



DESIGN ELEMENTS OF DIGITAL NUDGES
AND EFFECTS ON CONSUMER BEHAVIOR:
A LITERATURE REVIEW

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List of Abbreviations

AIS	Area of Information Systems
CCH	Consumer Choice
EDU	Education
FIN	Finance
GOV	Government
HEA	Health
Lab	Laboratory
MISC	Miscellaneous
PSB	Pro-social Behavior
SCP	Security and Privacy
SUS	Sustainability
TRA	Transportation
UI	User Interface
UT	University of Texas
UX	User Experience
VHB	Verband der Hochschullehrer für Betriebswirtschaft

Abstract

1 Introduction

It is a typical Sunday afternoon. John is sitting on the couch, watching the match of his favorite soccer club on TV. On his lap, he is holding his tablet while browsing the internet. John is looking for a good travel deal for his upcoming trip to Bali with his girlfriend. On a news site, a prominent and bright advertisement catches his attention: *Booking.com - From cozy country homes to funky city apartments*. That is precisely what John is looking for. He clicks the link and finds himself on a website full of amazing images of traveling people. Moreover, there is a search field, too. John enters his dream-destination, the travel time and clicks on "search." After some seconds a list of hotels shows up. The first one catches his eyes. A beautiful beach, a nice pool and cozy, big bedrooms. Perfect. He clicks on the details. However, John is starting to become nervous. A bright, red piece of information is saying to him that this room has been booked three times in the last twelve hours. Also, there are only seven rooms left! His heart beats faster. He needs to get that deal! John clicks on the reservation button. He just has been nudged¹.

Johnson et al. 2012 states that "what is chosen often depends on the representation." This representation describes as the term of choice architecture, which should "alter people's behavior in a predictable way" (Thaler and Sunstein 2009). In the age of digital transformation, digital environments are powerful tools where the choice architecture can be controlled in detail and therefore provide opportunities to influence user behavior in several ways with the help of user-interface design elements. This process is called "digital nudging" (Weinmann et al. 2016).

Digital nudging and the design of online choice architecture have recently gained interest in different research areas. Because of the complexity behind this concept, it is significant to understand how such nudges influence the decision-making of the user and how the cognitive biases behind this process are working. Especially in consumer choices, there are good and bad patterns of nudging when it comes to an ethical point of view (Sunstein 2015). To get a better understanding of how digital nudges influence consumer choice this paper presents a systematic literature review from the last ten years in a scientific manner.

The goals of this paper are two-folded. The primary aim is to provide an overview of different research streams within the topic of digital nudges. The paper focuses here on digital nudges in the area of consumer choice and their specific design elements. Litera-

¹A screenshot of the web page can be found in the appendix on figure 1

ture in this domain shall be gathered, reviewed and analyzed. Secondary, a recommendation for future research is derived from the analysis to advance research in this particular subject. Because of the multidisciplinary assortment of digital nudged, this paper contributes to several scientific domains. First of all, it is major implications for the area of information systems by showing areas with little research. Furthermore, the paper holds implications for the areas of marketing and consumer research as well as psychology and behavioral economics with regards to digital environments.

2 Conceptual Background

2.1 Birth of Nudges

With the release of the book "Nudge" in 2009, Thaler and Sunstein have laid the foundation stone for the concept of nudging. This concept was primarily a subject of research in behavioral economics. Because of the multifaceted meaning of the word *nudging*, a consistent understanding is essential. Further on, this paper uses the central definition of nudges from Thaler and Sunstein 2009:

"A nudge [...] is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives."

One central aspect of this definition is the economic incentive of the consumer, which should not be changed. This fundamental thought is the basis of a concept called *libertarian paternalism*. In this concept, choices are influenced in a way to make them easy for people and aligning them with their interests. One example of that would be "putting the fruit at eye level." However, banning the food would not be a nudge. (Thaler and Sunstein 2009). This principle is the foundation of nudges for a good reason. Influencing people's behavior can simply be exploited. So, the ethical viewpoint on nudges should always be kept in mind when implementing and using them to guide customer choices (Sunstein 2015).

The underlying foundation for nudging the cognitive limitation of human brains. Because the human brain only has a limited capacity to store and process information, the consumer often feels subconsciously overloaded. This results in greater difficulty and complexity when it comes to decisions and cognitively demanding tasks (Broniarczyk and Griffin 2014). Therefore "many decisions are based on beliefs concerning the likelihood of uncertain events (Tversky and Kahneman 1974). Based on this assumption Tversky and Kahneman 1974 formulated three heuristics and several biases that build the underlying foundation of human decision making. Those heuristics and biases can also be found acting as a guideline in the world of digital nudges.

Besides the cognitive foundation of decision making, also the principles of nudges play a major role in their application and implementation. Overall, there are five general principles of nudging (based on Thaler et al. 2010)

Incentive Those kinds of nudges aim to make incentives more salient to increase the effectiveness of the nudge. The focus lays on the motivation behind the decision. The nudge should always search for the right motivation for the right people. This motivation goes beyond monetary and material incentives.

Understanding mapping Making the consequence of a choice clear is an essential part of easing the decision-making. Mainly, this concerns complex information that is difficult to evaluate. For example, the number of megapixels of a camera. Frequently, customers cannot evaluate this information directly and only compare on a single number. A rational mapping would be to display the maximum printable size of a taken picture. This way, the product attribute can be compared efficiently.

Defaults The pre-selection of certain information has enormous power. By changing the default option, consumers are more likely to choose that near to the selected default or even is the default. One prominent example of such a nudge is the question if people want to consent to be an organ donor. Simply by changing the default option, in this case, can nearly double the percentage of organ donors (Johnson and Goldstein 2003).

