



DIGITAL NUDGES AND EFFECTS ON
CONSUMER BEHAVIOR:
A LITERATURE REVIEW

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MARVIN MESSENZEHL

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Reviewer: Prof. Dr. Hartmut Höhle
Supervisor: Florian Pethig

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List of Abbreviations

AIS	Area of Information Systems
CCH	Consumer Choice
EDU	Education
FIN	Finance
GOV	Government
HCI	Human Computer Interaction
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

With the release of the book "Nudge" by Richard Thaler and Cass Sunstein, the concept of nudging began to gain interest in research. Nudging describes a way that alters people's decisions and behaviors predictably. Therefore, this concept has promising benefits for different target groups. On the one hand, a business can increase conversions with precisely designed nudges and on the other hand users face easier decisions they have to make which overall can increase the user experience and - satisfaction. This paper builds a literature review of different research streams concerning nudges in digital environments. A qualitative representation of the current research in forms of academic journal articles is gathered, reviewed and analyzed. This literature review sees a clear focus of nudging in the application area of consumer choice and an emphasis on empirical studies. The vast majority of research studies the effect of social-, as well as default nudges. To design those nudges, researchers consider only a few specific biases such as the status quo bias and social norms. Overall, current research provides an isolated view on decision-making with the focus on the nudge itself. No research with regards to the overall user experience is identified. The results of this literature review provide essential findings for future research in the area of digital nudging. This paper recommends a focus for research on complex decision domains like the finance and insurance sector, as well as an extended analysis of other heuristics and biases such as the middle-option bias and scarcity effect. Furthermore, the findings of this paper provide exciting insights for product designers and -managers to facilitate decision-making processes in digital applications.

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 (2012, p.488) states that "what is chosen often depends upon how the choice is presented." This representation describes as the term of choice architecture, which should "alter people's behavior in a predictable way" (Thaler and Sunstein 2009, p.6). 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 of the last ten years.

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. Literature

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

in this domain shall be gathered, reviewed and analyzed. Different target groups can, such as product designers, managers and user interface designers, can use this knowledge to implement nudges in digital application more thoughtful and efficient. Furthermore, the correct use of nudges in combination with design elements can increase user experience, customer satisfaction and therefore conversion rates for digital products.

Secondary, a recommendation for future research is derived from the analysis to advance research in this particular subject. Because of its multidisciplinary nature, research on digital nudges may contribute to several scientific domains, such as information systems, psychology, and behavioral economics.

2 Conceptual Background

2.1 The Birth of Nudging

With the release of the book "Nudge" in 2009, Thaler and Sunstein have laid the foundation 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, p.6): *"A nudge [...] is any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives."*

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" (Thaler and Sunstein 2009, p.6). However, banning the food would not be a nudge. Because influencing people's behavior can simply be exploited, the ethical viewpoint on nudges should always be kept in mind. (Sunstein 2015).

Because the human brain only has a limited capacity to store and process information, the consumer often feels subconsciously overloaded. This overloading is called cognitive limitation, which 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, p.1124). Based on this assumption Tversky and Kahneman (1974) formulated three heuristics and several biases that build the foundation of human decision making. Those heuristics and biases act as a psychological guideline in digital nudging.

Besides the cognitive foundation of decision making, there are five general principles of nudging (based on Thaler, Sunstein and Balz 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, based on a single number. A rational mapping is the displaying of 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 effect. By changing the default option, consumers are more likely to choose an option near to the selected default or even the default itself. 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 of the decision. 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 ac-

count when designing a decision, and the environment should be as forgiving as possible. That's why customers first have to remove their credit card from a cash machine before they can obtain the money. In this way, the systems makes sure that users do not forget their credit card (Weinmann et al. 2016).

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, researches evaluated the effect of such a nudge in a bar, when it comes to craft beer choice. By listing 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. (Johnson et al. 2012) describe the power of such choice architects and how they 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, p.488) for choices. Even small things like a default choice affect the decision-making. 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, p.609) people automatically shift a majority of their decisions in the online or digital world. However, digital environments are not less complex. Just like in non-digital 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, Münscher et al. (2016) created a taxonomy of choice architecture

categories 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" (Münscher et al. 2016, p.514). 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 modification 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, p.490), the concept of nudging recently gains interest in research of different disciplines. Thereby, the underlying concepts of non-digital nudges are transferred and adapted in digital environments. The result are digital nudges. According to Weinmann et al. (2016, p.433) 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.*

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, the use of cognitive heuristics and biases can act as a baseline to design digital nudges. Different user-interface design elements induce different nudges. Table 7 in the appendix 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 Harjuma 2009). Although both concepts share similarities, this paper solely focuses 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 in this literature review.

3 Methodology

This literature review follows a systematic approach, that is well-established in the discipline of information systems (Webster and Watson 2002) and review targets a qualitative subset of literature. Thereby trying 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 realize this strategy, several variables are necessary for the search process. Digital nudging is a concept that spans across several fields of research. At the same time the understanding as well as implementation and studying differs widely. Therefore, this literature review aims to cooperate different research streams to build a common ground, by identifying and analyzing the most representative research articles in the domain. Thereby search variables are set journal- and paper-wise. A graphic of the screening process is available in the appendix (Figure 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 search within the field of information systems research but also in other research streams. (Webster and Watson 2002). It is reasonable to examine academic journals with the most influence in the research domain. 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 starting point (Alavi and Carlson 1992). This scholarly basket consists out of eight well-respected journals in the domain. After the AIS scholarly basket, academic journals about management and marketing are recorded in the research process. Thereby, the journal list of the *UT Dallas* is taken as a reference point. Overall, the journal list of the UT Dallas contributes with twelve journals to the research pool. Relevant publications from the domains of behavioral economics, decision making and psychology are identified by the *VHB* journal rating *JOURQUAL3*². Journals with a rating of *B* or better are taken into account for the review. To finalize the list of sources for the upcoming analysis, conference publication from the AIS with a VHB rating of *B* or better were included, too. In total 32 academic journals were examined. A complete list of these journals is accessible in the appendix (Table 8).

