

Digital Nudging: Employing the psychological aspect of Nudges to influence user's decision

ANASS ELTAHIR¹, Prof. Cai Xing²

¹ School of business, Nanjing University of Information Science and Technology, Nanjing, Jiangsu Province, China,210044

² School of business, Nanjing University of Information Science and Technology, Nanjing, Jiangsu Province, China,210044

Abstract: Research on nudge theory has witnessed vast progress in several fields in recent years, which later was embraced in the digital world and particularly in HCI. In this paper, we conducted a systematic review of the usage of nudging in HCI research to set the layout of the design in the digital atmosphere –the research investigated the cause of using certain nudges in addition to biases nudges are combating also in what way particular mechanisms do nudges employ to cause behavior change. Overall, we discovered 23 devices of nudging, assembled in 6 classifications, and resulting in 15 distinctive cognitive biases. Later, it was presented as a framework for digital nudging and examine the factors determining nudges' usefulness and their implications.

Keywords: Nudging, Digital Nudging, Behavioural Economics, Nudge Design, Choice Architecture.

I. INTRODUCTION

Individuals are irrational when it comes to making decisions and apply judgments, (Kosters, 2015) which means individuals more often make decisions that contradict their intentions even though they acknowledge such contradiction, this is called the knowledge-attitude-practice gap (Parkinson, 2014). As described by Daniel Kahneman, people make decisions based on two different systems, when it comes to daily life financial decisions and quick judgments, people rely more on system one, which greatly influenced by their environment and judgmental heuristics¹ (Campbell-Arvai, 2012), as a result, they tend to repeat the same mistakes many times. (Tobias Mirsch, 2017) Thaler and Sunstein in their book Nudge, presented several techniques to choice architects, to get the desired results and to influence human behavior by designing a choice environment that alters (nudge) human behaviour toward the anticipated outcome (Campbell-Arvai, 2012). Also, they identified Nudge as “any aspect of the choice architecture that alters people's behaviour predictably without forbidding any options or significantly changing their economic incentives (Richard H. Thaler, 2008, p. 6).

In the same context, Nudging is known as engineering an environment using nudges to achieve a certain goal. An example of Nudging, in reality, is the placement of healthy products near the entrance of a supermarket so that it is the first thing the consumer would notice (Tobias Mirsch, 2017 & Richard H. Thaler, 2009).

Although nudging has been discussed in various fields ranging from psychology (Guthrie, Mancino, & Lin, 2015), sociology (C Demarque, 2015), medicine” (Birthe A Lehmann, 2016) etc. this literature generally investigates the application of nudging in business and economics, in the recent years and with the advancement of technology as well as the expansion of the market, nudging techniques have been implemented by companies and governments both in physical and digital world to influence people choices. Moreover, in the digital world, there is an imperative need to apply nudging techniques to various decision-making process due to the increasing amount of decisions the user is making while using apps, websites, e-commerce sites, and other platforms on the internet (Markus Weinmann, 2016) which make it tedious for the user to constitute efficient decisions. employing nudging mechanisms in the digital sphere is greatly important and valuable to guide the user decision-making process, In comparison with the use of nudge in the physical world, digital nudging is more effective, easier, and faster (Markus Weinmann, 2016).

¹ Any method of solving a problem that is based on straightforward rules of thumb and is not warranted to be most favorable, best or rational, but it is still enough to achieve instantaneous, short-term results.

This paper discusses digital nudging as a related and promising research field for business and design researchers in particular, although, previous research studied the design elements involved in the process (Tobias Mirsch, 2017) and its applications (Dennis Hummel, 2019) there are few research delve into other concepts and theories related to nudging design. (Datta, 2014) and (Ly, 2013) in behavioral economics, employed the nudge theory to the online context by introducing the life cycle of designing digital nudge designs as illustrated in figure 1.

