) saying manipulation is seldom subtle and, therefore, nudging cannot be mistaken for manipulation. Even though we perceive such topics as important, in this work we do not deepen ethical discussions but focus on the methodology of nudging.

Digital nudging has been introduced as “the use of user-interface design elements to guide people’s behavior in digital choice environments” (Weinmann et al., 2016, p. 1). However, this definition does not reflect the importance of a free decision without coercion or a fundamental change of options and the subtle mode of action. Further, nudges are not necessarily limited to the design of user-interfaces only, since the form and content of information or messages can also represent a nudge. Hence, we define digital nudging as 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.*

3 Method

3.1 Literature analysis and process model

To develop the DINU Model, we analyzed literature on nudging, persuasion and persuasive technology. We organized the literature search based on the framework by vom Brocke et al. (2009). In combination with the taxonomy for literature reviews by Cooper (1988) we were able to align the depth of the search to the goal and target group (see Figure 1). Considering Cooper’s characteristics, we focus on *applications* of nudging and similar concepts. The goal of the literature analysis is the *integration* of nudging, persuasion and potential further concepts in the form of a process model. The literature is organized *conceptually*. Our perspective on the literature is not completely neutral as we selected those works and parts that could be used for the process model based on our prior knowledge. The audience are *general scholars* as nudging can be implemented and, thus, researched in many areas as well as *practitioners/politicians* who can use the process model to design and implement nudges in real world. We choose to include a *representative* volume of research papers in our analysis because contents and, especially, nudging elements are often mentioned redundantly so that the representative volume contributed most to the combination.

Characteristic		Categories			
(1)	focus	research outcomes	research methods	theories	applications
(2)	goal	integration		criticism	central issues
(3)	organization	historical	conceptual		methodological
(4)	perspective	neutral representation		espousal of position	
(5)	audience	specialized scholars	general scholars	practitioners/politicians	general public
(6)	coverage	exhaustive	exhaustive and selective	representative	central/pivotal

Figure 1. Taxonomy of literature reviews (Cooper, 1988); visualization (vom Brocke et al., 2009)

The first phase of the literature review involved articles referring to *nudging* or *nudge* in an explorative search with the databases AISEL, IEEE, Scopus and Google Scholar. The primary objective was to test the terms for other meanings. In fact, we found different meanings of nudging e.g. in geology. Adding the keywords *prevention*, *behavio(u)r change* or *policy* in combination with *nudg** limited the results to the intended meaning. *Persuasive technology* was also searched in combination with the additional terms *prevention*, *behavio(u)r change* or *policy*. For *persuasion* we started with literature of B. J. Fogg (e.g. Fogg, 2003) as it is otherwise difficult to demarcate the term *persuasion*. We performed backward and forward searches for all identified works. We carefully selected a representative set of articles to include those works that describe different elements or applied nudging and persuasion in different settings. We decided to mainly exclude ethical essays and opinions in this analysis. We analyzed 30 papers in detail focusing on (1) elements and strategies of nudging and similar concepts, (2) success factors and (3) examples (see Tables 2 and 3). To develop the DINU Model we compared the approaches and grouped similar nudging elements iteratively. We further differentiated between preparatory work, the main design of the nudge, and evaluative tasks.

3.2 Model evaluation (in progress)

Since we combine results from mainly independent streams of research into one newly created model, it needs a thorough evaluation with the intended target group e.g. software or process designers who try to direct people to a certain behavior. For this purpose, we adapted the generic evaluation process model by Stockmann and Meyer (2014). This model defines three phases in an evaluation project: (1) *Planning*, (2) *Execution*, and (3) *Exploitation*. The model is supplemented by the Framework for Evaluation in Design Science Research (FEDS) (Venable et al., 2014). Though the framework depicts