3.2 Paper selection

Paper-wise, only articles with a publication date older than 2010 are concerned. This literature review sets this date because nudging is a rather new concept that first was 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 is conducted on 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 the keyword *nudg**. Those additional keywords are *decision*, *choice*, *consumer*. Overall 534 journal articles were identified in the initial search. Those articles mention the term nudge or match the described keywords. Articles are excluded based on several criteria to extract

²more information under <https://vhbonline.org/vhb4you/jourqual/vhb-jourqual-3/gesamtliste/>

the most relevant sources. This concerns journal papers that only embody offline nudges. Such articles are excluded from the final article list, as well as articles that focus on the topic of persuasion.

In the end, the final concept matrix include 37 research articles. Figure 2 shows the information flow and screening process. The complete list of articles is available in the appendix (Table 9, 10 and 11)

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). On the one hand the research approach and field of used is evaluated to recognize trends in current research. On the other hand, major theories, concepts, heuristics, and biases are investigated to study the effect and implementation of digital nudges.

Concerning the in-depth analysis, a concept matrix codes the identified articles. To answer the underlying research questions, this paper inspects different categories of the relevant articles. 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 (see table 13, 14 and 15).

4 Results

4.1 Overall research output

Since the release of the "Nudge" by Thaler and Sunstein in 2009, the concept of nudges gains more and more interest in several research streams and domains. Table 1 gives an overview of the overall research output. Domain names are coded with abbreviations. The complete coding of the domain names is available in the appendix in table 12 as well as in the abbreviation section.

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 1: Overall research output across domains

Considering the number of published articles, the overall research output increased since 2011, especially in the last five years. Firstly this can be explained by the increased adoption and knowledge of nudging. Secondly, there are also more possibilities where digital nudges can be used. More and more domains face digitization, which leads to an expansion of digital applications and their adoption.

The primary research within the last ten years is conducted in the area of consumer choice. Here, a digital environment builds a typical buyer/seller relationship, where the application offers a good or service and the user is the consumer/buyer. This tendency in research shows an economic incentive behind the concept of nudging. If done right digital nudges are an excellent tool to increase conversion rates and overall revenue (Mirsch et al. 2018). However, the interest in digital nudging also spans across other domains, especially complex domains, where some form of expert knowledge is necessary 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. Those 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 is implemented by a default choice. Because of the default choice the

amount of carbon offset payments could increase significantly. Finally, this leads to an environmentally friendly decision (Székely and Weinmann 2016).

4.2 Research type and methods

The different research articles for this literature review use different research approaches and methods. Those articles should be categorized based on Alavi's and Carlson's (1992) research classification scheme. A graphic of this classification approach is available in the appendix (3).

4.2.1 Non-empirical

Non-empirical research includes articles based on the subjective opinions of the authors and literature reviews. They do not include empirically collected data (Alavi and Carlson 1992). Overall, seven articles can be classified as non-empirical research. This accounts for approx. 19% of the findings. Those papers follow two different non-empirical research approaches. Namely, literature reviews and conceptual studies. In the identified basket of literature, there is only one exception, which creates a theoretical concept based on survey data (Gamliel and Peer 2017). The literature reviews present literature in the field, and their findings. Conceptual studies describe theories, models or frameworks for the application of (digital) nudges. Four research articles follow both approaches. Broniarczyk and Griffin (2014), for example, review different literature and create a model that describes which techniques can aid in the decision-making process.

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 2: Non-empirical research across domains

As described in table 2, the area of consumer choice contributes the most non-empirical research. Lades (2014), for example, evaluates the theoretical effect of nudges in intertemporal choices and the context of ethical usage. Thereby, the author concludes that "self-imposed nudges should be preferred to nudges by third parties" (Lades 2014, p.122). Fur-

thermore, impulsive nudges should be reduced to allow more humane handling of nudges in consumer choice.

4.2.2 Empirical

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

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 3: Empirical research across domains

Laboratory experiments In the findings of the 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. As can be seen from previous parts of analysis, most lab experiments take place in the field of consumer choice. Lee et al. (2014) for example, study the effect of colorful versus monochrome product pictures. The finding of this study show 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 abstraction making it harder to compare different products. This study states that marketers 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 in the identified literature.

Considering the underlying evaluation of the choice architecture design, most lab experiments study the use of nudges with regards to decision information. Such an experiment is designed by Kretzer and Maedche (2018). This study uses digital nudging 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 at the beginning of the decision-making process. Five out of 15 lab experiments shapes the choice architecture by changing the decision structure with regards to the choice options. In this part the usage of specific 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 focus on one particular research variable those approach only evaluates the effect of a nudge in limited scope with no regards to the overall decision-making process. There is no valuation concerning the influence of the digital nudge on the whole user experience.

Field experiment Field experiments provide a 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 of the evaluation and how the user perceives a nudge. This literature review identifies five field experiments within the findings. The study by 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, the study discovers two other effects. 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 observe a combination of different choice architecture elements (Miller et al. 2016; Cosmo

and O’Hora 2017; Mazar et al. 2018). Cosmo and O’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 the electricity consumption of the user and therefore affects all three categories of choice architectures. The findings of the study show that informational displays cause a reduction in costs.

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 4: Empirical research across parts of the choice architecture

Survey Surveys make only a small part of the research on the topic of digital nudges. The five surveys in the findings spread across different domains. Additionally, three surveys are conducted together with a lab experiment. Those experiments take the survey data as a base and further examine the findings. One of those surveys investigates the effect of bonus-malus taxes. In combination with a social guidance nudge, users are drawn towards more sustainable transportation options (Hilton et al. 2014). In the identified literature, surveys typically evaluate the decision information as well as a combination of choice architecture categories.

Case Study The results of the research include only one case study. Guthrie et al. (2015) study 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 digitally in a better way than non-digital nudges do. Furthermore, the overall

food choice is perceived as healthier, whereas the understanding of the information still is an intricate 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 identified literature. Digital nudging is a concept that is based on research across several research streams and domains. The same goes for the underlying concepts, theories, and models. Within the 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 prospect theory with eight mentions (Kahneman and Tversky 1979). The libertarian paternalism (Thaler and Sunstein 2009) with seven mentions. The model of judgment under uncertainty with six mentions (Tversky and Kahneman 1974) and the bounded rationality, an important basic theory for decision making, with five mentions (Simon 1955). All those theories and models have 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" (Cialdini and Goldstein 2004, p.591). This kind of influence is subtle, indirect and outside of awareness.