Giving feedback By giving feedback during the decision-making, people can evaluate their performance and estimate the output or consequences of the decisions they face. Such an example can be found in an experiment for pre-ordering lunch in a school. Students arrange their lunch with different kind of foods. According to this arrangement they receive feedback about how balanced and healthy their food compilation is. Only based on this feedback, students selected significantly more fruits and vegetables in their meals (Miller et al. 2016).

Expecting error Precisely because of the underlying complexity of the decision-making process, it is necessary to expect errors to be made. Such errors should be taken into account when designing a decision, and the environment should be as forgiving as possible. In complex choice environments, such as the food of healthy and balanced food, many people make mistakes. By giving direct feedback on those errors and providing information on how to improve the performance, this decision can be made easier (Guthrie et al. 2015).

Structure complex choices Another difficult task in decision-making is to compare different product alternatives. By listing all attributes, people can evaluate trade-offs and make better decisions, based on their interests. In a field experiment, researchers evaluated the effect of such a nudge in a bar, when it comes to craft beer choice. By listing product more product attributes that naturally describe the taste, people could decide easier what they want to order (Malone and Lusk 2017).

2.2 (Online) Choice Architectures

The concept of nudges builds on the assumption that decisions are made in choice architectures, which are designed by choice architects (Thaler and Sunstein 2009). In this case, the parallel to a "real" architect of a building is not far-fetched. Johnson et al. 2012 describes the power of such choice architects and how choice architects guide people's choices like other architects guide behavior through the design of the "placement of doors, hallways, staircases, and bathrooms. Just like in a hotel or building, "there is no neutral architecture" (Johnson et al. 2012) for choices. Even small things like a default choice affect the decision which is made by the user. The mobile payment app Square, for example, nudges people into giving tips only by setting a default value. This way, customers actively must select a "no tipping" option if they do not want to give a tip (Weinmann et al. 2016). "Because advances in technology and the user of the Internet also provide new ways of finding, creating and exchanging information [...]" (Broniarczyk and Griffin 2014) people automatically shifted a majority of their decisions in the online or digital world. However, those digital environments are not less complex. Just like in offline environments, there is no neutral way to present choices. Therefore, any user interface can be viewed as a digital choice environment (Schneider et al. 2018). This ranges from the positioning of elements, the colors in the interface, the language, even the design elements themselves and beyond.

To get a better understanding of how such choice architectures can be built up and what elements are available, MÃnscher et al. 2016 created a taxonomy of choice architectures and their techniques. Overall, there are three major categories with several associated techniques.

Decision information The first level of choice architectures targets the "presentation of decision-relevant information" (MÃnscher et al. 2016). One important aspect is that

this category only includes the presentation and no altering of the options itself. Techniques for that choice architecture category are the translation of information, visibility of information and the providence of social reference points

Decision structure Secondly, choice architects directly modify the available options of choice itself. This includes techniques like choice defaults, the related effort and consequences of an option and also the range of composition and options.

Decision assistance Lastly, choices can be designed in a way that consumers follow their intentions. Techniques for such assistance can be the fostering of a commitment or by providing reminders of the preferred behavior.

2.3 Nudging became digital

Because various choices we take today "involve some form of information technology" (Johnson et al. 2012), the concept of nudging recently gains interest in research of different disciplines. Thereby, the underlying concepts of "offline" nudges are transferred and adapted in digital environments. The result is digital nudges. According to Weinmann et al. 2016 digital nudges are defined as follows:

Digital nudging is the use of user-interface design elements to guide people's behaviors in digital choice environments.

Just like in the offline and analog environments, digital environments face multiple sources of decision difficulty such as task complexity, information load, information uncertainty, conflicts, emotional difficulty and preference uncertainty (Broniarczyk and Griffin 2014). To face those challenges in digital environments, the use of cognitive heuristics and biases can act as a baseline to design digital nudges. Different user-interface design elements facilitate different nudges. Table 1 gives an overview of the different biases, in which way they influence decision-making and how those are translated to specific design elements.

Even though nudges aim to influence behavior in digital environments, they should not be mistaken with persuasion. A persuasion is instead a form of human communication, that is also used in technology. The goal of this technique is also to influence user behavior, but more persistently, so that underlying attitudes are influenced (Oinas-Kukkonen and Harjumaa 2009). Although both concepts share similarities, this paper solely focuses

Heuristic / Bias	Example Design elements and mechanisms
Status quo bias	<ul style="list-style-type: none"> - Radio buttons - Checkboxes - Dropdown menus - Sliders with default position - Pre-filled inputs
Decoy effect	Presentation of options in: <ul style="list-style-type: none"> - Radio buttons - Checkboxes - Dropdown menus
Primacy and recency effect	Positioning of elements (earlier or later)
Middle-option bias	<ul style="list-style-type: none"> - Addition of higher- and lower-price alternatives around the preferred option. - Ordering of alternatives. - Modification of the option scale.
Anchoring and adjustments	<ul style="list-style-type: none"> - Variation of slider endpoints. - Use of default slider position. - Predefined values in text boxes for quantities.
Norms (moral / social)	<ul style="list-style-type: none"> - Display of popularity (social norms). - Display of honesty codes (moral norms)
Scarcity effect	<ul style="list-style-type: none"> - Use of default slider position. - Language and displaying additional information about quantity and availability

Table 1: Heuristics and Design elements of digital nudges (based on Schneider et al. 2018)

on digital nudges and the decision-making process. An ongoing influence on underlying behavior is still possible, but not directly part of a nudge and therefore not further evaluated.