strategies for Design Science Research (DSR), it provides theoretical underpinnings for the evaluation of the DINU Model as well. At the current state, we have started to plan the evaluation regarding the first phase of the evaluation process. This phase entails the tasks (1.1) *Determining and restricting the evaluation project* and (1.2) *Developing the evaluation concept and scheduling*. In the following we will briefly go through some steps that describe the intended evaluation project. Subject of evaluation will be the derived DINU Model. With the FEDS, evaluations can be distinguished according to two dimensions: functional purpose and paradigm of the evaluation study (Venable et al., 2014). We understand our evaluation as *summative* for the first dimension because it should assess how well the result match expectations (William and Black, 1996). As we have carefully developed and iteratively improved the DINU Model based on prior literature, the next step is a *naturalistic evaluation* i.e. in real world with empirical data (Venable et al., 2014). In sum, the goal is to legitimate the accomplished work by proving the applicability and efficacy of the DINU Model (Stockmann and Meyer, 2014). We propose and aim at testing the hypothesis that the DINU Model allows an easier access and design of nudging in information systems.

The evaluation is planned as an internal evaluation project with relevant external stakeholder who were not involved in the model development (Stockmann and Meyer, 2014). They will be selected due to their interest and expertise in designing decision situations in the field of information systems, which is not limited to software architects but may also involve consultants accompanying the introduction of software. Further, we see high relevance in the avoidance of regretful behavior e.g. self-disclosure in social media (Binns, 2014; Weinmann et al., 2016). Therefore, we will involve experts from this field as well. Specifically, we plan to conduct seven to ten semi-structured interviews with closed and open questions. The participants will see the DINU Model for the first time. Questions will be framed around the perceived value and usability of the model and its smaller parts in relation to what the participants have used or known before. They are also invited to recommend changes and supplements based on their expertise. The main goals of the evaluation are, hence, to prove whether the experts understand all parts of the model and to identify areas that need improvement from the application perspective.

4 Preliminary Results: The DINU Model

Combining the ideas and elements identified in the literature analysis we created a three-phase process model to access the nudging environment in a structured manner and provide an easier access to digital nudging for practitioners and researchers. We separate the digital nudging into the three phases (1) **Analyzing**, (2) **Designing**, and (3) **Evaluating** including a feedback loop. The whole model is shown as a summarizing Figure 2 after the following explanations. We use the terms *nudger* for *choice architect*, i.e. the person using the model to design the decision situation, and *nudgee* for the *decision-maker*, e.g. the software user, as those labels can be seen exclusive in the context of (digital) nudging.

4.1 Analyzing

First, while collecting and analyzing requirements, the nudger should develop a target behavior for a defined *target audience* (Fogg, 2009). She needs to analyze the nudgee in detail to assess *reasons* of undesired behavior (e.g. limited cognitive capacity) and consequently *goals* for digital nudging (e.g. overcoming flaws). Usually, there are goals like increased productivity which should be achieved through smaller goals like restoring the intended use. The preference analysis and the focus on welfare are topics in the field of behavioral economics (Goldin, 2015; Grüne-Yanoff and Hertwig, 2016) that distinguish nudging from persuasion and should apply for digital nudging as well.

4.2 Designing

The design phase is about finding the right elements and situations to design the digital nudge according to the pre-defined reasons, goals and characteristics of the nudger. We identified most elements in nudging literature but also combined and added further components from persuasion. Additionally, we collected considerations that can improve the element selection and, thus, the success of the digital nudge. The following Table 2 contains the identified and grouped digital nudging elements from the literature analysis. Some elements are similar but have not been combined due to important differences. E.g. customized information focus on the tailoring of information whereas informing means providing (additional) information in general. In literature, different elements are often combined and applied simultaneously or successively. We include only those elements that meet the suggested definition of nudging i.e. they need to be subtle enough and do not alter the choice set. Table 2 distinguishes between sources that were identified in the nudge context and those related to persuasion. Sources that are published in IS or computer science outlets but mention *nudging* were grouped in the left column as this should highlight the prevalent wording or understanding and not the discipline. The same applies to Table 3.

