Zsófia Gyulai

THE IMPACT OF DIGITAL NUDGES ON USER DECISIONS IN SOFTWARE AS A SERVICE

Theses of the Ph.D. Dissertation

Szeged, 2023

University of Szeged
Faculty of Economics and Business Administration
Doctoral School of Economics

THE IMPACT OF DIGITAL NUDGES ON USER DECISIONS IN SOFTWARE AS A SERVICE

Theses of the Ph.D. Dissertation

Supervisor:
Dr. Balázs Révész
associate professor
University of Szeged
Faculty of Economics and Business Administration

Szeged, 2023

Table of Contents

1. Relevance and justification of the topic

In the age of the digital economy, where Software as a Service (SaaS) business models are becoming increasingly dominant, it is vital to have a deep understanding of the decision-making processes of users. This dissertation focuses on a particularly interesting area within the SaaS sector: how digital nudges influence the online decision-making processes of software as a service users. The central question of the research is: "How do digital nudges affect the online decision-making processes of users of the software as a service? This question leads the research to not only explore the direct effects of digital nudges, but also to embrace a bold objective: to categorise and organise digital nudges in a scientifically rigorous way.

As SaaS platforms reshape market dynamics and user behaviour, the importance of digital nudges is increasingly coming to the fore. By establishing a clearer classification of digital nudges, this work aims to enrich the literature and provide practical insights for companies seeking to optimise their user engagement strategies in a world where the relevance of the software as a service is increasing year on year. In this introduction I will provide insights into the relevance and key concepts of software as a service**.**

The software as a service model is a modern way of delivering software services based on the principle that software is offered as a service rather than a product. Customers are provided with a single set of functionality, with minimal scope for customer-specific changes, and vendors seek economies of scale (Godse és Mulik, 2009; Liao, 2010). With the rapid growth of the delivered software market, there is an increasing emphasis on providing an enjoyable, customer-centric service, as this can provide companies with a long-term competitive advantage (Halvorsrud, Kvale és Følstad, 2016; Lemon és Verhoef, 2016).

The development of the SaaS industry has been remarkable, with a 3.5-fold increase in revenues since 2016, according to STATISTA 2022. The dynamic growth of the industry can be attributed to the even greater uptake of online solutions, as well as to more efficient working and leisure activities provided by cloud-based systems.

The increased use of digital nudges has changed the way users interact with the software they use. Given the importance of digital nudges in the purchase decision (in this case subscription) process, it is essential to understand their impact on users' willingness to subscribe to the SaaS. Advances in information technology have led to more complex and irrational purchase decision processes, which highlights the importance of studying digital instincts (Bergram *et al.*, 2022) such as the phenomenon of 'flash sales', where consumers make quick and often ill-considered

purchases in response to limited-time promotions, or the proliferation of online offers, which leaves consumers unable to review all options and make rational decisions.

Software as a services usually use two main business models: one is the freemium subscription offer and the other is the free trial, but they can be used simultaneously (Ju et al, In the freemium model, the basic services are provided free of charge, while premium services are provided for a fee (Osterwalder and Pigneur, 2010). In contrast, with the free trial model, the service is provided with full functionality for a limited period of time (Ju et al, Marketing professionals in SaaS companies use various digital incentives to persuade users to upgrade from the freemium plan to the premium plan or to subscribe after the free trial period (Koch, 2017).

2. The theoretical background of the research

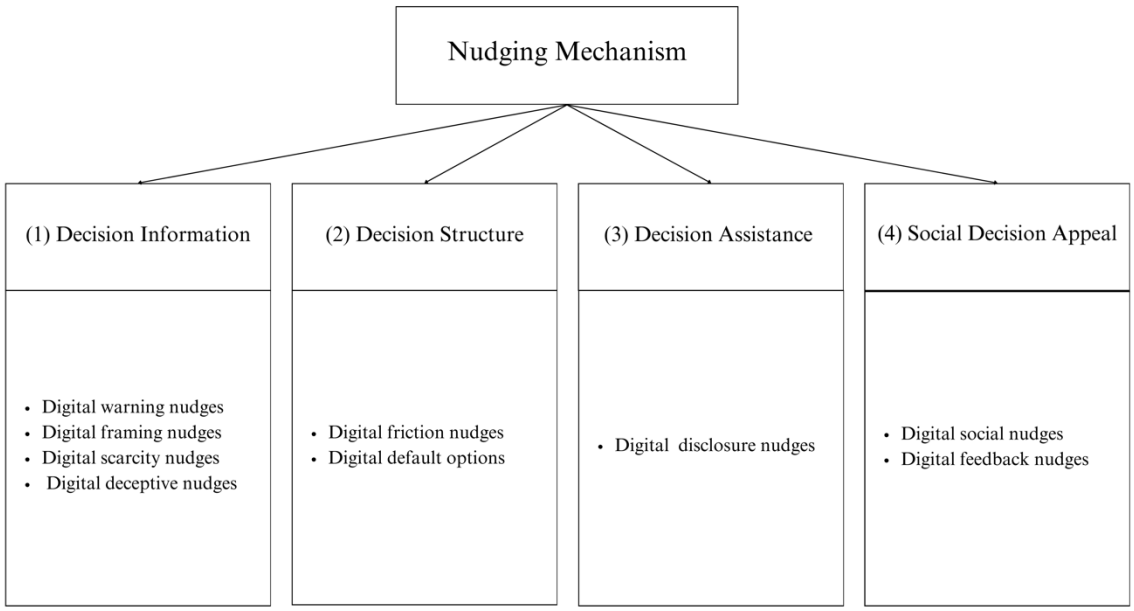
Behavioural economics focuses on the study of human economic behaviour and decision making from a psychological perspective, with an emphasis on heuristics and biases (Koltay and Vincze, 2009). These mental shortcuts and systematic errors are key to understanding human decision making, as they affect how we process information and react to different economic situations. As simplifying rules, heuristics allow people to make decisions quickly in complex or uncertain environments, but can often lead to biases that can distract them from rational thinking (Tversky and Kahneman, 1974). These biases, such as overconfidence or the anchor effect, can have a significant impact on economic decisions, so behavioural economics contributes to a deeper understanding of economic behaviour and to more effective decision-making strategies by understanding and analysing such phenomena. Heuristics and biases are often used in practice to design pricing and various "nudges".

Nudges are aimed at influencing human behaviour without coercing, constraining or changing economic factors (Thaler and Sunstein, 2008). Nudges can help improve individuals' decisions by exploiting human psychological biases and heuristics. Types of nudges include social nudges, informational nudges, disclosure nudges, reinforcement nudges, default options, frictional nudges, feedback nudges, attention nudges, scarcity nudges, framing nudges, deceptive nudges, commitment nudges, simplification nudges, and reminders.