Research articles that lay a focus on psychological factors, reference 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 concerning their behavior. If these behavioral freedoms are reduced or threatened, the individual will be motivated 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, p.343). Those insights have important meanings for the design of social nudges. The construal level theory emphasizes 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, it describes a model with "states which help to account for behavior" (Rosenstock 1974, p.354) in the domain of health. Such insights in behavioral psychology provide essential guidelines for the efficient design of health nudges.

4.3.2 Heuristics and biases

Heuristics act as a rule of thumb for guiding a choice in cognitive loaded environments (Thaler and Sunstein 2009). In the 37 identified papers, 21 articles reference or use a heuristic in the design and implementation of a digital nudge. Zarghamee et al. (2017) execute 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 giving about 25%. This gain 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 can implement nudges that use norms in two ways. Where social norms nudge users towards a social reference point (Wang et al. 2018), moral norms 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 book store. The result shows that members, 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 a form of default. Defaults are one of the most efficient forms 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, p.71). One interesting finding of the identified literature is shown by Steffel et al. (2016). In this study, the researchers try to de-bias the effect of a default choice by

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 5: Heuristics used across parts of choice architectures

communicating the nudge transparently. The result shows that it is not entirely possible to de-bias a default choice and that the user is still nudged towards the default value. This result shows the cognitive strength of the status quo bias.

Other heuristics and biases are used less. Such an example is the decoy effect. 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 effect. The target environment is an online crowdsourcing platform where users can donate money to an upcoming project. Here, the user has the choice between different donation-packages that include some reward. 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, such as the positioning and ordering of choice options. (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 confronted with three options are most likely to choose the middle-option considering the price or size of a product (Schneider et al. 2018). In an offline environment, one can observe this effect in several coffee-shops. Here, the customer typically has a 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 could also be 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 a nudge that is based on the scarcity effect. This effect shows that people tend to perceive rare items as more attractive and desirable (Fromkin and Snyder 1980). One crucial aspect of the scarcity effect is a difficult implementation. Users often perceive nudges that build on top of this effect unethical (Sunstein 2015), while at the same time they are 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 decision assistance. Such a social reference point provides orientation for users and make choices more accessible. Other heuristics are more efficient in decision-making when it comes to the decision structure itself. In every study the decision structure is changed, researchers use the status quo bias. Other techniques like the decoy effect and the primacy and recency effect are also used to manipulate decision structure.

4.4 Influence on the choice architecture and decision making

Another important aspect shows the design of the choice architecture. To guide choices efficiently, different parts of the choice architecture should be altered according to the part of the decision-making process. For example, it is not perceived as useful to design a nudge for decision information, when the user is right in the decision process. Such nudges should always be implemented beforehand. Because those decision steps have dif-

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 6: Choice architecture parts used across the domains

ferent requirements, the use of the right heuristics and biases is essential. Table 5 shows the heuristics and biases used to guide decisions in different categories of the choice architecture. Here, the status quo bias is solely implemented in nudges which influence the decision structure. The same holds for heuristics and biases concerning the decision information. Besides the heuristics, several other possibilities to influence the choice architecture exist. This can be plain informational text and the visibility of information (used by twelve research articles). Also, the translation of information (used by eight research articles) is a simple decision that designers can make to guide choices.

Across the domains, there is no real pattern to be recognized. The vast majority of the research articles explores the impact of choice information on consumer choice. In this decision environment consumers typically decide on their own, with no need for expert knowledge. Many consumers nowadays use technology to compare different choices and products. Accurate decision information is a powerful tool to guide those choices. However, the simplification of decision information proves to be beneficial in other domains, too. As for example in the health domain. Langley et al. (2015) study the effect of decision information in an online forum to nudge users towards a vaccination decision. The finding shows that the decision information provides helpful advice for users, but at the same time demonstrates that vaccination decisions are not taken in social isolation. This experiment implements a complex nudge, by targeting the user in a digital environment, whereas the decision has to be made in a non-digital environment. For such

specific nudges, no further literature to date is identified. In terms of decision structure, heuristics such as the status quo bias, the primacy and recency effect, and the decoy effect have proved to be effective. With six research articles, the majority manipulates choice defaults to nudge users towards certain decisions. As mentioned before, defaults provide a valid form of nudging. Other techniques used to design effective nudges are about the choice options, their position, effort and also consequences (Münscher et al. 2016). One of the studies explores the framing effects of intertemporal choices (Faralla et al. 2017). Here the authors try to nudge users towards a more future-oriented decision. Participants of the study have the option between two amounts of money such as "55€ today or 75€ in 60 days" (Faralla et al. 2017, p.13). The experiment additionally gives information about an explicit penalty if participants take the money now. This gentle nudge leads towards a more future-oriented decision by changing only the consequences of the choice. Concerning domains, no real pattern can be recognized for the category of decision structure.

A minor part of the research articles studies nudges with regards to decision assistance. Decision assistance can be achieved by providing reminders or facilitate commitment for a choice (Münscher et al. 2016). In a study of 2018 customers were nudged with the help of planning prompts. Those prompts asked for a specified timeframe for paying credit card debts. Within the help of this particular nudge the likelihood for following the set intentions increases significantly (Mazar et al. 2018). Research articles that emphasize a longer decision-making process or intertemporal decisions often use nudges in the category of decisions assistance.

Another crucial finding is that only six research articles use a combination of choice architecture techniques. An effective nudging can only happen if the entire decision-making process is taken into scope of the nudge (Miller et al. 2016; Hilton et al. 2014; Cosmo and O'Hora 2017; Mazar et al. 2018; Basu and Savani 2017; Schneider et al. 2017).

5 Conclusion

5.1 Summary of Findings

The results of this literature review are manifold. A vast majority of identified research articles studies nudging in the consumer choice area. Additionally, the superior part deals with empirical research, which provides also more precise information and contributions to nudging research. Empirical studies usually build a useful way of studying the effect of nudges and furnish ways to understand the use of them. With a clear focus on laboratory experiments, researchers limit on an isolated view on the decision-making process and the nudge implementation. Furthermore, it is important to mention, that also other factors than the nudge itself have an influence on the decision environment. Other variables that do not directly have an impact on the decision should also be taken into account. Dong et al. 2019.