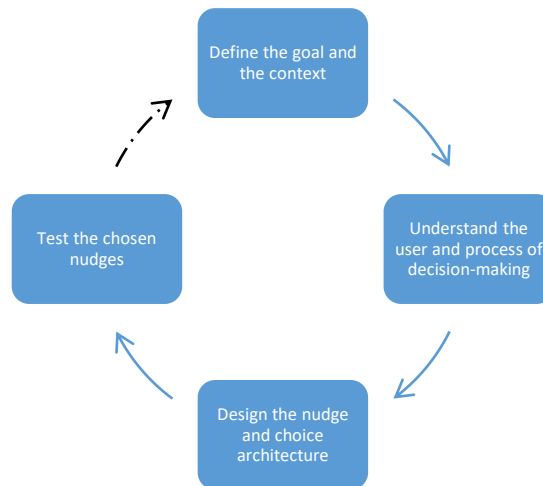


Figure 1: Designing digital nudge cycle²

In their research paper, (Markus Weinmann, 2016) addressed the stages of digital nudge design briefly, therefore, this paper focuses more on the third step in creating a nudge which is the nudge design, by conducting a systematic review of the literature from different specialties, as well as, relevant examples as a reference for possible implementations.

This paper contributes to the existing literature in two ways, as a recent field, digital nudging is a promising research subject in the information system IS, and specifically on interface design, while existing approaches and guidelines were mainly developed for nudging in the physical environment, digital nudging is drawing on these guides to execute it in the digital environment, in this way this paper addresses how nudge is being designed based on the previous literature and thus provide the foundation for initial ideas to be tested.

This paper is structured as follows: the first section introduces an overview of the theoretical background of behavioural economics followed by nudge theory and behavioural design, afterward the applied methodology of the literature analysis and its results. The paper then concludes with a summary, limitations, and further research.

II. THEORETICAL BACKGROUND

A. Behavioural economics and Nudge theory

Contrary to economics preconceptions about human beings as relational, recent studies in sociology and psychology proved empirically that humans are far from being rational in making decisions and judgment, taking into consideration these findings and to better understand human behaviour, economists have integrated psychology which resulted in behavioural economic thus, behavioural economics provide economic analysis with a deeper and more accurate psychological background. “(LOEWENSTEIN, 2004).

According to The Two Systems of Thinking proposed by Daniel Kahnmann, and dual-process theory, there are two different way of thinking operate the human mind also called systems “system1 and system2”, system 1 is intuitive, automatic, fast, and influenced by emotions while system 2 is rational, slow and rule-based. On repeated daily life decisions, individuals tend to rely on system 1 for making an effortless, quick decision which makes them more disposed to heuristics and biases. furthermore, system 1 to a great extent is prejudiced to the environment and the context of choices are presented. (Kahneman, 2011) (Maps of Bounded Rationality: Psychology for Behavioural Economics, 2003).

Nudging is a related theory to behavioural economics inducing subjects to behave in a certain manner by altering the environment.

² Adapted from (Datta, 2014) and (Ly, 2013).

Nudge is a simple intervention in choice design to guide individuals using particular psychological effects or to overcome them. Nudges are a favourable kind of intervention because they maintain the full freedom to choose. (Richard H. Thaler, 2008) An example of a nudge is organ donation, nowadays donors usually need to “opt-in” by filling forms to donate, this in most cases results in low participation rates, as people tend to become hesitant and lazy to join, on the other hand, using “opt-out” as a default option most likely will lead to a higher rate of donors.” (Pettinger, 2021)”

Nudges are not counted when a donor enrolls by his own choice without the “opt-out” option being applied. The same concept applies to the digital context, in which digital nudges are the use of interface design elements to influence user’s choices in the digital environment.” (Markus Weinmann, 2016).

B. User Interface design

Studies in the UI design fieldwork aim to maximize the usability of design elements to facilitate the interaction between human and IT devices. UX term refers to a wide range of meanings from “traditional usability to beauty, hedonic, affective or experiential aspects of technology use”. UX goes beyond the implemental needs of design to the acknowledgment of its use as a personal, situated, intricate and lively encounter. It can be defined as a result of the inner state of the user, such as needs, motivation, expectations, or feelings.

HCI researchers have investigated numerous principles and strategies for worthy UI design e.g., (Debbie Stone, 2005), (Ben Shneiderman, 2010). Those strategies are based on a thorough understanding of users’ behaviors and needs also admit demographic diversity as an initial point for the design process (e.g., IFIP reference model (Oppermann, 2002)).