The thesis links the foundations of behavioural economics and decision-making processes to online purchasing decisions, emphasising the role of digital nudges. In the digital space, trust, the functioning of websites, and social proof are all important in **online decision making**, but this research focuses on the role of digital nudges.

Digital nudges are a combination of behavioural economics and technological innovation to influence user decision-making in the digital space (Bergram *et al.*, 2022). The impact of digital nudges is much more widely felt than traditional nudges. According to Mirsch, Lehrer and Jung (2018), digital interfaces enable a personalised and dynamic approach, which will be further enhanced by the development of artificial intelligence. Digital nudges can be used not only for shopping incentives, but also for ethical purposes such as reducing energy consumption or helping to make prudent financial decisions. The study by Jesse and Jannach (2021) helps us to fit nudges to heuristics. Bergram *et al.* (2022) identified nine types of digital nudges, such as social nudges, reinforcement nudges, disclosure nudges, frictional nudges, feedback nudges, default options, warning nudges, scarcity nudges and deceptive nudges. Based on the studies of Bergram *et al.* (2022) and Jesse and Jannach (2021), I have created my system for categorising digital nudges (Figure 1).

Figure 1 Categorisation of digital nudges identified by Bergram et al (2022) based on the framework of Jesse and Jannach (2021)

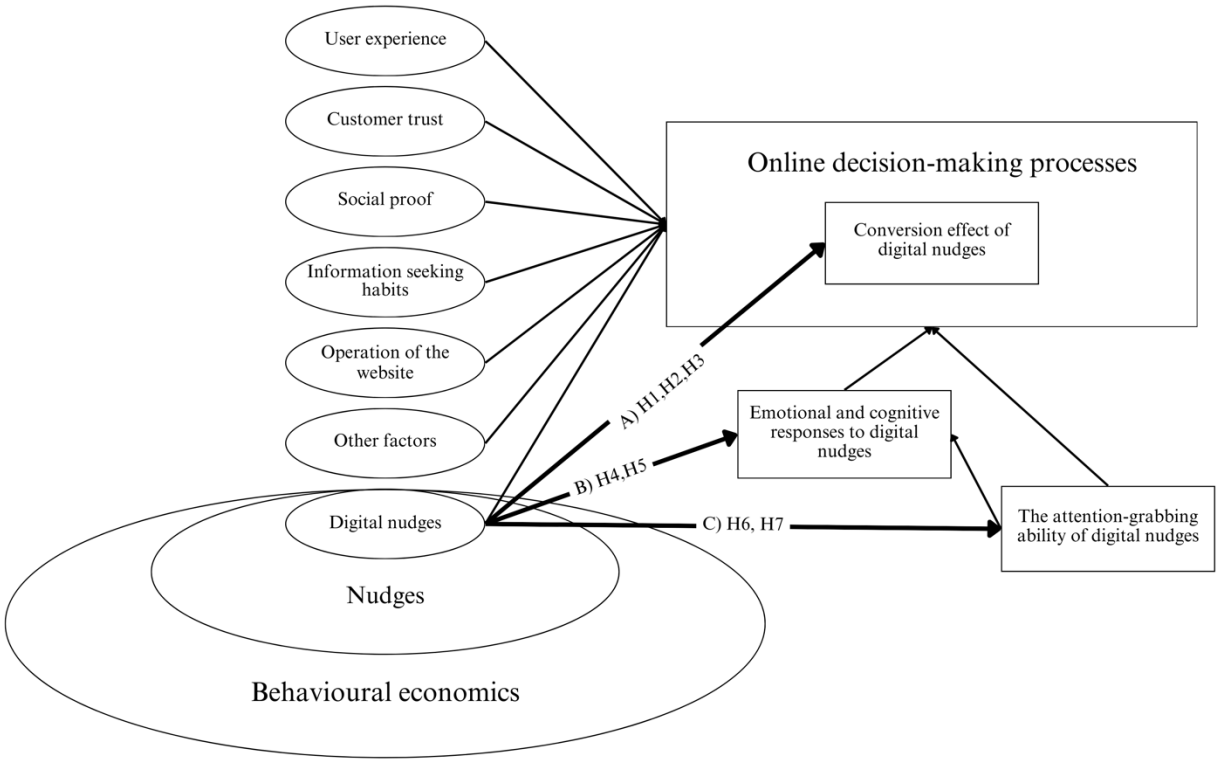


Source: based on Jesse and Jannach (2021) and Bergram et al., (2022) own editing

My theoretical model focuses on the analysis of the impact of digital nudges on the online decision-making processes of software as a service by digital nudges. The model aims to provide a visual representation of the factors that influence online decision-making processes and the specific impact of digital nudges on these processes (Figure 2).

Figure 2 Theoretical model

RQ: How do digital nudges affect the online decision makingdecision-making processes of users of software as a services?



Source: own editing

The model shows how, in the theoretical summary, after a detailed discussion of the foundations of behavioural economics - where the reader can also learn about the various heuristics and biases - I narrowed the focus of the secondary research to digital nudges by analysing traditional nudges.

The model also looks at how digital nudges influence users' thoughts and feelings about these devices, and how these psychological reactions are related to the attention-grabbing capacity of nudges. Attention-grabbing has a twofold effect: on the one hand, it directly influences decision-making processes and, on the other hand, it indirectly influences them through the thoughts and feelings it evokes.

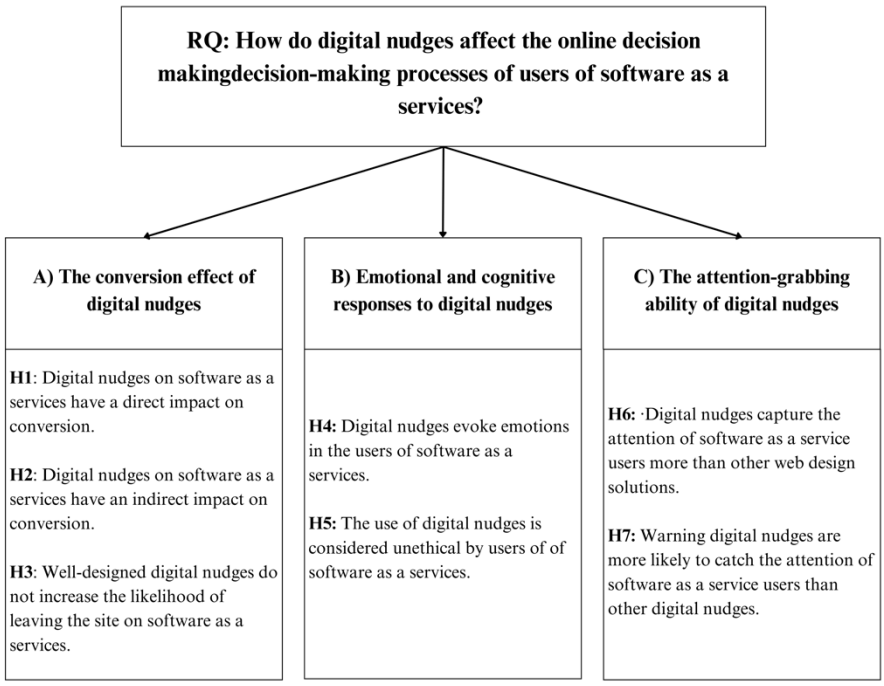
The research question of my dissertation is: How do digital nudges affect the online decision-making processes of users of the software as a service? To this end, my hypotheses H1, H2 and H3 investigate the conversion ability of digital nudges, while my preliminary hypotheses H4 and H5 analyse the cognitive and emotional reactions generated by digital

nudges. My preliminary hypotheses H6 and H7 investigate the attention-grabbing ability of digital nudges.