Considering the type of digital nudges, research articles lay a clear focus on default effects and social nudges with the status quo bias and social norms as most used heuristics and biases. Moreover, the current research targets mainly the choice architecture categories of decision information and decision structure. The category of decision assistance is less pronounced. One of the underlying reasons for that is the psychological background and complex implementation of nudges. Decision assistance often goes beyond the boundaries of digital environments so that a digital nudge affects a decision in a non-digital environment.

5.2 Limitations

It is important to notice that not every research articles directly mentions the concept of nudging. One possible explanation for this is the novelty of the concept of nudging. With the first research in 2010, nudging theory is known less than ten years. Additionally, nudging has its roots in the area of behavioral economics. Other research streams might study the same concept but do not label it as nudging directly. If nudging research continues, this problem will fade away with the broader adoption of the term "nudging" across research streams. At the moment many research articles, specifically about digital nudging, are in the review process and will probably be released in the near future. Those articles

in review are not part of this literature review.

Moreover, there is only a limited amount of articles that mentions specific interface design elements of digital nudges. Design elements are the building stones of every user interface and therefore have a significant influence on the choice architecture presented to the user. Unfortunately, those design elements are rarely specified in current studies. Studies with a focus on digital nudges barely include detailed descriptions of the digital environment and the user interface of the experiment. Such additional information can have a significant impact on the understanding of digital nudges.

5.3 Recommendations for future research

Based on the limitations and findings of this literature review, one can derive several recommendations for future research. One of those recommendations is the use of other heuristics. As described in the review of the literature, no research article uses the scarcity effect, as well as the middle-option bias. Both techniques successfully support nudging in non-digital environments. Therefore, a transfer to digital choice environments might provide promising results.

Another implication for future research is the connection to the domain of Human-Computer Interaction. Here, further research on how design elements influence digital nudges can be conducted. This can provide useful information for product designers and managers, to build efficient choice architectures.

Finally, future research can place more emphasis on other domains than consumer choice. Especially domains where complex decisions are taken. Such a domain is the finance and insurance sector. Here, users face complex decisions without being domain experts. In the past, a lot of financial services and insurances were sold with the help of a consultant in the sales department. Nowadays, more and more self-services allow users to act by themselves and independently. Such an example is the online bank N26 that provides full banking functionalities and services without a physical bank in the background. The only interfaces between bank and user are the mobile app and the web dashboard. In finance and insurance, decisions typically have a long term effect and usually are locked-in for an extended time. That is why it is critical to make good decisions and to provide an

easy to understand choice architecture for users. Besides the likely possibilities, nudging is very critical in this domain, because of the importance of the ethical aspect of nudging. If done wrong, a company can quickly lose the trust of users and conversions might go down. With a field experiment in the finance and insurance sector, future research can study the possible performance of digital nudges and provide useful insights for nudging theory as well as for product designer and -managers.

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Appendix

Booking.com € [List Your Property](#) [Register](#) [Sign in](#)

[Accommodations](#) [Flights](#) [Flight + Hotel](#) [Car Rentals](#) [Airport Taxis](#)

Search
Destination/Property Name:

Check-in Date
 Monday, April 22, 2019
Check-out Date
 Sunday, April 28, 2019
6-night stay
2 adults
No children 1 room
☐ I'm traveling for work
[Search](#)

Bali: 6,417 properties found – including 1629 with great value today!
3 reasons to visit: [relaxation](#), [beaches](#) & [food](#) [Map View](#)

[Our Top Picks](#) [Price \(lowest first\)](#) [Review Score & Price](#) [Stars](#) [Star rating and price](#) [Top Reviewed](#)

Dewangga Bungalow ★★
Downtown Ubud, Ubud - [Show on map](#)
3 people are looking right now
Booked 3 times in the last 12 hours on our site
Double or Twin Cottage
Only 7 rooms left on our site!
Risk Free: You can cancel later, so lock in this great price today!
Excellent **8.7**
759 reviews
Location **9.5**
Price for 6 nights
€282
includes taxes and charges
FREE cancellation
No prepayment needed
[See availability >](#)