UI design principles are constantly changing as the interaction methods are varying with digital devices. As a matter of fact, studies on HCI striving to improve its approaches along with interfaces and experiences related to technological and user advancement. thus, HCI researchers frequently rely on other fields to enhance their understanding, for example, ethnography and phenomenological philosophy (Hurtienne, 2009). On that account, researchers in HCI can benefit greatly from behavioral economics findings and nudge theory insights in particular. As mentioned earlier, human decisions are mostly biased and imperfect, this could be reflected in digital nudges design. Additionally, following this strategy, a thorough analysis would link the concept with practice. As a result, It will pave the way for developing new theories in addition to experimental approaches or further understanding of how different methods are integrated.

In general, further discussion can be established together with practical results drawn from experiments, this will lead to performance enhancement, satisfied users, and error reduction (Proctor & Vu, 2016).

III. REVIEW OF LITERATURE ABOUT NUDGING

A. Systematic literature review

A comprehensive review of literature conducted in March 2021, demonstrates a wide-ranging outline of the current research on digital nudging, the appropriate framework nudges in addition to relevant concepts, such as libertarian paternalism and behavioural economics. Based on Literature reviewing framework and methodology suggested by vom Brocke et al., we followed the literature search process, by searching in scholarly journals and academic conferences databases. Using related terms in the field, four searches conducted in the title, abstract, and keywords as illustrated by table 1.

<i>Search phrase Database</i>	<i>Nudging OR Digital Nudge</i>	<i>Digital Nudge AND Choice architecture</i>	<i>Digital Nudge AND Nudging mechanism</i>	<i>Digital Nudge AND Interface design</i>
ScienceDirect	197	190	504	226
EbscoHost	105	85	308	150
ACM Digital library	920	757	397	764
Google Scholar	59	109	600	317
Overall results				1457
Sum of relevant articles				96

After refining the results from duplicated papers and non-relevant field articles such as atmospheric and meteorology subjects and lastly, we concentrated on only articles discuss concrete nudges and/or nudging frameworks utilized by designers to pick out appropriate nudges. Afterward, the desired choice determines the elements and patterns of design that are going to be employed.

B. Identified nudges mechanisms and their applications

Across the literature review, nudges were being identified, they were categorized into six nudging sorts based on the motive behind making a decision and the feelings associated with it (Caraban, 2019) they are as follow: **facilitate, confront, deceive, social influence, fear, and reinforce** which cover **23 nudges**. These nudges were mainly implemented in the medicine, environmental, and privacy field. The majority of papers explained the mechanisms, the related nudges, and provided examples. However, they failed to classify them according to their functions. Figure 2 provides an overview of the identified nudges based on the literature review.