3. Aims, hypotheses and structure of the research

Three themes are related to the research question: A) the conversion ability of nudges, B) the cognitive and emotional reactions they elicit, and C) their ability to attract and retain attention (Figure 3).

Figure 3 Hypotheses related to the research question, grouped by topic



Source: own editing

The **broader aims of the research** included the categorisation and classification of categories of digital nudges, which are key to the field of behavioural design, in a scientifically rigorous way in secondary research. In the primary research, I aimed to analyse the impact of each type of digital nudge by type through a specifically selected, well-defined contextual study. A further objective is to provide in-depth insights into users' needs and preferences for digital nudges, which will provide valuable input for design processes. In the following, the hypotheses are presented in detail, topic by topic.

A) The conversion effect of digital nudges

For the SaaS under analysis, the target conversion is the transition from the freemium or free trial business model to the premium business model, i.e. the activation of the

subscription. This transition can only take place for customers who are already active users of the SaaS as in all cases the service starts with a free trial phase.

H1: *Digital nudges on software as a services have a direct impact on conversion.*

In this research, I define the concept of "direct effect" as a phenomenon where the digital nudge integrates a button that explicitly encourages the user to subscribe, thus allowing the effect to be quantified. In this case, the data provided by web analytics software will allow to accurately measure whether the increase in the number of subscriptions is directly due to the presence of the nudge.

Schneider (2021) examines the impact of digital nudges on conversion rates in companies with different business models and finds that digital nudges are successful in increasing conversion rates on the platforms he studies. The SaaS has not been analysed so far.

H2: *Digital nudges on software as a services have an indirect impact on conversion.*

The term "indirect effect" in the research refers to the fact that the general presence of digital nudges on the website is associated with an increase in the number of subscribers, without these subscriptions being clearly identifiable as a direct response to specific calls for action in the nudges. In this case, the effect of nudges on user behaviour and decision making on the website can be understood more generally, where the increase in subscriptions is the result of more subtle psychological and behavioural influences of nudges.

A study on the indirect effectiveness of digital nudges was not available in the databases available to me, but Mittal and Nault (2009) research can make a significant contribution to the discussion of this hypothesis. Mittal and Nault's (2009) work, while not specifically concerned with digital incentives, does examine in depth the broad -indirect- effects of IT developments, including the design of web design elements.

Digital nudges play a key role in indirectly increasing conversion rates by providing subtle psychological nudges to users, encouraging them to take the desired action. For example, scarcity nudges take advantage of the limited availability of products or services, thereby increasing their perceptual value and urging users to act quickly. Social proof, such as positive reviews from other customers, reinforces user confidence and reduces the perception of risk associated with purchase decisions. And the strategic use of free trials allows users to test a product or service risk-free, which can lead to long-term commitment and migration to premium versions. Overall, these techniques improve the user experience, increase the

attractiveness of products and services, and contribute to higher conversion rates (Schneider, 2017; Schneider et al., 2018).

H3: *Well-designed digital nudges do not increase the likelihood of leaving the site on software as a services.*

The research hypothesised that carefully designed digital nudges would not be an obstacle or distraction for users but would be integrated into the design of the website in a way that would be intuitive to ignore. The nudge strategies implemented on the website under analysis meet these criteria. Based on this, my hypothesis is that such well-implemented nudge elements do not lead to an increase in the number of check-outs from the website for the subpages where these nudges appear. The exit rate is the percentage of visitors to a website who have left a particular page, regardless of whether they have visited other pages in that session.

HubSpot expert Juviler (2023) points out that exit rate, as a website metric, can help improve the user experience, i.e. identify the points at which visitors leave a website. Every site will have an exit rate, but an exit rate of 100% may indicate performance issues on the website. An appropriate exit rate will depend largely on the type of site and its purpose. For content-driven sites such as blogs or articles, a higher exit rate of around 70%-80% is expected, while for deeper points in the e-commerce process such as product pages or payment sites, a lower rate of between 20%-40% is ideal. A high exit rate on product pages or payment pages may indicate problems with navigation, content quality or user experience, which, based on studies by Schneider (2017) and Schneider et al. (2018), may indirectly reduce conversion rates. Exit rate research also supports that the quality of use and ease of use of a website or application has a direct impact on user engagement and purchase intentions (Garrett, 2011; Norman, 2013). Research by Gallino, Karacaoglu and Moreno (2023) also supports that user-friendly website design plays a crucial role in driving website visitors to convert. According to Congiu and Moscati (2022), the positive user experience created by digital nudges can contribute to increased brand loyalty and consumer trust, which can benefit companies in the long run.

B) Cognitive and emotional responses to digital nudges

H4: *Digital nudges evoke emotions in the users of software as a services.*

One segment of the digital nudge strategies I analysed was designed by the company in question to generate targeted emotions (guilt, regret) in users, with the ultimate goal of

increasing subscription. In this research, I will examine the effectiveness of this design and the true nature of user reactions in order to confirm or refute the company's intention.

Digital nudges can trigger a variety of emotions in users, ranging from positive to negative. According to the literature, digital nudges can lead to positive emotions such as satisfaction, trust and self-confidence by directing users towards useful and personalised recommendations to help them make decisions (Weinmann, Schneider and Brocke, 2016). However, if nudges are perceived as too manipulative or if users feel that they restrict their freedom of choice, they can trigger frustration, resistance or even distrust (Cialdini, 2007; Sunstein, 2017), so it is crucial to take users' feelings and preferences into account when using digital nudges.

According to Bavel et al. (2019), the effectiveness of warning nudges depends on the emotional and cognitive reactions of consumers, so accurate knowledge of the stakeholders and targeted messaging are essential.

H5: *The use of digital nudges is considered unethical by users of software as a services.*

The literature shows that nudges can sometimes raise ethical questions. As such, one of the focal points of my research is to investigate the extent to which users perceive carefully crafted digital nudges as unethical.