Figure 1: Digital nudging example - booking.com

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

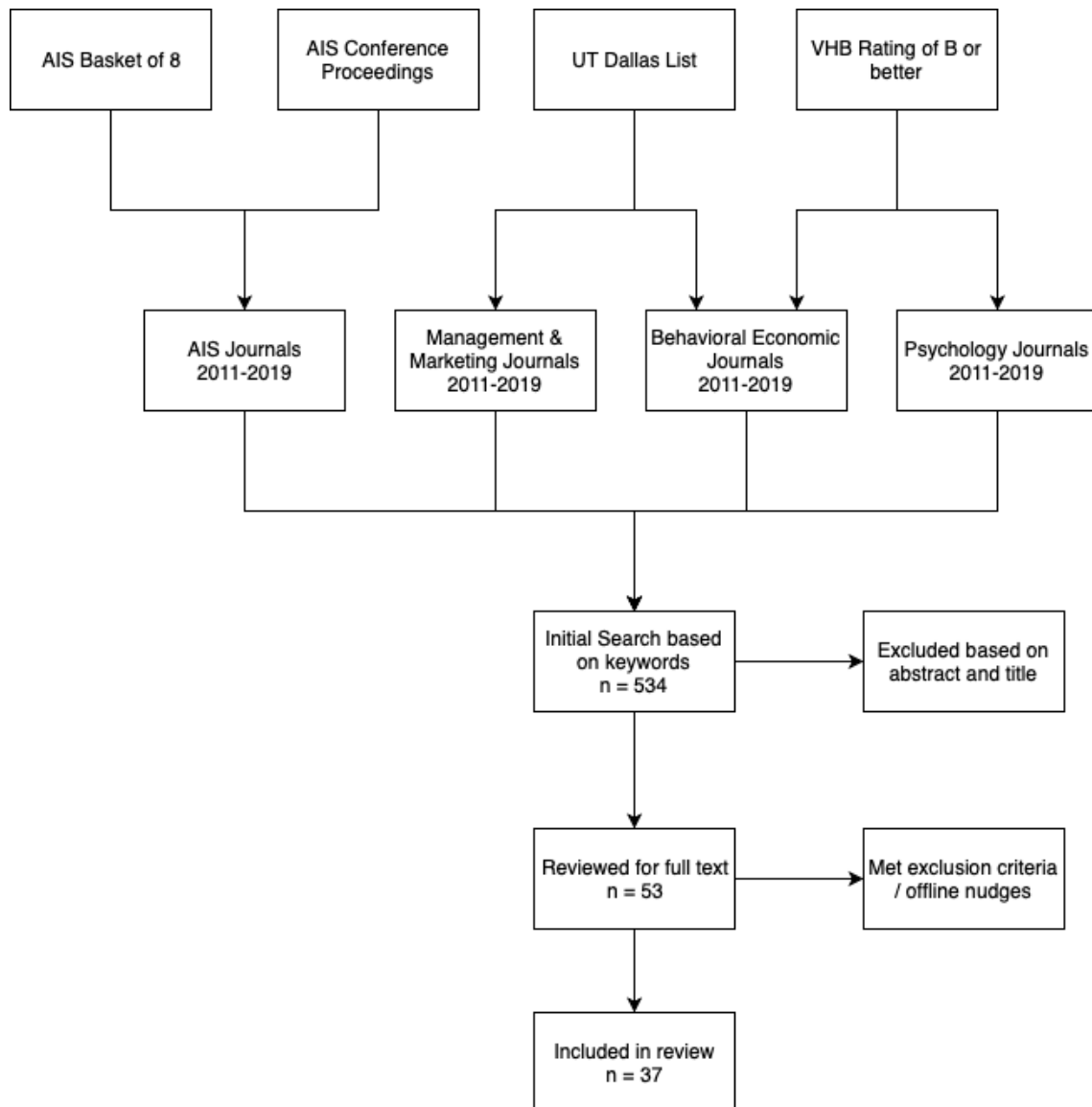


Figure 2: Information flow of the screening process

	Library / Source	Journal	VHB Rating
1	AIS (Basket of 8)	European Journal of Information Systems	A
2	AIS (Basket of 8)	Information Systems Journal	A
3	AIS (Basket of 8)	Information Systems Research	A+
4	AIS (Basket of 8)	Journal of AIS	A
5	AIS (Basket of 8)	Journal of Information Technology	A
6	AIS (Basket of 8)	Journal of MIS	A
7	AIS (Basket of 8)	Journal of Strategic Information systems	A
8	AIS (Basket of 8)	MIS Quaterly	A+
9	UT Dallas	Journal on Computing	A
10	UT Dallas	Journal of Consumer Research	A+
11	UT Dallas	Journal of Marketing	A+
12	UT Dallas	Journal of Marketing Research	A+
13	UT Dallas	Marketing Science	A+
14	UT Dallas	Management Science	A+
15	UT Dallas	Operations Research	A+
16	UT Dallas	Academy of Management Journal	A+
17	UT Dallas	Academy of Management Review	A+
18	UT Dallas	Journal of International Business Studies	A
19	UT Dallas	Strategic Management Journal	A
20	VHB	Journal of Behavioral Decision Making	B
21	VHB	Journal of Behavioral and Experimental Economics	B
22	VHB	Journal of Applied Behavioral Science	B
23	VHB	Organizational Behavior and Human Decision Processes	A
24	VHB	Applied Psychology	B
25	VHB	European Journal of Work & Organizational Psychology	B
26	VHB	Journal of Applied Psychology	A
27	VHB	Journal of Business and Psychology	B
28	VHB	Journal of Consumer Psychology	A
29	VHB	Journal of Economic Psychology	B
30	VHB	Psychology & Marketing	B
31	AIS Conferences	Proceedings of the International Conference on Information Systems (ICIS)	A
32	AIS Conferences	Proceedings of the European Conference on Information Systems (ECIS)	B