Nudging Element	Related to Nudging	Related to Persuasion
Anchoring	(French, 2011; Oullier et al., 2010; Thaler and Sunstein, 2009)	
Customized information (Tailoring)	(Johnson et al., 2012)	(Consolvo et al., 2006; Oinas-Kukkonen and Harjumaa, 2009)
Decision staging (Tunneling)	(Johnson et al., 2012)	(Oinas-Kukkonen and Harjumaa, 2009)
Default setting	(Acquisti, 2009; French, 2011; Grüne-Yanoff and Hertwig, 2016; Hausman and Welch, 2010; Van der Heijden and Kusters, 2015; Johnson et al., 2012; Knijnenburg and Kobsa, 2014; Marteau et al., 2011; Oullier et al., 2010; Sunstein, 2014a; Thaler and Sunstein, 2009)	
Framing	(Acquisti, 2009; French, 2011; Grüne-Yanoff and Hertwig, 2016; Johnson et al., 2012; Lehner et al., 2016; Luoto et al., 2014; Oullier et al., 2010; Thaler and Sunstein, 2009; Thomas et al., 2013; Wang et al., 2014; Wilkinson, 2013; Zhang and Xu, 2016)	
Informing	(Blitstein et al., 2016; Evans et al., 2014; French, 2011; Marteau et al., 2011; Newell and Siikamäki, 2013; Oullier et al., 2010; Sunstein, 2014b; Wilkinson, 2013)	
Limited time window	(Johnson et al., 2012)	
Praise and reward (Gamification)		(Sohn and Lee, 2007; Toscos et al., 2006)
Precommitment strategy	(Lades, 2014; Luoto et al., 2014; Sunstein, 2014b; Thaler and Sunstein, 2009)	
Priming	(Balebako and Cranor, 2014; Sunstein, 2014b; Thaler and Sunstein, 2009)	
Reminders	(Sunstein, 2014b)	(Lee et al., 2006; Oinas-Kukkonen and Harjumaa, 2009)
Simplification (Reduction)	(Balebako and Cranor, 2014; Johnson et al., 2012; Lehner et al., 2016; Oullier et al., 2010; Sunstein,	(Lee et al., 2006)

	2014b; Thaler and Sunstein, 2009)	
Social influence (Social comparison)	(French, 2011; Sunstein, 2014b; Thaler and Sunstein, 2009; Zhang and Xu, 2016)	(Consolvo et al., 2006; Oinas-Kukkonen and Harjumaa, 2009; Sohn and Lee, 2007)
Warning	(Balebako and Cranor, 2014; Oullier et al., 2010; Sunstein, 2014b; Thaler and Sunstein, 2009)	

Table 2. Overview of Nudging Elements

Explaining all elements in detail would go beyond the scope of this paper (however, the table provides an overview about relevant literature for each element). Hence, we will introduce some potentially new elements or those that are interpreted slightly differently than in persuasion. While the choice set should remain unchanged in nudging (i.e. it is not allowed to disperse an undesirable option), a simplification of the choice architecture can be a helpful digital nudge (Balebako and Cranor, 2014; Sunstein, 2014b). In persuasion, the strategy of reduction is similar but it is not excluded to omit options (Oinas-Kukkonen and Harjumaa, 2009). We argue that simplification contributes to digital nudging as long it only refers to a simplification of the decision environment by reducing distractions but not the options. IT can support people when confronted with too many alternatives (Johnson et al., 2012). Visual markers can be a simple orientation (Oullier et al., 2010). To simplify and make the target behavior easier to do, one might also decrease cost and burdens (Fogg, 2009; Thaler and Sunstein, 2009). Johnson et al. (2012) propose the idea of giving a limited time window for certain decision that are often hindered by procrastination and inertia. This can be considered a digital nudge if the decisions can be changed afterwards. Lastly, nudgers can make use of praise and rewards (e.g. verbal feedback or badges) which can act as a subtle form reinforcement. Though it sounds like gamification the latter is neither subtle nor does it leave incentives unchanged (Meske et al., 2015). It can be seen as a tool to increase motivation, though (Wu, 2014).

Besides the nudging elements we have found hints and strategies in the literature which we deem helpful in selecting the right digital nudging elements summarized in Table 3 as considerations. Johnson et al. (2012) describe problems that arise in decision environments and certain choice sets that require specific changes in the choice architecture. Therefore, studying the decision environment before the intervention may directly point to problems (e.g. attribute overload). Though flawed thinking often explains undesired behavior it can also be used to digitally nudge people to the intended behavior if the flaws or cognitive shortcuts are known to the nudger (French, 2011; Oullier et al., 2010; Thaler and Sunstein, 2009).