Examining the ethical dimensions of digital nudges reveals a complex and multifaceted set of issues, with a focus on consumer autonomy and manipulation, transparency in decision-making processes, and consumer welfare. Nudges have a significant impact on consumer behaviour that neither market actors nor researchers can ignore (Smith, Goldstein and Johnson, 2013). From an ethical perspective, it is particularly important that nudge designers keep consumer welfare and autonomy in mind when designing nudges, and that they use nudges that promote consumer decision-making without being manipulative (Smith, Goldstein and Johnson, 2013). Despite concerns about consumer autonomy and welfare, Lemken (2021) points out that transparent and ethically designed nudges can be as effective as non-transparent versions of nudges, and that structuring choice frameworks appropriately can increase the success of nudges. Thus, the formulation of ethical guidelines and respect for autonomy are not only possible but also desirable when using nudges (Meske and Amojo, 2020). Schmidt and Engelen (2020) argue that nudges should be examined on a case-by-case basis to determine whether they are ethical. When designing and applying nudge interventions, it is of paramount importance to consider their potential impact on personal freedom, avoidance of discretionary manipulation, preservation of human dignity, and promotion of social reform. A well-designed

nudge strategy is based on the principles of transparency, electoral autonomy and ethical management of decision-making processes. Adherence to these principles will allow nudge interventions to contribute positively to desired behavioural changes without becoming a means of influencing in violation of ethical standards.

However, the literature available to me does not include studies that have focused on the user perspective in the context of these ethical concerns (e.g. Ioannou et al., 2021; Costello, Yun and Lee, 2022; Kuyer and Gordijn, 2023), so I considered it particularly important to investigate this issue.

C) The attention-grabbing ability of digital nudges

H6: *Digital nudges capture the attention of software as a service users more than other web design solutions.*

Research conducted by Özdemir (2020) analyses the effectiveness of the design process of digital nudge use and the design of behavioural interventions, highlighting that well-designed digital nudges significantly increase users' interaction with the desired content. The study by Wu, Taneja and Webster (2021) examines the mechanisms and effects of attention flow on digital media platforms, showing how the design of online platforms can guide users' attention and influence their media consumption patterns. The research shows that digital nudges on websites subtly direct users' attention, creating online attention flows.

These studies call for an investigation of the attention-grabbing potential of digital nudges, which can be most effectively investigated by eye-tracking.

H7: *Warning digital nudges are more likely to catch the attention of software as a service users than other digital nudges.*

My research aimed to find out whether digital nudges designed specifically to attract attention attract and engage users' attention to a greater extent than their counterparts in other nudge categories.

Newall et al., (2022), in their research on gambling warning labels, found that labels showing the average percentage of winnings retained by the casino (also known as the "house edge") during the games are more effective at informing players and may help them make better decisions than labels showing how much of the amount deposited by players is returned (i.e., the "return to player" rate). Research suggests that direct and clear information may be more beneficial in informing users and influencing their decisions (Newall et al, 2022). In their research analysing personalised safety warnings, Malkin et al. (2017) concluded that users

often ignore these warnings and do not remember their content accurately, suggesting that warning nudges alone do not necessarily increase awareness.

These results show that the use of nudge warnings is a complex task that depends not only on accurate, well highlighted and easy to understand information, but also on taking into account the needs and behavioural patterns of the target audience.

4. Research methodology and sources

For the three key themes of my research - the conversion effect of digital stimuli, the emotional and cognitive responses they elicit, and the attentional capacity of nudge mechanisms - I have used a variety of research methodologies, trying to choose the one that best fits the hypotheses for each theme.

The research method corresponds to a mixed method research approach, as I used both qualitative and quantitative methodologies (Neulinger, 2016). In the quantitative analysis, I conducted a quantitative analysis of web analytics data, while in the qualitative analysis I used focus groups, conducted in-camera observations and conducted in-depth interviews.

The benefits of mixed method research include the ability to take a multifaceted approach to complex research questions, allowing for mutual validation of data and integration of different perspectives. Disadvantages include methodological complexity and challenges in integrating data (Neulinger, 2016).

4.1. Investigating the conversion impact of digital nudges by analysing web analytics data

In this research, my aim was to investigate the conversion efficiency of digital nudges, which I approached through a detailed analysis of web analytics tools and data. I used Google Analytics to analyse the digital nudges on the Capturly software platform and the exit rates of the sub-pages containing nudges.

The SaaS under study uses a combination of freemium and free trial as a business model, which provided an excellent platform for the research. Digital nudges and their conversion impact were identified and analysed by nudge type using event tags.

In the study, I compared the year before the introduction of digital nudges (base period: June 2018 - June 2019) with the year after the introduction (reference period: June 2019 - June 2020), taking into account the rate of natural growth. The digital nudges were introduced to the user interface in June 2019, but no important economic impact changed between the base and

reference period, only the nudges did not draw attention to the limitations of the freemium package.

Furthermore, from a research perspective, it is important to highlight that there was no difference in marketing activity on the website between the base and reference period. To examine indirect effects, I filtered out direct nudge effects in addition to the natural growth rate.

In addition to the Google Analytics data, I also used the company's own CRM system provided by the Saas, which gave an even more accurate picture of the number and nature of subscriptions.

For the purpose of this study, I examined nudges in the user interface of the Capturly web analytics software, which were selected exclusively from the ethical nudges that can be categorized as decision information. A total of nine such nudge elements were examined in detail in the research (Table 1).

Table 1 Display of digital nudges researched on the software as a service under investigation

N.	Digital nudge display	Digital nudge category
1.	Settings (masking function)	Warning
2.	Recordings (tagging function)	Warning
3.	Funnel (limit exceeded)	Warning and framing
4.	Dashboard bottom CTA	Warning and framing
5.	Dashboard (website limit)	Warning and framing
6.	Recordings (playback limit)	Warning and framing
7.	Dashboard top CTA	Warning and scarcity
8.	Date picker	Warning and scarcity
9.	Subscription page	Warning and scarcity

Source: own editing

All these nudges belong to the group of warning nudges, but there is further differentiation in terms of function and application.

Four of the nine warning nudges can also be categorised as framing nudges because of the wording of the warning nudge. Three of the buttons have a "Maybe next time" option next to the button to encourage subscription.

This is a very typical digital framing nudge, but later research will show that aggressive wording such as "I don't want to benefit from the promotion", "I want to miss out on the best offer" will trigger strong negative resistance from users, so this nudge mechanism needs to be used very carefully.

In addition, three of the digital nudges examined could be classified as nudges of scarcity in addition to warning nudges. To test the conversion ability, I studied the aggregated results of the Google Analytics event tags pre-set for nudges, where the secondary dimension is conversion, in this case subscription.

4.2. Examining cognitive and emotional responses to digital nudges with focus groups

In order to understand the cognitive and emotional reactions elicited by digital nudges, I conducted qualitative research using focus groups. This method allowed me to explore in depth the thoughts and feelings elicited by digital nudges. While the web analytics data provides insights into immediate conversion rates, the qualitative analysis distinguishes more subtle, long-term effects. This complex approach enriches our understanding of digital nudges beyond mere quantitative metrics.