Table 8: List of inspected journals

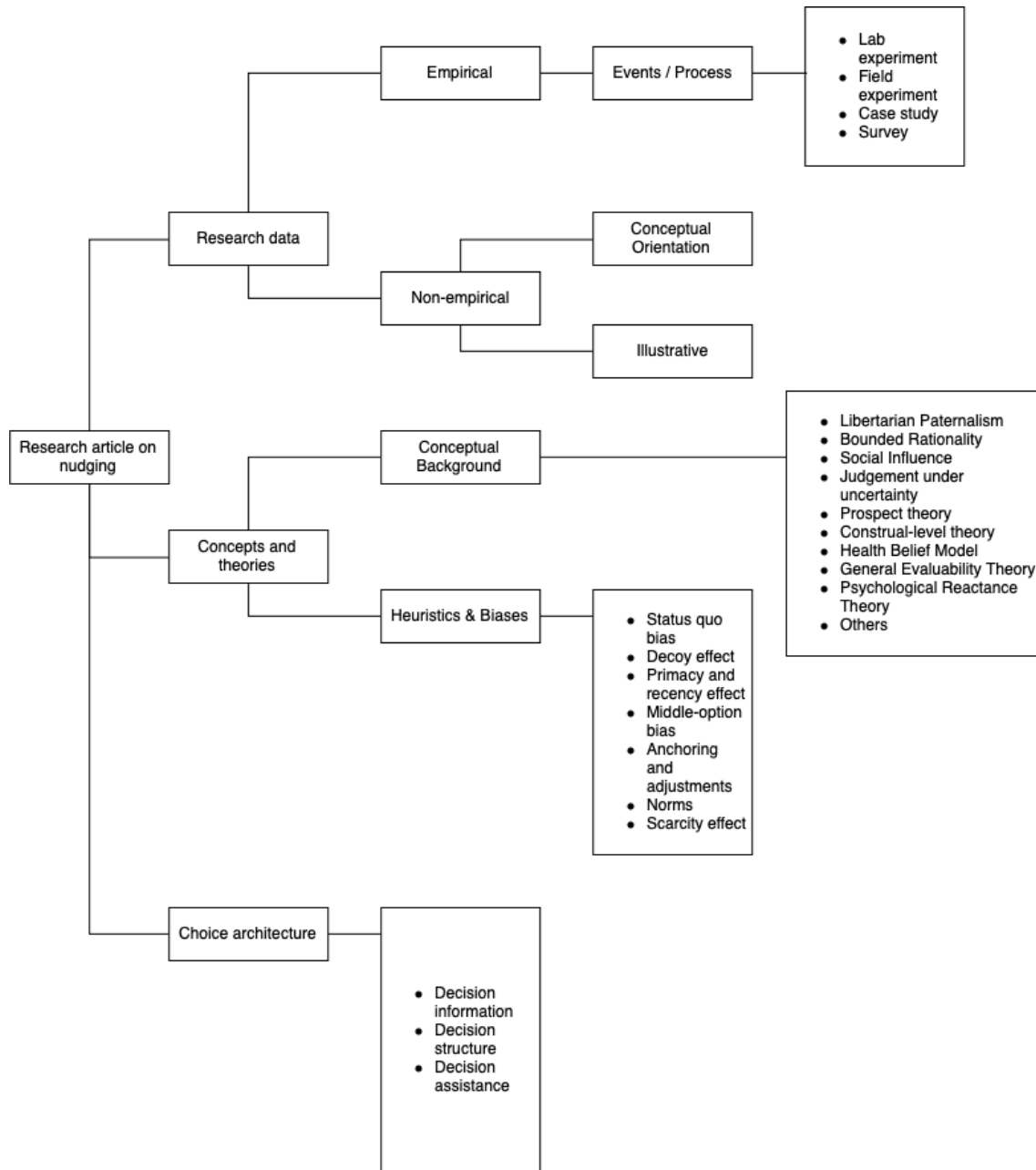


Figure 3: Classification of findings-detailed

	Author & Year	Title	Publication
1	Basu and Savani 2017	Choosing one at a time? Presenting options simultaneously helps people make more optimal decisions than presenting options sequentially	Organizational Behavior and Human Decision Processes
2	Broniarczyk and Griffin 2014	Decision Difficulty in the Age of Consumer Empowerment	Journal of Consumer Psychology
3	Bruns et al. 2018	Can Nudges Be Transparent and Yet Effective?	Journal of Economic Psychology
4	Cao et al. 2018	An Economic Analysis of Peer Disclosure in Online Social Communities	Information Systems Research
5	Cosmo and O'Hara 2017	Nudging electricity consumption using TOU pricing and feedback: evidence from Irish households	Journal of Economic Psychology
6	Dolan et al. 2012	Influencing behaviour: The mindspace way	Journal of Economic Psychology
7	Eigenbrod and Jansson 2018	How Digital Nudges Influence Consumers – Experimental Investigation in the Context of Retargeting	ECIS 2018 Proceedings
8	Faralla et al. 2017	Framing effects in intertemporal choice: A nudge experiment	Journal of Behavioral and Experimental Economics
9	Gamliel and Peer 2017	The Average Fuel-Efficiency Fallacy: Overestimation of Average Fuel Efficiency and How It Can Lead to Biased Decisions	Journal of Behavioral Decision Making
10	Goswami and Urminsky 2016	When should the Ask be a Nudge? The Effect of Default Amounts on Charitable Donations	Journal of Marketing Research
11	Gravert 2017	Pride and patronage - pay-what-you-want pricing at a charitable bookstore	Journal of Behavioral and Experimental Economics
12	Guthrie et al. 2015	Nudging Consumers toward Better Food Choices: Policy Approaches to Changing Food Consumption Behaviors	Psychology & Marketing
13	Hilton et al. 2014	A tax can nudge: The impact of an environmentally motivated bonus/malus fiscal system on transport preferences	Journal of Economic Psychology
14	Huh et al. 2014	Social Defaults: Observed Choices Become Choice Defaults	Journal of Consumer Research
15	Hummel et al. 2017	Designing Adaptive Nudges for Multi-Channel Choices of Digital Services	ECIS 2017 Proceedings

Table 9: List of reviewed research articles - Part 1

	Author & Year	Title	Publication
16	Jones et al. 2015	Effects of informational nudges on consumer debt repayment behaviors	Journal of Economic Psychology
17	Kretzer and Maedche 2018	Designing Social Nudges for Enterprise Recommendation Agents: An Investigation in the Business Intelligence Systems Context	Journal of the Association for Information Systems
18	Lades 2014	Impulsive consumption and reflexive thought: Nudging ethical consumer behavior	Journal of Economic Psychology
19	Langley et al. 2015	Should I Get That Job? Exploring Influence to Encourage Vaccination via Online Social Media	ECIS 2015 Proceedings
20	Laran et al. 2018	Nonconscious Nudges: Encouraging Sustained Goal Pursuit	Journal of Consumer Research
21	Lee et al. 2014	Monochrome Forests and Colorful Trees: The Effect of Black-and-White versus Color Imagery on Construal Level	Journal of Consumer Research
22	Lembregts and Van Den Bergh 2019	Making Each Unit Count: The Role of Discretizing Units in Quantity Expressions	Journal of Consumer Research
23	Mazar et al. 2018	If You Are Going to Pay Within the Next 24 Hours, Press 1: Automatic Planning Prompt Reduces Credit Card Delinquency	Journal of Consumer Psychology
24	Miller et al. 2016	The effects of pre-ordering and behavioral nudges on National School Lunch Program participants' food item selection	Journal of Economic Psychology
25	Münscher et al. 2016	A Review and Taxonomy of Choice Architecture Techniques: Choice Architecture Techniques	Journal of Behavioral Decision Making
26	Romero and Biswas 2016	Healthy-Left, Unhealthy-Right: Can Displaying Healthy Items to the Left (versus Right) of Unhealthy Items Nudge Healthier Choices?	Journal of Consumer Research
27	Schneider et al. 2017	Nudging Users Into Online Verification: The Case of Carsharing Platforms	ICIS 2017 Proceedings
28	Sleesman and Conlon 2017	Encouraging Prosocial Decisions: The Role of Fairness Salience and Uncertainty: Encouraging Prosocial Decisions	Journal of Behavioral Decision Making