3 Methodology

This literature review follows a systematic approach, that is well-tried in the discipline of information systems (Webster and Watson 2002). Because of a limited time frame, this review was done in limited scope which means that it does not cover all papers and studies of the subject. Rather, this literature review targets a qualitative subset of literature and thereby tries to be as representative as possible. The focus lies on publications of academic journals. To get a qualitative representation of the current research a journal-wise analysis is preferable to a database-based analysis. The overall approach follows a known pattern in information systems literature reviews (Alavi and Carlson 1992).

1. Identifying, reviewing and analyzing existing literature in the field of digital nudges. This includes empirical, as well as non-empirical studies
2. Identifying theoretical and methodological approaches used to understand the use of nudges in consumer choice. This also includes the type of choices and the designed choice architecture.
3. Identifying a research gap within existing literature to guide future research.

To facilitate this strategy, several variables are necessary to consider. Because the underlying multidisciplinary of digital nudges it is was not feasible to analyze all articles. Digital nudging is a concept that spans across several fields of research. Those variables are set journal- and paper-wise. A graphic of the screening process is available in the appendix (2).

3.1 Journal selection

Journal-wise variables are the journal domain and its rating. As suggested in existing literature, it is reasonable to not only look within the field of information systems research but also outside (Webster and Watson 2002). It is reasonable to examine academic journals with the most influence in the research domain. As already mentioned, nudging is a subject of several research streams. This includes research from the area of information systems, management, marketing, behavioral economics, and psychology. Regarding research about information systems the *AIS Basket of 8* provides a good source (Alavi and Carlson 1992). This basket consists out of eight well-respected journals in the domain.

After the AIS scholarly basket, academic journals about management and marketing were recorded in the research process. Thereby, the journal list of the *UT Dallas* was taken as a reference point. Duplicate journals from the lists of the AIS scholarly basket and the UT Dallas were eliminated and only analyzed ones. Overall the journal list of the UT Dallas contributes with twelve journals to the research pool. To gain further insights into the concept of nudges, academic journals from the domains of behavioral economics, decision making and psychology (with regards to human decision making) are included in the research process. The relevant publications are identified by the *VHB* journal rating *JOURQUAL*³. Journals with a rating of *B* or better are taken into account for the research. To finalize the list of sources for the upcoming analysis, conference publication from the AIS pool with a *VHB* rating of *B* or better were included, too. In total 36 journals were examined. A complete list of these journals can be found in the appendix.

3.2 Paper selection

Paper-wise, only articles with more than two pages and a publication date older than 2010 are concerned. This date is set because nudging is a rather new concept that was first introduced under this definition in 2009 (Thaler and Sunstein 2009). To obtain relevant articles, a keyword-based search is conducted. The major keywords in this search are *nudg* AND digital*. A full-text search searches all journals. Because the term nudging is not always directly mentioned in the articles, additional keywords are added to the search query if the examined journal does not provide any necessary results with regards to their keyword *nudg**. Those additional keywords are *decision, choice, consumer*. Overall 87 journal articles were found that mentioned the term nudge or matched the described keywords. To extract the most relevant sources, articles were excluded to based on several criteria. This concerns journal papers that only embody offline nudges. Such articles were excluded from the final article list, as well as articles that focus on the topic of persuasion and long-term behavior change. In the end, 37 articles are evaluated in the final concept matrix. The complete list of articles is available in the appendix.

³more information under <https://vhbonline.org/vhb4you/jourqual/vhb-jourqual-3/gesamtliste/>

3.3 Analysis approach

To guide the analysis, the research takes several questions into account. The structure of those questions is based on prior literature research (Alavi and Carlson 1992).

- What is the type of choice?
- What is the research approach?
- What major theories, concepts, heuristics, and biases are used to study the effect of the evaluated nudge and how is the choice guided?
- What part of the choice architecture is influenced?

Concerning the in-depth analysis, the extracted articles are coded in a concept matrix. To answer the underlying research questions, different categories of the relevant articles are inspected. Those categories are

- General research information and metadata
- Influence on choice architecture
- Underlying concepts and theories

A complete version of the coding and concept matrix is available in the appendix.

4 Results

4.1 Overall research output

Since the release of the "Nudge" by Thaler and Sunstein in 2009, the concept of nudges gained more and more interest in several research streams and domains. Table 2 gives an overview of the overall research output. To get a better overview, the domain names are coded with abbreviations. The complete coding of the domain names is available in the appendix in table 8 as well as in the abbreviation section.

Considering the amount published articles, the overall research output increased since 2011. Especially in the last five years the research has gained interest. On the one hand this can be explained by the increased adoption and knowledge of nudging. On the other hand there are also more possibilities where digital nudges can be used. More and more domains face the digitization. This leads to an expansion of digital applications and their adoption. Digital nudges also gained awareness in across several domains. Thereby, the main research within the last ten years is done in the area of consumer choice. Here a digital environment builds a typical buyer / seller relationship, where the application offers some kind of good or service and the user takes the role of the consumer / buyer. One explanation for that is the economic interest behind the concept of nudging. If done right digital nudges are a good tool to increase conversion rates and overall revenue. But the interest in digital nudging also spans across other domains. Especially complex domain, where typically some form of expert knowledge is needed in decision-making. Such an example is the health domain, where five of the overall 37 research articles evaluate the usage of digital nudges. Miller et al. 2016 study the effect of digital nudges within the MyPlate food recommendation systems. Through a feedback nudge during the pre-ordering process they discover a significant positive effect on the meal composition of students. "Students who received the MyPlate nudge while pre-ordering selected statistically significantly more fruits, vegetables, and low-fat milk than students who pre-ordered without nudging" Miller et al. 2016. Another example of such a digital nudge in a complex field describes Székely and Weinmann 2016. With a nudge in a default choice the amount of carbon offset payments could be increased significantly. Finally this leads to an environment friendly decision.