I organised five focus groups in total. In the spring of 2021, I set up two general focus groups, each consisting of five participants who were regular online shoppers and online administrators. These focus groups were broad, discussing general attitudes towards digital nudges. To ensure a diversity of perspectives, one group consisted of marketing experts (who were the target audience for the software as a service).

In the spring of 2022, I focused the research specifically on digital nudges on software as a service, for which I organised three additional focus groups, each with six participants. Participants in the latter focus groups were required to be subscribers to at least one of the software as a service, thus ensuring informed and relevant discourse.

4.3. Studying the attention-grabbing ability of digital nudges using eye-tracking and in-depth interviews

The criteria for selecting participants were that they should be relevant players in the B2B web analytics market: people who are responsible for editing and designing websites, such as business owners, web developers, marketing professionals and managers in various positions. The sample composition was 27 males and 23 females, 50 persons in total, which provided a reliable sample size as recommended in the study by Lázár and Szűcs (2020). The age of participants ranged from 24 to 57 years. Data collection took place in May 2023, over a period of approximately two weeks. The calibration process, RTA interviews and in-depth

interviews took approximately one hour each. The interviews were audio recorded for later detailed data analysis.

Data collection was carried out using a Tobii eye-tracking camera and Tobii Pro Lab software. Participants viewed ten images that showed the user interface of Capturly's integrated web analytics software after logging in, displaying digital nudges. The time available to view the images was 15 seconds, which I determined based on a previous test with a smaller sample.

There was a three-second pause between viewing each image with the display of a fixation cross, taking into account that the "areas of interest" (AOIs) did not coincide with the location of the fixation cross, thus avoiding sample bias. The order of the images was randomized for each participant, as multiple images could have the same nudges or nudge categories. The eye movement tracking process was preceded by a calibration, which would have allowed for the possible exclusion of participants if the "accuracy" did not meet the defined criteria (Lázár and Szűcs, 2020).

While eye-tracking provides accurate data on gaze orientation, it does not provide insight into the "whys" of the observed person's visual fixation or lack thereof, so I supplemented eye-tracking with a Retrospective Think Aloud (RTA) interview, during which the researcher and participant retrospectively review the eye-tracking recording, heat maps, and gaze-tracking map, allowing the participant to articulate his or her thought process and decision-making (Elbabour, Alhadreti and Mayhew, 2017).

After the RTA interview, I concluded the data collection process with an in-depth interview with the eye-tracking participants. The purpose of the in-depth interview was to explore the evaluation of digital stimuli beyond the perception process. During the in-depth interview, the exact definition of digital nudges was clarified, and then ranged from general questions ("Can you recall a situation when you encountered a digital nudge during your online activity?") to the most specific ones ("Do you think you have ever made a purchase as a result of a digital nudge?") relevant to the research question.

5. Results of the thesis

The research question "**How do digital nudges affect the online decision-making processes of users of software as a services?"** covers three topics, the conversion ability of nudges, the cognitive and emotional reactions they elicit, and their ability to attract and retain attention. These themes form the basis for the grouping of hypotheses below. In addition to the results, the chapter includes my conclusions drawn from the analysis of the data and their

comparison with the existing literature, or even the gaps in the literature that have been identified. This structured approach allows me to put the findings into context and show my contribution to the scientific discourse on the mechanisms of action of digital nudges.

A) The conversion effect of digital nudges

H1: *Digital nudges on software as a services have a direct impact on conversion.*

The direct impact of nudges on conversions on software as a services was examined based on the precise data provided by web analytics and event tagging. The 132 direct conversions recorded during the period under review (total conversions during the period: 238) show a significant increase compared to the 50 conversions recorded during the baseline period, which is also due to the direct influence of digital nudges.

Scarcity nudges, which influence consumer decisions by creating a sense of limited time or supply, achieved significantly higher conversion rates than those that did not (Table 2).

Table 2 Digital nudges and their associated metrics in the period under review

N.	Digital nudge display	Digital nudge category	Appearances	Unique events	Conversion	Conversion rate
1.	Settings (masking function)	Warning	1739	376	6	1,595%
2.	Recordings (tagging function)	Warning	1628	245	3	1,224%
3.	Funnel (limit exceeded)	Warning and framing	1332	348	2	0,005%
4.	Dashboard bottom CTA	Warning and framing	10869	1367	22	1,609%
5.	Dashboard (website limit)	Warning and framing	231	19	0	0%
6.	Recordings (playback limit)	Warning and framing	1076	230	12	0,052%
7.	Dashboard top CTA	Warning and scarcity	10869	1520	36	**2,368%**
8.	Date picker	Warning and scarcity	8766	1334	45	**3,373%**
9.	Subscription page	Warning and scarcity	455	56	6	**10,714%**

Source: own editing

The high conversion rates observed on the subscription side can be attributed to the prior motivation of subscribers to subscribe.

The variance in web analytics data and the motivations behind different nudge functions can have a significant impact on conversion rates. It is important to note that the frequency with which nudges are displayed can also affect the results.

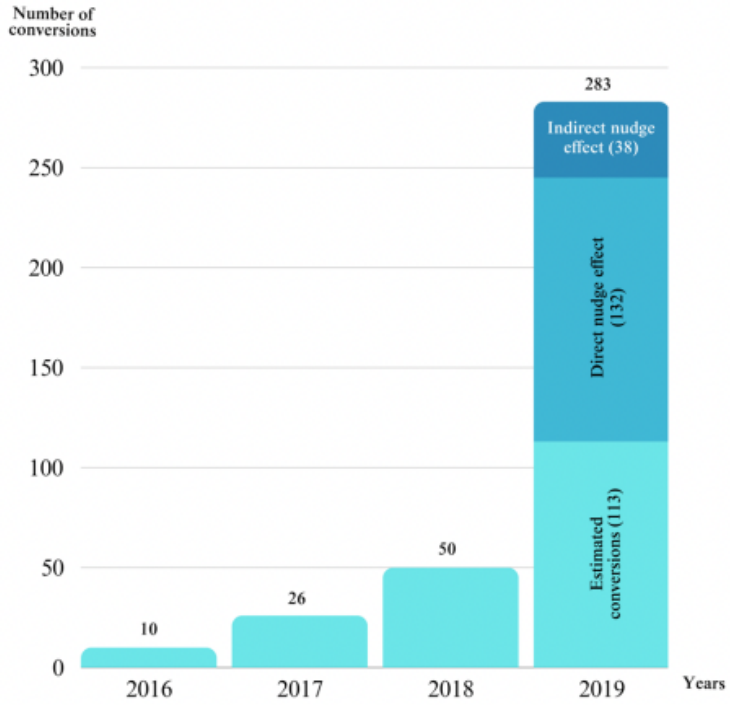
The effectiveness of digital nudges is also shown to increase conversion rates in Schneider's (2021) study, but this researcher's study did not examine them separately by Saas and nudge category.