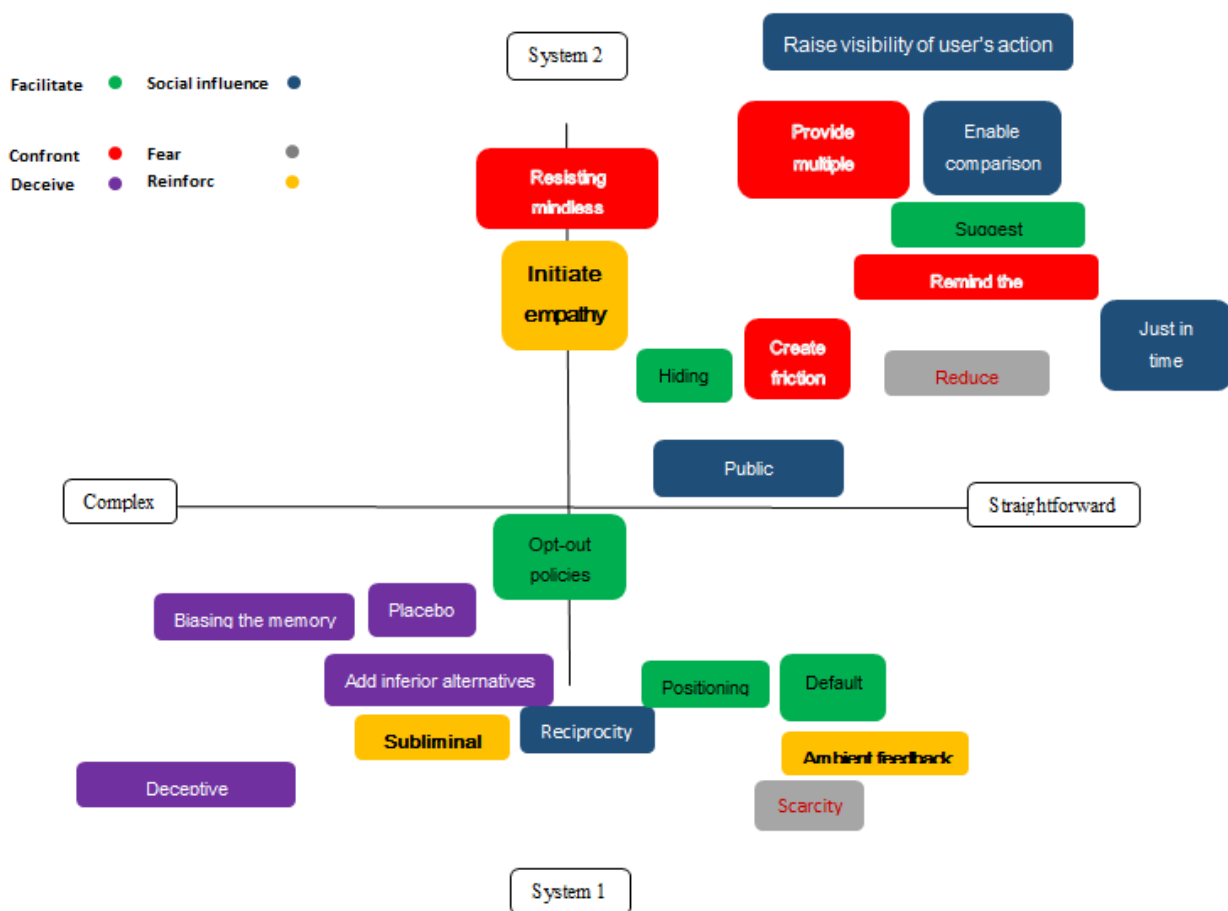


Figure 2: Nudges placed on the complexity and the two systems axes

1) Facilitate

Nudges under this category work as facilitators in decision-making using system 1 way of thinking as fast and effortless system which individuals tend to rely on in making decisions. They are mainly designed to incite users to automatically follow default options, which appeals to the user's propensity to stick to the status quo and to follow the least resistant path (Richard H. Thaler, 2008), (Ritov & Baron, 1992). The inclination of "choosing not to choose" steers individuals to uphold pre-made choices since figuring out the best choice takes time, and unreliable (Kahneman, Knetsch, & Thaler, Anomalies: The endowment effect, loss aversion, and status quo bias, 1991), (Sunstein, 2013). The followings are the most commonly used nudges that are considered as facilitators.

- **Default options**

Setting defaults is an efficient nudge used usually in uncertain situations during the decision-making process (Samson, 2014). Given that defaults are convenient for users, defaults perhaps a simple but also an effective tool when there is inaction (Ramani, 2018). Likewise, defaults is suggested when options are complex. In the digital world, various instances can be detected. For example, in one study, around double of participants granted permission to receive e-mail marketing about healthcare when receiving a positive default option in comparison when the default option was negative (Johnson, Bellman, & Lohse, 2002). The most suitable design element for this nudge is **Radio buttons** (with default choice). Radio buttons are applied when two “binary “or “discrete” more choices are equally exclusive and the user should pick just one option. further functional design elements for defaults are **Checkboxes** and **Dropdown menus** that can be employed in the case of discrete choices.

- **Opt-In, Opt-Out policies**

Resembling defaults, opt-out policies operate by supposing users’ agreement to a process, leading to automatic membership. There are several examples of opt-out policies applied on the internet. For example, Lehmann et al. (Birthe A Lehmann G. B., 2016) replaced an opt-in policy, where the user to sign up has to fill in the registration form to become a member to opt-out policy by simply following the link sent to the email to enroll. By the same token, Pixel (Kankane, DiRusso, & Buckley, 2018) attempt to strengthen password security by spontaneously joining users to the password generation feature. If a user wants to create her password, he/she ought to opt-out of the feature.