Publishing year	CCH	EDU	FIN	HEA	PSB	SUS	TRA	SCP	GOV	MISC
2011 (1)	1	0	0	0	0	0	0	0	0	0
2012 (1)	0	0	0	0	0	0	0	0	0	1
2013 (0)	0	0	0	0	0	0	0	0	0	0
2014 (5)	4	0	0	0	0	0	1	0	0	0
2015 (3)	0	0	1	2	0	0	0	0	0	0
2016 (7)	3	0	0	1	1	1	0	1	0	0
2017 (10)	6	0	0	0	2	1	0	1	0	0
2018 (9)	5	0	0	1	0	1	0	1	0	1
2019 (1)	1	0	0	0	0	0	0	0	0	0
Total (37)	20	0	1	4	3	3	1	3	0	2

Table 2: Overall research output across domains

4.2 Research type and methods

While main focus of this paper is on nudges in consumer choice digital nudges are also used and researched in other domains and fields of application. The different research articles, that were identified for this literature review use different research approaches and methods. Those articles should be categorized based on the Alavi and Carlson's research classification scheme (Alavi and Carlson 1992). A graphic of this classification approach is available in the appendix (3).

4.2.1 Non-empirical

Non-empirical research	CCH	SCP	MISC
Literature review (1)	1	0	0
Conceptual (2)	1	1	0
Literature review and conceptual (4)	3	0	1
Total (7)	5	1	1

Table 3: Non-empirical research across domains

Non-empirical research includes articles based on the subjective opinions of the authors and/or literature reviews. They do not include empirically collected data Alavi and Carlson 1992. In the identified basket of literature there is only one exception, where Gamliel and Peer 2017 which creates theoretical concept based on a survey. Overall, seven articles can be classified as non-empirical research. This makes ca. 19% of the find-

ings. Those papers use in particular two different, non-empirical research approaches. Literature reviews and conceptual studies. The literature reviews are present literature in the field and their findings, where as conceptual studies describe theories, models or frameworks for the application of (digital) nudges. Four research articles do follow both approaches. Broniarczyk and Griffin 2014 for example reviews different literature and creates a model that describes which techniques can aid in the decision-making process.

As described in 3 most non-empirical research is done in the area of consumer choice. Lades 2014 for example evaluates the theoretical effect of nudges in inter temporal choices and the context of ethical usage. Thereby, he concludes that "self-imposed nudges should be preferred to nudges by third parties". Furthermore, impulsive nudges should be reduced to allow more ethical handling of nudges in consumer choice.

4.2.2 Empirical

Empirical research	CCH	EDU	FIN	HEA	PSB	SUS	TRA	SCP	GOV	MISC
Lab experiment (15)	10	0	0	2	1	1	0	0	0	1
Field experiment (5)	2	0	0	1	1	1	0	0	0	0
Lab experiment and field experiment (1)	0	0	0	0	1	0	0	0	0	0
Lab experiment and survey (3)	2	0	0	0	0	0	0	1	0	0
Survey (5)	2	0	1	0	0	0	1	1	0	0
Case Study (1)	0	0	0	1	0	0	0	0	0	0
Case Study, survey and lab experiment (1)	0	0	0	0	1	0	0	0	0	0
Total (31)	16	0	1	4	4	2	1	2	0	1

Table 4: Empirical research across domains

Empirical articles are classified as articles that rely on observation and capture data through different research techniques such as survey, case studies or laboratory experiments Alavi and Carlson 1992. Overall 31 articles emphasize empirical methods and capture or work with some form of data.

Given the context of use, the location is one important aspect to keep in mind. The identified literature shows a clear focus on research in the USA and Europe. Only two studies take place in Asia. This aspect is important to bear in mind because of different

Empirical research	Decision Information	Decision structure	Decision assistance	Combination
Lab experiment (15)	9	5	1	0
Field experiment (5)	0	1	1	3
Lab experiment and field experiment (1)	0	1	0	0
Lab experiment and survey (3)	1	2	0	0
Survey (5)	2	0	0	3
Case Study (1)	1	0	0	0
Case Study, survey and lab experiment (1)	1	0	0	0
Total (31)	12	9	2	6

Table 5: Empirical research across parts of the choice architecture

underlying mental models and mindsets. Those mindsets demand diverse requirements on the application as well as on the ethical perspective Sunstein 2015.

Laboratory experiments In the findings of literature the majority (48%) uses laboratory experiments to evaluate the efficiency and use of digital nudges. A lab experiment describes an artificial setting in which researches can control several variables, manipulate them and evaluate the impact of that manipulation. This kind of research is ideally as a research method for digital nudging. As can be seen from previous parts of analysis, most lab experiments take place in the field of consumer choice. For example, Lee et al. 2014 study the effect of colorful versus monochrome product pictures. The finding of this study is that colorful images impact the product choice in several ways and act as a kind of "psychological nudge". On the one hand color can pull attention and highlight certain product features. On the other hand colorful product images can create some kind of abstraction that makes in harder to compare different products. Lee et al. 2014 state that markets have to choose carefully whether to use black-and-white versus colorful imagery in advertisements and online shops. Furthermore, lab experiments with regards to health (Laran et al. 2018; Langley et al. 2015), as well as sustainability (Bruns et al. 2018) and pro-social behavior (Zarghamee et al. 2017) are part of the findings. Focusing on the underlying evaluation of the choice architecture design most lab experiments study the use of nudges concerning decision information, which typically takes place as the first

step right before the decision. Such an experiment is designed by Kretzer and Maedche 2018. In this study digital nudging is used in the context of enterprise recommendation agents. A precisely targeted recommendation through a social nudge allows employees to reuse existing document resources more effectively which saves time and costs. This recommendation is a typical influence on the decision information of the choice architecture and nudges the user right in the beginning of the decision-making process. Another vast part of lab experiments shapes the decision structure of the choice architecture. Here, the choice architect manipulates the decision itself, often through the change of choice options. In this part the usage of certain heuristics and biases is common Tversky and Kahneman 1974. One downside of laboratory experiments is the isolated view on the decision-making process. Because of the artificial setting and variables set in advance, those studies only evaluate the effect of a nudge on only one part of the overall decision-making. There is no measurement concerning the digital nudge influence on the whole process.