Based on the above results, it can be concluded that the strategic use of digital nudges and their impact on conversion rates can increase conversion rates, so my first hypothesis is accepted. Analysing the effectiveness of nudges by category and data-driven optimisation provides an opportunity to fine-tune marketing strategies and user experience.

H2: *Digital nudges on software as a services have an indirect impact on conversion.*

The data analysis involved comparing the information provided by web analytics and customer relationship management (CRM) systems, and creating a detailed trend analysis of the company's conversion metrics. Based on this analysis, the data identified shows that the company's conversion rate is steadily increasing. Based on the trend, my forecasting model predicted 113 conversions for 2019, which is in line with the expected value calculated by continuous trend analysis and modelling, as shown in the attached figure (Figure 4).

Figure 4 Company conversion values 2016-2019 and identification of nudge effects in 2019



Source: own editing based on Capturly CRM system and Google Analytics data

However, the actual figures are much more impressive, as the company managed 283 conversions in 2019, compared to the expected 113. Out of this surprisingly high number, 132 conversions were clearly the result of the direct impact of digital nudges, while a further 38 conversions were the result of indirect nudge-generated effects. **Based on my research findings, it can be stated that digital nudges on the software as a service I studied have an indirect effect on conversions, thus my second hypothesis is accepted.**

This research result is in line with the findings of Schneider (2017) and Schneider et al., (2018) that the use of digital nudges improves the overall user experience, increases the attractiveness of products and services, and thus indirectly contributes to higher conversion rates.

H3: *Well-designed digital nudges do not increase the likelihood of leaving the site on software as a services.*

My analysis focused on how disturbing digital nudges are for users, in particular how these nudges affect the frequency of exits from online platforms. In examining the context of exit rate, I was faced with an important limiting factor: only three nudges had a separate URL address (e.g. pop-ups, date pickers, etc. did not appear on a separate URL), and of these, two digital nudges were available on the same URL. For the two nudges displayed on the user home page, the exit rate showed a minimal decrease of only 0.07 percentage points compared to the default period, while for the other nudge with a separate URL, the company recorded a slight increase in the exit rate of only 0.3 percentage points over the period. This amount cannot be considered a statistically significant change. **Therefore, based on the analysis results, I can reasonably claim that well-designed digital nudges do not increase the probability of leaving the site on the software as a service under study, and thus I accept my third hypothesis.**

However, further findings from the focus group research refined this picture. Several of the participants reported experiences with nudges that triggered negative cognitive reactions, causing them not only to leave the site, but also to not return to it. This suggests that the adjective "well-designed" plays a key role in the effectiveness of nudges. Well-designed nudges are defined as not being an obstacle or a distraction to the user, but rather as being harmoniously integrated into the design of the website. This definition now needs to be complemented by the results of the focus group, emphasising that nudges should not trigger negative cognitive reactions in users, as these reactions can be counterproductive in the long term.

Juviler (2023) points out that the change in exit rate as a website metric can point to the quality of the user experience, which according to Schneider (2017) and Schneider et al. (2018) also affects conversion rates, and thus constitutes an important element of conversion studies.

B) Cognitive and emotional responses to digital nudges

H4: *Digital nudges evoke emotions in the users of software as a services.*

Three of the nudges I studied were designed by the company in question to generate targeted emotions in users, with the ultimate goal of increasing subscription. These strategies included graphic elements such as the image of a sad owl, which I found to be emotionally effective in my research. The RTA interviews revealed that this graphic element was particularly memorable for users. In the eye-tracking research, many participants, especially women, rated this graphic positively.

However, the company's idea that positive emotional reactions increase conversion rates was not confirmed. Although the broad conclusions drawn when examining negative nudges cannot be drawn for positive emotional nudges, the data in Table 2 show that these nudges produced the lowest conversion rate of all the nudges examined.

Of course, the research limitation that the meaning of the functions behind each nudge may differ for different users must also be taken into account.

Focus group research shows that scarcity and inappropriately worded framing nudges can trigger negative emotional reactions. Stress caused by time or stock scarcity, as well as framing wording that insults users, such as "I'm moving on and staying silly" type messages, can have long-term negative consequences. Interestingly, although these nudges were viewed negatively by focus group participants, by their own admission they were often the very nudges that encouraged them to buy, citing stock shortages. This result is also consistent with the web analytics data measured.

The literature review shows that research on the relationship between nudges and emotions is still in its early stages, but preliminary results show that especially framing and scarcity nudges can elicit emotions, which are not always associated with an increase in conversion. Thunström 's (2019) research shows that attention nudges can trigger negative emotions. These have been termed "emotional transmitters", indicating the need for further research on the effects of nudges on emotions and consumer welfare. Thus, while such incentives can reinforce positive emotions and behaviours, they can also trigger negative emotional reactions if not used carefully. According to research by Thunström, Gilbert and Ritten (2018), nudges can have different emotional effects depending on the context. Taken

together, the research suggests that although nudges are capable of eliciting positive emotional responses, they can also elicit negative emotional responses if they are not used carefully.

According to the literature, digital nudges can lead to positive emotions such as satisfaction, trust and self-confidence by directing users towards useful and personalised recommendations, helping them to make better decisions (Weinmann, Schneider and Brocke, 2016). However, if nudges are perceived as too manipulative, or if users feel that they limit their freedom of choice, they can trigger frustration, resistance or even distrust (Cialdini, 2007; Sunstein, 2017). Categorising digital nudges can provide deeper and more accurate research into the emotions elicited by digital nudges.

Based on the research findings, **I can only partially accept my hypothesis that digital nudges evoke emotions in users of software as a services, as only scarcity and framing nudges evoked emotions, but further research is needed to obtain general results.**

H5: *The use of digital nudges is considered unethical by users of software as a services.*

Examining the ethical dimensions is essential for evaluating the practice of digital nudges. The preliminary hypothesis H5, that the use of digital nudges is perceived as unethical by users of the Saas, basically questions the ethical implications of nudge practices and the respect of user autonomy, i.e. whether users perceive digital nudges as manipulative. The definition of manipulative nudges used in this research, according to which these nudges subconsciously influence user decision-making without being obvious to the user, fits well with the ethical concerns found in the literature.

The literature, such as Bruns et al.'s (2018) review, emphasises the need for transparency and support for user decision-making, which is consistent with the study of default nudges and their potentially manipulative nature. Thaler and Sunstein's (2008) original definition of nudge focuses on helpful decision support with a positive direction, while questionable nudges represent the negative side of nudge theory. Ariely's (2015) finding that deceptive information can effectively influence decision making, especially when it confirms individuals' prior beliefs, further strengthens the prior assumption.