Consideration	Related to Nudging	Related to Persuasion
Ability (Money, physical effort, etc.)		(Fogg, 2009)
Context	(Campbell et al., 2014)	
Credibility		(Oinas-Kukkonen and Harjumaa, 2009)
Motivation		(Fogg, 2009)
Possibility of using human flaws	(French, 2011; Oullier et al., 2010; Thaler and Sunstein, 2009)	
Problems with given choice architecture	(Johnson et al., 2012)	
Triggers		(Fogg, 2009)

Table 3. Overview of Considerations

4.3 Evaluating

The DINU Model's last step comprises the evaluation of the designed digital nudge after implementation. Primarily, it should be assessed whether the target behavior is achieved or modifications of the digital nudge have become necessary. The nudger may also use this step to reflect on the selected elements. They might have been designed without the intention to confine the nudgee

in her freedom of choice. Still, unexpected factors can change the decision situation. The complete DINU Model is displayed in Figure 2, in which the process flow is visualized. Further, the mentioned aspects for each phase are linked to the respective phases.

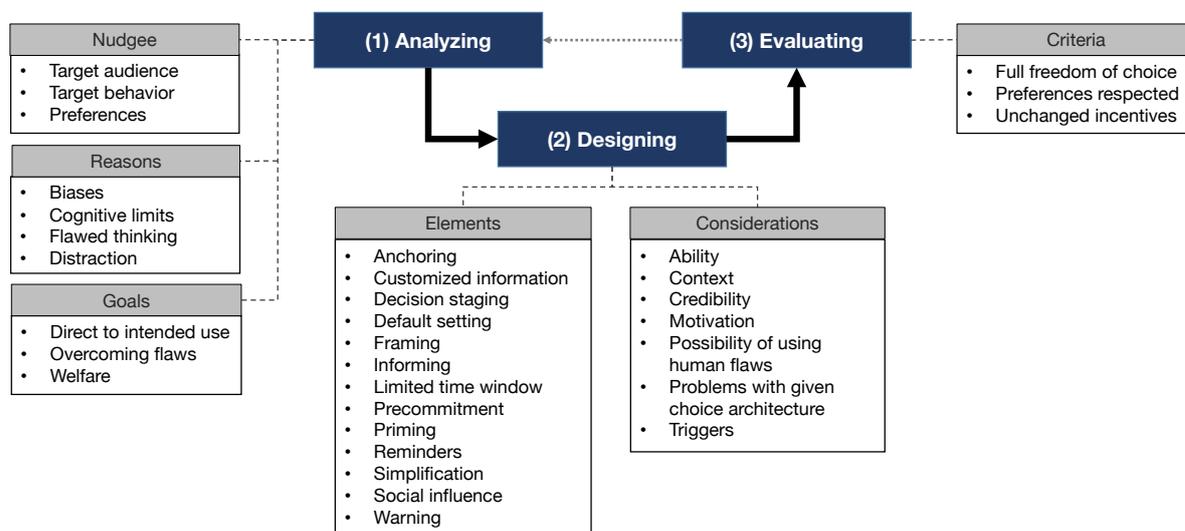


Figure 2. Digital Nudging Process Model (DINU Model)

5 Conclusion

First, in this paper we presented the results and implications of a literature analysis in the fields of nudging and persuasion. Second, we developed and described a digital nudging process model (DINU Model). With this model, we aim to provide a tool for the application of digital nudging in the IS field and to support choice architects in the utilization of nudging elements.

Though we argue that our literature analysis with a representative sample is valuable for the implementation, this approach is limited in terms of completeness. Further, the literature search on *persuasion* appeared problematic due to its multiple meanings. Hence, other corresponding articles may not be included, also due to the selected search databases. In this paper, we have not yet discussed ethical and moral concerns about digital nudging in detail, which is of high importance but should be studied separately. For now, we refer to the discussion paper of Hansen and Jespersen (2013) and call for future research about the ethical implications of digital nudging.

The important next steps for this research in progress have been presented and comprise the evaluation and potential adjustment of the DINU Model for nudging with potential users in real-world settings. The evaluation is based on an evaluation process model and an evaluation framework for DSR.

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