Table 10: List of reviewed research articles - Part 2

	Author & Year	Title	Publication
29	Steffel et al. 2016	Ethically Deployed Defaults: Transparency and Consumer Protection through Disclosure and Preference Articulation	Journal of Marketing Research
30	Stryja et al. 2017	A Decision Support System Design to Overcome Resistance Towards Sustainable Innovations	ECIS 2017 Proceedings
31	Székely and Weinmann 2016	Nudging People to Pay CO2 Offsets - The Effect of Anchors in Flight Booking Processes	ECIS 2016 Proceedings
32	Tietz et al. 2016	The Decoy Effect in Reward-Based Crowdfunding: Preliminary Results from an Online Experiment	ICIS 2016 Proceedings
33	Wang et al. 2018	Socially Nudged: A Quasi-Experimental Study of Friends' Social Influence in Online Product Ratings	Information Systems Research
34	Watson et al. 2018	Swayed by the Numbers: The Consequences of Displaying Product Review Attributes	Journal of Marketing
35	Yang et al. 2011	The supremacy of singular subjectivity: Improving decision quality by removing objective specifications and direct comparisons	Journal of Consumer Psychology
36	Yoo and Sarin 2018	Consumer Choice and Market Outcomes Under Ambiguity in Product Quality	Marketing Science
37	Zarghamee et al. 2017	Nudging charitable giving: Three field experiments	Journal of Behavioral and Experimental Economics

Table 11: List of reviewed research articles - Part 3

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 12: List of domain codings

Research Method	Study	Sample	Application Area	Description	Heuristics	Choice architecture category	Choice architecture technique	Theoretical Perspective
1. Empirical	Zarghamee et al. (2017)	328 students	Prosocial behavior	An opt-out default increased donations by about 25%. Additionally, talking about the charity and giving more info material nudges social and moral norms and increases donations	Satus quo bias and social norms	Decision structure	Change choice defaults	Prospect theory
	Gravert (2017)	156 mixed adults	Consumer choice	Members, who are reminded of their membership right before making the pricing decision adjust their price upwards, while there is no reac- tion from non-members.	Social and moral norms	Decision assistance	Provide reminders	-
	Miller et al. (2016)	71 elementary students	Health	Nudge food pre-orderings in schools to a more healthy choice and balanced meal by giving feedback during the decision-making process. Students who receive the nudge order significantly more vegetables and low-fat products	-	Combination	Make information visible; Provide social reference point; Provide reminders	Libertarian paternalism
	Cosmo and O'Hara (2017)	5000 US households	Sustainability	Decision feedback resulted in reduction of electricity costs. Households with greater education react to the information associated to the TOU tariffs slightly more than the average.	-	Combination	Make information visible; Change option-related effort; Provide reminders	-
	Mazar et al. (2018)	53,075 US households	Consumer choice	Planning prompts affect consumer behavior. Specifying more concrete timeframe for paying credit card debts increases likelihood for following intentions	-	Combination	Change option-related effort; Facilitate commitment	-
	Jones et al. (2015)	approx. 500 US households	Finance	CARD act disclosures and additional information induces households to increase repayment amount	-	Decision information	Translate information; Make information visible	-
	Hilton et al. (2014)	887 students	Transportation	Nudge towards a more sustainable and environment friendly public transportation option. Taxes combined with social guidance nudge users towards the more sustainable option	Moral norms	Combination	Make information visible; Change option-related effort; Change option consequences	Reinforcement theory, Cognitive evaluation theory
	Basu and Savani (2017)	7 different survey conducted via MTurks. Each survey has approx. 200 participants	Consumer choice	People choosing among multiple options presented all together were more likely to select the optimal option than those choosing from the same options but presented one at a time	-	Combination	Make information visible; Change range or composition of options	Judgement under uncertainty
	Schneider et al. (2017)	299 adults	Security and privacy	Communication arguments can increase online verification conversions rates. But this depends heavily on the structure and framing of the argument (statement / motivation & label)	-	Combination	Translation of information, Change option consequences	Bounded rationality, Judgment under uncertainty, Model of argumentation, Regulatory focus theory
	Guthrie et al. (2015)	-	Health	Information efforts make people more aware of food choices. Understanding and finding the right amount of information is still difficult	Norms	Decision information	Translate information; Make information visible; Provide social reference point	Libertarian paternalism, Health Belief Model

Table 13: Coding matrix of empirical studies

Research Method	Study	Sample	Application Area	Description	Heuristics	Choice architecture category	Choice architecture technique	Theoretical Perspective
Laboratory experiment	Kretzer and Maedche (2018)	187 students	Business process management	In an enterprise setting, the the nudge in a recommendation systems allows employees to reuse existing resources more effectively.	Social norms	Decision information	Provide social reference point	Libertarian paternalism, Bounded rationality, Social cohesion, Social influence, Institutional isomorphism, Power in organizational hierarchies
	Wang et al. (2018)	50. Million ratings	Consumer choice	Social influence is stronger for more popular items and for users with smaller friend networks. In addition, extremely negative and more recent friends' ratings tend to exert greater influence	Social norms	Decision information	Provide social reference point	Social influence
	Romero and Biswas (2016)	122 adults (MTurk)	Consumer choice	Nudging food choices based on option positionings. It is more likely to choose the healthy option when it is located on the left side	Primacy and recency effect	Decision structure	Change range or composition of options	Left & right stimuli, Body-specificity
	Watson et al. (2018)	250 students	Consumer choice	Nudges in the number of product reviews can lead to suboptimal decisions for consumers and an increase in choice deferral for brands and retailers	Social norms	Decision information	Make information visible; Provide social reference point	Prospect theory
	Huh et al. (2014)	54 students	Consumer choice	The choice of another person appears to create a social default option which creates choice mimicry	Social norms	Decision information	Provide social reference point	Social influence, Behavioral Mimicry
	Laran et al. (2018)	865 students	Health	Introducing a delay between activation of a nonconscious goal and an initial choice encourages pursuit of the nonconscious goal. The second choice is consistent with the goal	-	Decision assistance	Provide reminders	-
	Lee et al. (2014)	94 students	Consumer choice	Make better decisions based on product attributes, not only product image. Colorful images influence the choice	-	Decision information	Make information visible	Construal level theory
	Bruns et al. (2018)	498 students	Sustainability	Default options nudge users towards a higher contribution to carbon emissions. Furthermore the transparency (info message) does not influence the default and the nudge. So, default nudges can be transparent and effective, too	Status quo bias	Decision structure	Change choice defaults	Salience theory, Psychological reactance theory
	Yang et al. (2011)	165, 179 and 92 students	Consumer choice	Consumers are more likely to choose what brings the best consumption experience if they are provided with subjective "feel like" product attributes. Objective specifications cause friction and make the choice more complex	-	Decision information	Translate information, Make information visible	General evaluability theory
	Tietz et al. (2016)	40 mixed adults	Consumer choice	Nudge people towards a specific reward on crowdfunding platforms. Decoys increased the donations by appr. 11 %	Decoy effect	Decision structure	Change range or composition of options	Libertarian paternalism, Judgement under uncertainty, Prospect theory
	Langley et al. (2015)	184 US mothers	Health	Nudge people towards healthier behavior and a specific vaccination. The nudge is performed on a online forum. The result shows that accination decisions are not taken in social isolation	Norms	Decision information	Provide social reference point	Health Belief Model
	Székely and Weinmann (2016)	150 adults	Sustainability	Proposing higher levels of default payments, significantly increases the amount of carbon offset payments	Status quo bias	Decision structure	Change choice defaults	Bounded rationality, Judgment under uncertainty,
	Hummel et al. (2017)	800 adults	Consumer choice	Participants can be nudged towards the Internet Channel when they are presented an individualized design feature	Norms	Decision information	Translate information, Provide social reference point	Libertarian paternalism
	Strjya et al. 2017	20 students	Consumer choice	Setting the sustainable innovation as default option has significant effect on its selection	Status quo bias	Decision structure	Change default options	Prospect theory, Speect act theory
	Eigenbrod and Janson (2018)	195 adults	Consumer choice	Thoughtful nudges lead to desirable consumer behavior in terms of retargeting. If nudges are not aligned with consumer needs, this can lead to increasing privacy concerns, cognitive overload and the fail of the retargeting strategy	-	Decision information	Make information visible, Provide social reference point	Libertarian paternalism, Psychological reactance theory