My own research used focus groups to investigate the cognitive and emotional effects of digital nudges. Participants' sceptical attitudes, particularly towards nudges of scarcity, and the frustration caused by nudges perceived as manipulative, suggest that more attention should be paid to user experience and transparency when designing nudges. Interestingly, among the groups surveyed, marketing experts were more confident in the content of nudges for Saas, while less so for nudges in general. I conclude that because they are more aware of the legal

regulations and have a better understanding of the process of developing nudges, they are less likely to perceive these marketing tools as risky when they encounter them.

Nudges with unclear and confusing content have generated negative feedback, which clearly reflects the negative perception of manipulative nudges.

Some forms of digital nudges, especially scarcity and framing nudges and their applications, can be considered manipulative, especially if they do not comply with transparency, user autonomy and ethical standards. Ethical considerations must be given priority in the design and use of nudges, so that nudges do not lose their original purpose: to support positive, helpful decision-making. Developing and adhering to an ethical and legal framework for digital nudges is essential to maintain consumer trust and long-term business success.

Data from the focus group interviews show that the perception of digital nudges is significantly influenced by users' prior attitudes and expertise. Given the positive perceptions of the expert sample, where nudges were seen as a helpful and informative tool, they do not appear to be overly manipulative or unethical. However, the need for ethical use of nudges should not be ignored, as even a single negative opinion points to the existence of critical voices criticising the manipulative nature of nudges and their use in the service of profit maximisation. A comparison of the literature and research findings highlights a dichotomy. On the one hand, nudges are generally accepted by experts as a useful tool, but on the other hand, there is a risk that nudges can be manipulative if they are not used in a transparent and ethical manner. Companies and designers need to develop nudge strategies that are not only effective, but also in line with ethical standards and respect user autonomy.

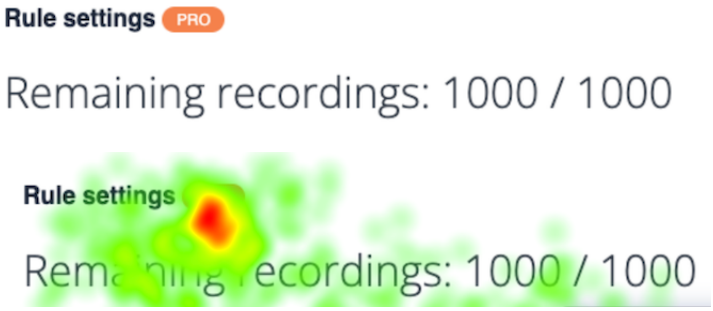
The possibility of sampling bias should also be borne in mind, as the research points out. Experts managing websites may be more open to nudges, as they may use these tools themselves. Nevertheless, the target group of the software as a service is precisely these experts, so the results are relevant despite sampling bias. Combining the data obtained in this study with the literature context, we can conclude that the use of digital nudges is not considered unethical by the target group of the Saas (thus, the preliminary assumption H5 is refuted), as long as they add value and help in the decision-making process. However, while preserving ethical considerations and user autonomy, the principles of transparency and informed decision-making should be kept in mind when designing and implementing nudges.

C) The attention-grabbing ability of digital nudges

H6: *Digital nudges capture the attention of software as a service users more than other web design solutions.*

Heatmaps from eye-tracking data show that users' gaze stays longer on nudge elements than on traditional web design elements. This suggests that nudges capture users' attention significantly. Based on this data, it can be concluded that digital nudges are more effective in attracting and retaining users' attention than other web design elements, confirming hypothesis H7 (Figure 5).

Figure 5 An example of the attention-grabbing potential of nudge content in images used in eye-tracking.



Source: Own editing

As can be seen in Figure 5, the "PRO" label attracted the participants' attention much more than other web design elements, **thus hypothesis H7 is confirmed based on the results presented.**

H7: *Warning digital nudges are more likely to catch the attention of software as a service users than other digital nudges.*

The H7 hypothesis suggests that digital nudges with warnings attract users' attention more than other nudge categories. Based on eye movement tracking data, the time to first fixation for warning nudges is significantly lower than that for scarcity nudges, supporting this hypothesis. Nudges that also affect emotions, such as sad owl images, had even shorter first fixation times (0.93 seconds for females and 2.71 seconds for males), which also highlights the importance of the emotional charge of the visual elements. A comparison of the average length of fixations provides even more detail on the behaviour of users, where the average length of the warning nudges of 0.445 seconds is noteworthy, especially compared to the lower attention band, where the average length of fixations was only 0.21 seconds.

These data clearly suggest that warning digital nudges are more likely to attract and hold users' attention than other digital nudges or traditional web design elements, so my hypothesis H8 is accepted.

Research by Newall and colleagues (2022) suggests that direct and clear information may be more beneficial in informing users and influencing their decisions when using nudges. Malkin and co-authors (2017) have shown in their research that warning nudges with personalised messages do not increase attention per se.

In this chapter, I have analysed in detail and accounted for the specific effects of digital nudges on the users of software as a services, all using a hypothesis-based approach. Then, based on my research findings, I formulate the theses to answer my research question. I will review the extent to which I have been able to meet the research objectives set and the new areas in which I have contributed to fill existing gaps in the literature. I will also discuss the practical implications that my research provides and outline further research directions that may be relevant for future academic work.

8. Theses of the dissertation

The systematic literature review on digital nudges (Gyulai and Révész, 2023) identified the research gaps in the field of digital nudges.The research suggests that the effectiveness of digital nudges varies widely, while detailed research within different categories is lacking, thus the dissertation addresses a well-defined topic. Software as a service as a key application area for digital nudges has also received little research attention. In addition to the dominance of quantitative, mainly questionnaire-based research, more qualitative research is essential to gain a deeper understanding of the motivations and reasons behind online behaviour. The scarcity of field studies to clarify the mechanisms of action of digital nudges is a further challenge. Particular caution should be exercised in drawing conclusions for field experiments that are explicitly designed for research purposes but are not conducted in a real business environment and thus lack the dynamics of real economic actors (Gyulai and Révész, 2023). One of the main advantages of this dissertation is the analysis of real company web analytics data, which allows to explore the long-term effects of nudges and thus provides a basis for longitudinal research that can investigate long-term trends and effects after fine-tuning nudges.

The research question of the dissertation, " **How do digital nudges affect the online decision-making processes of users of software as a services?** is the central element of the dissertation, and the following theses support the answer:

T1: Digital nudges on software as a services have a direct impact on conversion.
T2: Digital nudges on the software as a services also have an indirect effect on conversion.
T3: Well-designed digital nudges do not increase the likelihood of leaving the site on software as a services.