- **Positioning**

Differently to draw on the status-quo bias is by adjusting the visual placement of the choices presented. For example, Turland et al. (Turland, Coventry, Jeske, Briggs, & Moorsel, 2015) re-arranged the appearance of wireless networks (i.e. ranking the most protected options at the topmost) and utilizing the color codes to mark them. Results show a significant increase with 60% in selecting the secured networks in comparison with unsecured networks. Following the same strategy, Cai et al. (Cai & Xu., 2008) experimented with different types of orders related to the quality of products in a wholesale website. They discovered that the descending order guided consumers to consider the first option as the reference, to compare it with the following options. simultaneously, it enhances the perception of quality associated with products in comparison to the ascending list, where shoppers attributed more value to the products' price.

2) **Confront**

Confront nudges dissuade unwanted actions through impress upon doubts. By taking advantage of the regret aversion bias—which states that humans favor cautious and risk-averse decisions (Samuelson & Zeckhauser, 1988)—bringing awareness and inducing reflection thinking during the decision process.

- **Controlling mind-numbing activity**

When attacking tedious activity, a simple time barrier to turn around the action can be appropriately useful. For example, to provoke such an effect Wang et al. (Wang, et al., 2014) designed a plugin that gives Facebook users 10 seconds to re-check their post before posting. They discovered that some users edit their post content during the buffer time and some even canceled the post altogether.

- **Recall Consequences**

Individuals are heavily influenced by their surroundings and their choices and judgments are products of the level of exposure to information provided to them. The availability heuristic point toward the aforementioned statement which is our propensity to judge the likelihood of incidence of an event is based on its readiness to be remembered (Richard H. Thaler 2008) (Tversky & Kahneman, 1974). Consequently, we are more inclined to expect certain events to occur when they are instantly available to our cognitive processing, on the other hand, incidents are more likely to fade away over time. Nudges in this category aim to urge users to ponder on the consequences of their behaviors. For example, Harbach et al. (Harbach, Hettig, Weber, & Smith, 2014) reframed the permissions message of the Google Play Store to remind the users about the potential privacy threats from app authorizations. Correspondingly, Minkus et al. (Minkus, Liu, & Ross, 2015) built a Facebook plugin that confronts the user when revealing children's pictures: “It looks like there’s a child in the photo you are about to upload. Consider making your account private or Limit the audience of the potential viewer”.

3) Deceive

Benefiting from deception mechanisms, nudges in this category play on individual perception and experience to stimulate certain results.

- **Inserting inferior options**

The decoy effect denotes our predisposition to increase the liking for an option when a lower alternative (decoy) is added to the primary set (Bateman, Munro, & Poe, 2008). For example, Lee et al. (Lee, Kiesler, & Forlizzi, 2011) leveraged the decoy effect to offer various healthy products on a snack ordering website. To entice the preference for fruit over a cookie, the picture of a huge and polished Fuji apple was placed next to a minute withered apple. Only by positioning an inferior choice, the value of the attribute is amplified. By the same token, Fasolo et al. (Fasolo, Misuraca, McClelland, & Cardaci, 2006) encouraged the buying of a high-quality laptop on an e-commerce site by position it next to lower quality.

4) Social Influence

Social influence nudges make the most of people's longing to conform and live up to the expectations of others.

- **Leveraging public commitment**

The commitment bias is our inclination to be true to our word, even if it is against our interest (Staw, 1981). For example, asking patients to confirm verbally their appointments stimulates decisions per the arrangement made (Hansen & Jespersen, 2013). following this strategy, in online classes, Cheng et al. (Cheng, Kulkarni, & Klemmer, 2013) managed to reduce the rate of student drop-outs, simply by adding a button at the top of the assignment site with the note "I've started on this Assignment". by clicking, the button turns green, and the student logged in to the system which displays the progress through the assignment to the class teacher. This approach proved to prompt higher task fulfillment and goal attainment (Cheng, Kulkarni, & Klemmer, 2013).

5) Fear

Fear nudges conjure feelings of fear, loss, and insecurity to drive the user to act.