Field experiment Field experiments provide exactly this natural consideration of the application. In a field experiment there is only limited or no control on research variables. This leads to a realistic view on the evaluation and how a nudge is perceived by the user. This literature review identifies five field experiments within the findings. The research article of Goswami and Urminsky 2016 combines a laboratory experiment with a field experiment while studying the effects of default effects in donations. Surprisingly, the most optimistic prediction, the significant increase of funds, is not supported. Rather, two other effects can be discovered. The "scale-back" and "lower-bar" effect. Concerning the influence on the choice architecture, field experiments grant a broad view on the whole decision making process. Three out of the five field experiments take a look at a combination of choice architecture elements (Miller et al. 2016; Cosmo and Oâ□□Hora 2017; Mazar et al. 2018). Cosmo and Oâ□□Hora 2017 study the effect of time-of-use pricing models for electricity consumption in households. Thereby, a little, standalone display acts as the UI. This display gives feedback, information and reminders about electricity consumption of the user. This is a digital nudge that effects all three categories of the choice architecture. The finding of the study shows that informational displays cause a reduction of costs.

Survey Survey make only a small part of the research in the topic of digital nudges. This can be explained because of the experimental nature of nudges and survey data is not current. The five surveys in the findings spread across different domains. Additionally, three survey are done together with a lab experiment. Those experiments take the survey data as a base and further examine the findings. The survey of Hilton et al. 2014 investigates the effect of bonus malus taxes. In combination with a social guidance nudge, users are drawn towards more sustainable transportation options. Surveys typically evaluate the decision information as well as a combination of choice architecture categories.

Case Study Within the results of the research, only one case study is identified. Guthrie et al. 2015 the usage of digital nudges in the form of recommendations. Those recommendations should nudge people towards healthier food choices. Findings conclude that such a nudge works digital in a better way than non-digital nudges do. Furthermore, the overall food choice is perceived as healthier, where as the understanding of the information still is a difficult part.

4.3 Theories and concepts used to study nudges

4.3.1 Conceptual Background

Overall, it is difficult to evaluate the conceptual background of the found literature. Digital nudging is a concept that is based on research across several research streams and domains. That is why underlying concepts, theories and models spread also across different domains. Within the total findings, 29 research articles mention one or more theoretical background concepts they refer to during their studies. All in all, those papers mention 25 different theories. From those 25 theories, models and frameworks the majority is only named once.

The most mentioned theories are the libertarian paternalism (Thaler and Sunstein 2009) with seven mentions, the bounded rationality, a important basic theory for decision making, with five mentions (Simon 1955), the model of judgment under uncertainty with six mentions (Tversky and Kahneman 1974) and the prospect theory with eight mentions (Kahneman and Tversky 1979). All those theories and models have a their origin in behavioral economic research and focus on decision making.

For social nudges, the theory of social influence (Cialdini and Goldstein 2004) is

named three times in the findings. The social influence theory "emphasizes the way in which [...] goals interact with external forces". This kind of influence is subtle, indirect and outside of awareness.

Research articles that lay a focus on psychological factors, reference among other things the reactance theory (Brehm 1966), the general evaluability theory (Hsee and Zhang 2010) and the construal level theory (Trope and Liberman 2010). Every single theory is mentioned two times. Brehm 1966 states that the theory of psychological reactance shows "that individuals have certain freedoms with regard to their behavior. If these behavioral freedoms are reduced or threatened with reduction, the individual will be motivationally aroused to regain them." This theory provides an important insight into how far nudges should take influence in decision-making and what their boundaries are. The general evaluability theory on the other hand focuses on the value system of individuals. It specifies "when people are value sensitive and when people mispredict their own or others' value sensitivity" (Hsee and Zhang 2010). Those insights have important meanings for the design of social nudges. The construal level theory puts emphasis on cognitive and mental processes with regards to similarity and comparisons (Trope and Liberman 2010).

Furthermore, the majority of research articles in the domain of health mentions the health belief model (Rosenstock 1974). This model evaluates three categories of preventive health behavior. With a focus on mental states is describes as model with "states which help to account for behavior" in the domain of health. Such insights in behavioral psychology provide important guidelines for the efficient design of health nudges.

4.3.2 Heuristics and biases

To design a successful digital nudge, some kind of heuristics should be used. Those heuristics as a "rule of thumb" for guiding a choice in cognitive loaded environments (Thaler and Sunstein 2009). In the 37 identified papers, 21 reference or use a heuristic in the design and implementation of a digital nudge. Zarghamee et al. 2017 executes the only study that relates to the status quo bias as well as social and mental norms. In this study, two implemented nudges increase the donation to charitable givings about 25%. This is achieved with a set default and an additional social nudge that provides a social reference point. The most used form of heuristics are norms which describes the effect that people tend to be influenced by the behavior of others (Schneider et al. 2018). Choice architects

Heuristic / Bias	Decision information	Decision structure	Decisions assistance	Combination
Status quo bias (5)	0	5	0	0
Decoy effect (1)	0	1	0	0
Primacy and recency effect (1)	0	1	0	0
Middle-option bias (0)	0	0	0	0
Anchoring and adjustments (1)	1	0	0	0
Norms (12)	8	1	2	1
Status quo bias and norms (1)	0	1	0	0
Scarcity effect (0)	0	0	0	0
Total (21)	9	9	2	1

Table 6: Heuristics used across parts of choice architectures

can implement nudges that uses norms in two way. Social norms and moral norms. Where social norms nudge users towards a social reference point (Wang et al. 2018) and moral norms which tend to emphasize value based decisions. In a field experiment of 2017 a "pay what you want" pricing model was changed to nudge users to a higher pricing decision at a books store. The result shows that member, who are reminded of their club membership right before the decision, significantly adjust their pricing decision upwards (Gravert 2017).