Table 14: Coding matrix of empirical studies - Part 2

Research Method	Study	Sample	Application Area	Description	Heuristics	Choice architecture category	Choice architecture technique	Theoretical Perspective
2. Non-empirical								
Conceptual	Cao et al. (2018)	-	Security and privacy	Sharing information among friends is mostly unregulated. A nudge to sensitize users is helpful if privacy is absolutely preferred	Social norms	Decision structure	Change option consequences	-
Literature review	Lades (2014)	-	Consumer Choice	Review factors that lead to impulsive choice behavior. How to build choice architectures that aim for more ethical decisions and less impulsive behavior	Social norms	Decisions assistance	Facilitate commitment	Theory of economic behavior
3. Diverse								
Literature review and conceptual	Yoo and Sarin (2018)	-	Consumer Choice	conceptual model on how to overcome ambiguity in product quality. Example: Quality of a product or service is difficult to estimate	-	Decision information	Translate information	-
	Münscher et al. (2016)	-	Consumer Choice	Classification of choice architecture techniques	-	-	-	Bounded rationality, Judgment under uncertainty
	Broniarczyk and Griffin (2014)	-	Consumer Choice	Several techniques can aid decision making such as: Preference Learning Tools, Product Filtering Tools, Comparison Tools, Recommendations, Defaults, Choice Delegation	-	-	-	Construal level theory
	Dolan et al. (2012)	-	-	In general a nudge should influence decision making process and make complex decisions easier	-	-	-	Libertarian paternalism, Prospect theory
Conceptual and survey	Gamliel and Peer (2017)	708 adults (MTurk)	Consumer Choice	Chaning measures in fuel efficiency is a nudge that helps people make better judgements and improved decisions. However, nudge is difficult to implement. 75% of the people choose the less efficient car	-	Decision information	Translate information	-
Laboratory experiment and field experiment	Goswami and Urmnsky (2016)	105 students, 3486 harvard alumni	Prosocial behavior	Nudging people towards higher charity donations. Default nudge cannot consistently increase funds raised	Status quo bias	Decision structure	Change choice defaults	Judgement under uncertainty
Laboratory experiment and survey	Steffel et al. (2016)	3 main studies with 363, 429 and 210 students	Security and privacy	Influence privacy decisions through default nudges. Default nudges should be made transparent. Results show that it's not easy to fully debase defaults. They still nudge the user	Status quo bias	Decision structure	Change choice defaults	Prospect theory
	Faralla et al. (2017)	135 students	Consumer Choice	Giving information about an "explicit penalty" (paying a fee if you take the money now) is a gentle nudge that leads to a focus on a more future-oriented future	-	Decision structure	Change option consequences	Prospect theory, Utility theory model of intertemporal choice
	Lembregts and Van Den Bergh (2019)	266 students	Consumer Choice	Expressing quantitative information about an unhealthy attribute in a more discretizing unit nudges consumers to the healthier option	Anchoring and adjustments	Decision information	Translate information	General evaluability theory
Laboratory experiment and survey and case study	Sleesman and Conlon (2017)	54 students for experiment 5000 adults for survey	Prosocial behavior	Nuge towards fairness and simple information can stimulate the willingness to pay or donate	Social norms	Decision information	Make information visible	Uncertainty theory

Table 15: Coding matrix of non-empirical and mixed studies

Coding category	Description
Research method	Approach the researchers follow. This can be an empirical or non-empirical approach
Study	Reference to the author of the study and the year
Sample	Short summary of the sample of the study. Only if it follows an empirical approach
Application area	Based on the literature review, eight domains are identified. Consumer choice, education, finance, health, prosocial behavior, sustainability, transportation, security & privacy, government. Additionally, other domains are summarized under the label "other"
Description	Summary of the study and the findings of the nudge experiment
Heuristics	Underlying cognitive heuristics and biases used to design the nudge
Choice architecture category	Based on Münscher et al. (2016), three categories of choice architecture manipulations are used to classify the literature. Decision information, decision structure and decision assistance. If more than one category is changed, this is labeled as "combination"
Choice architecture technique	Based on the choice architecture categories, several techniques for a change are listed. The techniques are: translate information, make information visible, provide social reference points, change option-related effort, change range or composition of options, change option consequences, provide reminders and facilitate commitment
Theoretical perspective	If one or more theoretical foundations are referenced in the study, they are listed here.

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, 7. April 2019

Marvin Messenzehl