- **Make resources scarce**

One approach is to diminish the perceived availability of a substitute in terms of number, scarcity, or time. The scarcity bias refers to our propensity to associate more value to an object since we believe it will be harder to acquire in the future (Cialdini, 1987) (Caraban, 2019). For example, publicizing limited seats at future events make it more likely for more audience to buy tickets earlier (Cialdini, 1987) (Caraban, 2019). (Cialdini, 1987) concludes that humans are theorized to be loss averse, therefore, they are more inclined to take actions when there is a high possibility of missing out. Kaptein et al. (Kaptein, Markopoulos, de Ruyter, & Aarts, 2015) used persuasive messages to derive benefit from this tendency such as: "There is only one chance a day to reduce snacking. Take that chance today".

6) Reinforce

Nudges in this category inspire to emphasize behaviors through intensifying their exposure in individuals' thinking.

- **Just-in-time prompts**

Just-in-time highlights certain behaviors at appropriate times (e.g., when a behavior strays from the standard). For example, WalkMinder (Hirano, Farrell, Danis, & Kellogg, 2013) rings when the user is dormant for lengthy periods, while EcoMeal (Kim, Park, & Lee, 2016) weigh up the food on the plate, and gives feedback when the eating pace is surpassing the limit. Likewise, Eco-driving (Lee, Lim, & Lee, 2012) offers simple feedback when the driver moves away from fuel-efficient driving, while the Smart Steering Wheel (Ibragimova, Mueller, Vermeeren, & Vink, 2015) shakes when aggressive driving behaviors are assumed. McGee-Lennon et al. (McGee-Lennon, Wolters, McLachlan, Brewster, & Hall, 2011) investigated the use of hearing icons to support prescription devotion among senior citizens, while Zhu et al. (Fengyuan Zhu, 2017) used pop-up alerts to urge posture correction.

- **Initiating empathy**

Drawing on the affect heuristic which indicates that, given that our first reactions to incentives are affective, they have a powerful influence on decision making (Slovic, Finucane, Peters, & MacGregor, 2007), empathy nudges capitalize on emotionally charged demonstrations to elicit feelings of compassion. One example is the Never Hungry Caterpillar (Laschke, Hassenzahl, & Diefenbach, 2011), a system for maintaining the energy that utilizes the illustration of a living animal, a ‘caterpillar’, to show the feedback and involve users in sustainable behaviors. When the system senses ‘ideal’ energy consumption, the ‘caterpillar’ extension breathes gently and slowly. When behaviors stray from the ideal (e.g. leaving a device on standby mode), the extension begins twisting in pain. Correspondingly, Dillahunt et al. (Dillahunt, Lyra, Barreto, & Kara, 2017) studied the value of different emotionally engaging picturing, such as bright versus gloomy and windy surroundings, or a polar bear whose life is endangered, to induce pro-environmental manners among children. Finally, Powerbar (Crowley, Heitz, Matta, Mori, & Banerjee, 2011) tries to encourage eco-friendly behaviors by allowing users to donate money to institutions related to childhood care and education, portraying information about the beneficiary’s location and the purpose.

IV. DISCUSSIONS

During the process of designing new types of nudges, there are some points designers need to take into consideration for instance, when choosing “Suggesting alternatives” as a nudge, he should be familiar with the number of choices he would suggest and at which point he proposes them, also what the most suitable design element to use for presenting the alternatives (e.g., highlighted, prechecked as in radio button). . Equally, in the “default” nudge, designers must reason what establishes a proper default choice and why; how clearly can users opt-out of the default and the effect will this have on users’ freedom and the usefulness of the system. Correspondingly, when designing signals, we recommend adhering to the following structural design: timing, tailoring, and frequency. To trigger certain behavior, choosing the right time for the signal is crucial. Next, reminders that are customized and aim at a particular situation repeatedly are more efficient in changing behavior than general reminders, moreover the effectiveness of prompts influenced by their frequency (Nef, 2009).

V. CONCLUSION AND FURTHER RESEARCH

This paper examines the design of nudges in the digital atmosphere by conducting a systematic review of technological patterns in HCI. Although preceding frameworks have reviewed the various cognitive biases and particular applications of nudges, they did not lay out the design mechanism of nudging. This paper attempts to link the cognitive biases and heuristics with the appropriate mechanisms of nudging. Future research should advance into designing a framework and tools to reinforce the design of digital nudging.

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