Five of the 21 research articles that use heuristics and biases in a certain way referred to the status quo bias which is some form of a default. Defaults are on of the most efficient form of nudging (Johnson and Goldstein 2003). The status quo bias shows that people tend to "favor the status quo so they are less inclined to change default options" (Schneider et al. 2018). One intersting finding of the identified literature is shown by Steffel et al. 2016. In this study the researchers try to debias the effect of a default choice by communicating the nudge transparently. The result shows that it is not completely possible to debias a default choice and that the user is still nudged towards the default value. This shows the cognitive strength of the status quo bias.

Other heuristics and biases are used less. Such an example is the decoy effect, which actually has promising influence on online choice architectures. The decoy effect is in theory a perfect technique for digital nudges. By showing an unattractive option besides an attractive one the user is nudged towards the attractive option (Schneider et al. 2018).

Only one research article studies the effect of this decoy effect. The target environment is a crowdsourcing platform where users can donate money to an upcoming project. Here, the user has the choice between different "donation-packages" that include some kind of reward for the trust and support. With the help of the decoy effect the study shows that donations can increase by 11% (Tietz et al. 2016).

Another less used heuristic and bias is the primacy and recency effect which describes the effect of the positioning of choice options and interface elements. One research article studies the effect of choice positioning across different sides of the screen. For food choices, the researchers find out that it is more likely to choose a healthy option when it is located on the left side of the screen. Overall, several visual cues play an important role in influencing choices (Romero and Biswas 2016).

Surprisingly, two heuristics often implemented in non-digital nudges are not present in the findings of the identified literature. First, this includes the middle-option bias, which explains that people fronted with 3 options are most likely to choose the middle-option considering the price. In an offline environment one can observe this effect in several coffee-shops. Here, the customer typically has the choice between three options in size. Because of the middle-option bias it is most likely that the customer will choose the medium sized coffee. Such a bias is also transferable to digital environments, for example in a scenario where the user has to choose between different pricing models or product configurations. Furthermore, none of the research articles studies the implementation of nudge that is based on the scarcity effect. This effect shows that people tend to perceive scarce items as more attractive and desirable (Fromkin and Snyder 1980). One important aspect of the scarcity effect is the difficult implementation. Users often perceive nudges that build on top of this effect unethical (Sunstein 2015), while at the same time they are very effective in forcing certain choices. An example of this nudge is described in the introduction chapter.

By mapping those heuristics to categories of the choice architecture, several insights can be made. The first observation is that norms are typically used for decision information. In eight out of twelve cases, norms are used in nudges that provide decision information. At the same time, norms are also efficient when it comes to long term decision and decision assistance. Such a social reference point makes it easier for users to have some kind of orientation. In complex environments this makes choices easier. Other heuristics

are more efficient in the decision making when it comes to the decision structure itself. All of the five times the status quo bias is used by researchers it has an effect on decision structure. Other techniques like the decoy effect and the primacy and recency effect are also used in decision structure. Those techniques influence choices directly when the decision is taken by manipulation the choice option, their outcomes and efforts (MÃEnscher et al. 2016).

4.4 Influence on the choice architecture and decision making

Choice Architecture	CCH	EDU	FIN	HEA	PSB	SUS	TRA	SCP	GOV	MISC
Decision information (15)	10	0	1	2	1	0	0	0	0	1
Decision structure (10)	4	0	0	0	2	2	0	2	0	0
Decision assistance (3)	2	0	0	1	0	0	0	0	0	0
Combination (6)	2	0	0	1	0	1	1	1	0	0
Total (34)	18	0	1	4	3	3	1	3	0	1

Table 7: Choice architecture parts used across the domains

- Another important aspect is the influence of the nudge design on the choice architecture and the overall part of decision-making - MÃEnscher et al. 2016 classified this parts of decision making in a taxonomy consisting out of decision information, structure and assistance - To guide choices efficient, different parts of the choice architecture should be designed different and according to the decision-making process - For example it does not make any sense to design a nudge for decision information, when the user is directly in the decision process - Such nudges should always be designed beforehand - important aspect: right use of heuristics and biases very important. See table - Special biases used to guide choice in decision structure - Same goes for biases in decision information - Norms very efficient - Outside the heuristics there are several other possibilities to influence the choice architecture - plain informational text and making information visible (12) - Also the translation (8) is a simple design decision tat designer can make to guide choices and influence right from the start with regards to choice information - Across the domains there is no real pattern to be recognized - Most part of the papers explored impact of choice information in consumer choice - In this area the consumer decides on his or her own, now expert knowledge - Lot of people use technology to compare different choices and prod-

ucts - Decision information is powerful tool to guide those choices - But also beneficial in other domains e.g. health → Example! - In terms of decision structure heuristics such as the status quo effect, primacy and recency effect and decoy effect have proven to be efficient - As well as for decision information, also other techniques provide good results - Most popular is the change of choice defaults (6) - Very effective. That's why defaults are a complete nudge principles for themselves - Other techniques used to design effective nudges are about the options. About their positions, effort and also consequences - manipulating these parameters in a choice architecture can nudge people towards certain decisions - Such as in - For domains, no real pattern can be recognized - Most used in choice architecture, most possibilities - A not so big part of the papers evaluates decisions assistance - This can be done by providing reminders or facilitate commitment for a choice - Examples! - Decisions assistance is often used in domains where longer choices are made - Such as health and sustainability - One crucial finding is that only 6 papers used a combination of choice architecture techniques - This is due to experiment design in laboratory setting - But also isolated view on nudge - Effective nudging can only happen if whole decision making process is viewed and designed - Papers like ... - Here, future research can close a gap with field experiments and the effective of multiple nudges on the decision making process

5 Conclusion

In the end of the thesis all results will be summarized and critically discussed. The goal is to identify a research gap and to give recommendations for future research that would advance the topic.

5.1 Summary of Findings

5.2 Limitations

Not every study talked directly about digital nudging or nudging itself...

5.3 Recommendations for future research

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Appendix

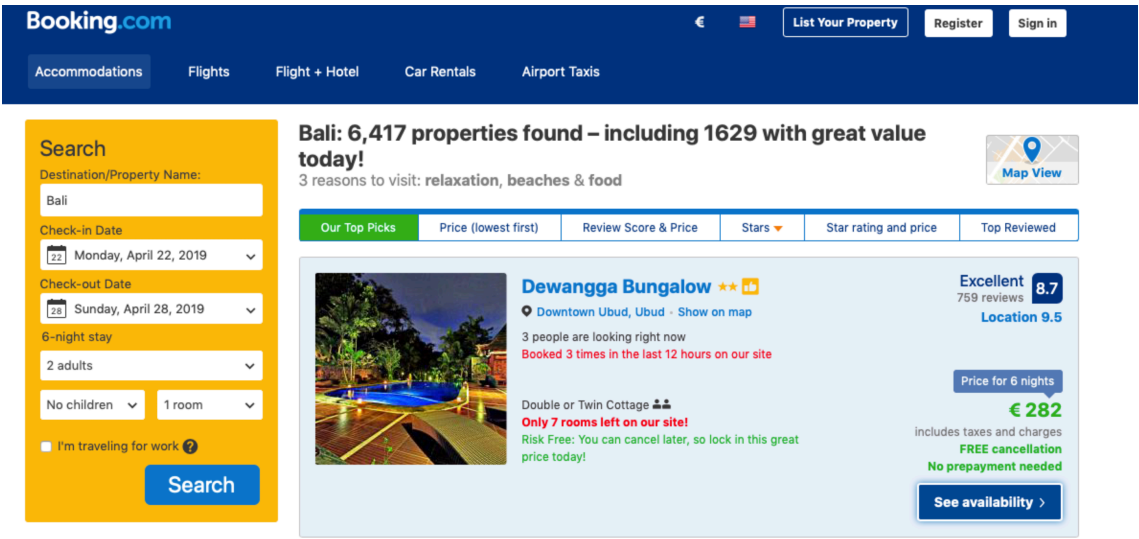


Figure 1: Digital nudging example - booking.com

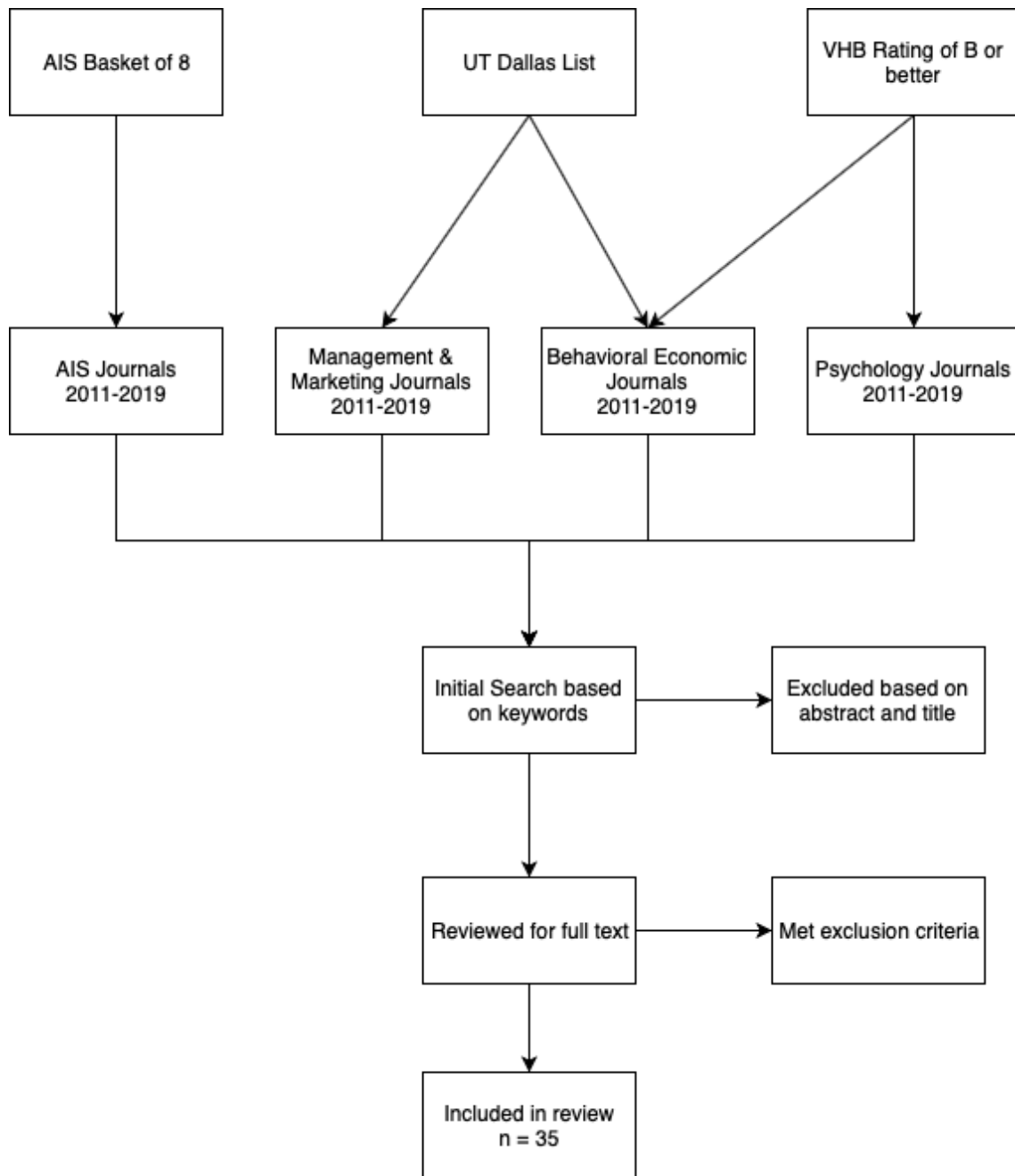


Figure 2: Information flow of the screening process

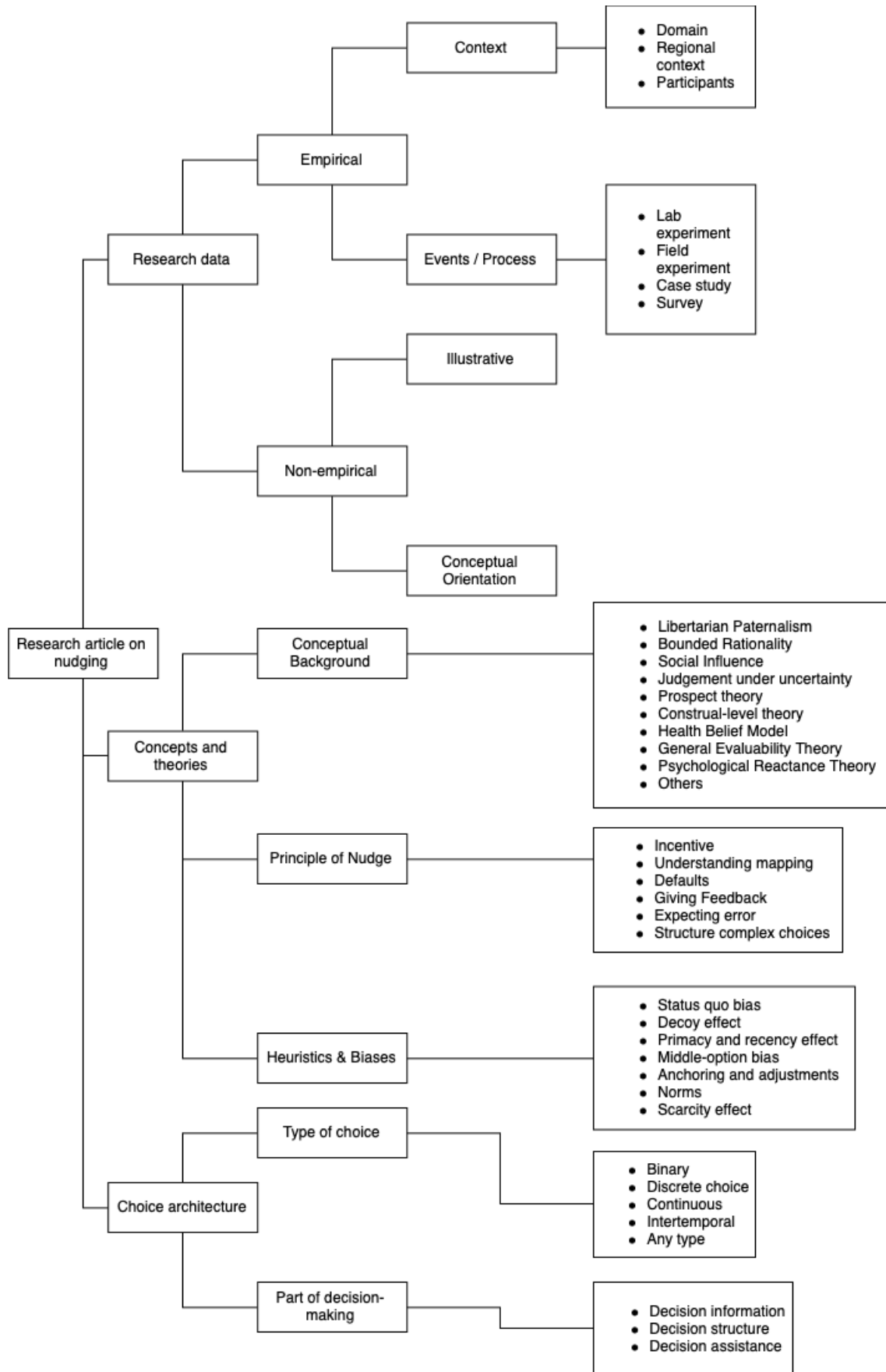


Figure 3: Classification of findings-detailed

Domain	Coding
Consumer Choice	CCH
Education	EDU
Finance	FIN
Health	HEA
Prosocial Behavior	PSB
Sustainability	SUS
Transportation	TRA
Security & Privacy	SCP
Government	GOV
Other	MISC

Table 8: List of domain codings

Affidavit

I hereby declare that I have developed and written the enclosed seminar thesis entirely on my own and have not used outside sources without declaration in the text. Any concepts or quotations applicable to these sources are clearly attributed to them.

This seminar thesis has not been submitted in the same or substantially similar version, not even in part, to any other authority for grading and has not been published elsewhere. I am aware of the fact that a misstatement may have serious legal consequences.

Mannheim, 1. April 2019

Marvin Messenzehl