The theses of my dissertation on conversion efficiency clearly show that it is a worthwhile investment for companies to develop and refine well-designed digital nudges, as these tools can significantly increase conversion rates and do so not only directly, but also indirectly, without increasing the rate of users leaving the website or being disruptive to users. Although the influence of digital nudges on the conversion process has already been discussed in previous studies, the market for SaaS has opened up new dimensions for this research. One of the most important contributions of this research to the scientific discourse was the exploration of indirect effects, an area that has not been discussed in previous literature in the literature of the databases I have access to. The present research, although based on a limited database, has yielded encouraging results and has laid the groundwork for future research with companies with an expanding data set. In particular, the study of the quit rate metric proved to be valuable, providing objective quantitative data on the extent to which nudges are disruptive to users. These tools often work through the subconscious, so the analysis of web analytics data proved particularly useful, allowing me to assess the effectiveness of nudges based on objective data in addition to user feedback.

T4: Framing and scarcity digital nudges evoke emotions in users of software as a services.

My research found that framing and scarcity nudges were particularly effective in eliciting emotional responses from research participants, often evoking negative emotions, frustration or annoyance. In contrast, well-designed digital nudges that conveyed useful information were also able to generate positive emotional responses. Of particular relevance is the observation that the emotions elicited by nudges did not guarantee an increase in conversion, and the research showed that women tended to be more strongly affected by these nudges. A/B testing can play an important role for companies to develop nudges that do not trigger negative emotions. This could be crucial given that some participants reported negative experiences with corporate messages to the extent that they distanced themselves from the site.

Poorly designed digital nudges can therefore have a lasting negative impact. In light of this, small-scale qualitative research, such as eye-tracking and in-depth interviews, before implementing or modifying digital nudges in companies seems justified. This research has significantly enriched the literature by focusing on the user perspective and contributing to the impact assessment of digital nudges through a thorough investigation of a well-defined research area.

T5: The use of well-designed, value-added digital nudges is not considered unethical by software as a services users supplied.

My research with users has revealed two crucial dimensions to the perception of digital nudges as manipulative and potentially unethical, dimensions that go beyond a broad spectrum of personality traits and past experiences. First, I examined the credibility of digital nudges, which is a fundamental determinant of the extent to which users accept the messages conveyed. If consumers find the nudges used by a company to be discredited - for example, if a product with limited availability turns out not to be in short supply in reality - this can fundamentally undermine their trust in subsequent nudge messages. The second dimension relates to users' online savvy: the more informed and confident they are in the digital space, the less threatening they will feel about nudges.

The ethical perception of digital nudges has been the subject of numerous studies, yet there is a research gap in the works that approach the issue from the users' perspective. Ethical debates on nudges are typically theoretically based, with little insight into the actual opinions of users.

On this basis, my research has added value for companies that operate software that supports websites, such as software for e-commerce platforms, web analytics or CRM systems. The results of this research may encourage these companies to boldly adopt digital nudges, as these incentives will be positively received by their target groups.

T6: Well-designed digital nudges capture the attention of the software as a services users they serve better than other web design solutions.

The widespread use of digital nudges has attracted considerable criticism, particularly in terms of the extent to which they go beyond the functionality of traditional web design solutions.

The results of research using eye-tracking techniques strongly confirm that carefully designed digital nudges are significantly more effective in capturing and retaining the attention

of users than standard web design elements. A key element of the research methodology is its ability to provide objective data on attention dynamics.

The RTA, or real-time attention tracking interviews, revealed that participants were often unaware of how much time they spent observing or studying an element, which highlights the subliminal influence of digital nudges. Previous research on the attention-grabbing efficacy of these types of nudges has been based on participants' self-reports, which may be subject to subjective biases.

T7: Well-designed warning digital nudges capture the attention of software as a service users better than other digital nudges.

A priority for the research project was to investigate digital nudges specifically designed to capture and hold the attention of users. This category of nudges has consistently been found by academic research to be more effective in attracting and retaining attention than other types of nudges. To date, however, the specific attention-grabbing capacity of each category of digital nudge has not been exhaustively discussed in the literature, and most of the findings are based on theoretical grounds.

Although it is widely accepted that these nudges are used to attract attention, the amount of research conducted in the digital context is limited. Eye-tracking as a research methodology is of paramount importance in this field, as it allows to provide objective and reliable data on users' behaviour and interactions.

In my dissertation, in addition to the importance of answering the research question, priority was also given to the issues of categorising digital nudges. Through the integration of two different frameworks, I have succeeded in effectively contextualising digital nudges in the literature, which has been a significant advance for academic research and fills a marked gap in the previous literature. The current broad definitions of nudges and their categories, while pointing the way forward for future researchers, raise the need to further refine these definitions. With well-defined and easily categorizable nudges, more effective research can be conducted, leading to more precise and targeted practical recommendations.

Throughout my dissertation, I have explored that, due to the shortcomings of current nudge definitions in the literature, the definition of types of nudges and their categories is to some extent based on subjective judgement. This relative interpretability has been a limitation for me in my research, especially with regard to the clear categorisation of nudges.

Another major limitation was the relative scarcity of data for the company, given that the company was still in its start-up phase, and thus did not have the sufficient amount of web analytics data necessary to draw statistically reliable conclusions from a large sample. This

limited database size posed a challenge for the research, as exploring and interpreting every possible pattern requires a larger amount of data.

Another potential limiting factor that may affect the interpretation of the study's results is that the functional diversity of digital nudges represents a variable that may bias the measurement of the effectiveness of digital nudges. This suggests that, in addition to the visual representation of nudges, the specific effects of different features may modulate participants' decisions - this could mainly affect the results of the conversion effect tests. In order to reduce these types of effects, in further research I will prefer to use an A/B testing methodology, which allows for isolated testing of individual nudges and systematic control of functional aspects.

9. Future research directions

I have set the ambitious goal of developing a more precise definition of the concept and categories of nudge as the further research path of my dissertation. In addition, I plan to develop a more detailed framework to define how to define a " properly designed nudge". The data and resources available to me provide an ideal basis for a long-term, longitudinal study of digital nudges. I have an exceptional opportunity to consult the companies under study in fine-tuning their digital nudge strategies based on the results of my analysis. As a result, it will be possible to compare the effectiveness of the revised nudges with the previously recorded data, so that a clear picture of the success of the changes can be established.

10. Literature used in the thesis booklet

Ariely, D. (2015) *The Honest Truth about Dishonesty: How We Lie to Everyone-Especially Ourselves*. doi: 10.1007/s11097-006-9017-z.

van Bavel, R. *et al.* (2019) 'Using protection motivation theory in the design of nudges to improve online security behavior', *International Journal of Human Computer Studies*. Elsevier Ltd, 123(September 2018), pp. 29–39. doi: 10.1016/j.ijhcs.2018.11.003.

Bergram, K. *et al.* (2022) 'The Digital Landscape of Nudging: A Systematic Literature Review of Empirical Research on Digital Nudges', *Conference on Human Factors in Computing Systems - Proceedings*, (April). doi: 10.1145/3491102.3517638.

Bruns, H. *et al.* (2018) 'Can nudges be transparent and yet effective?', *Journal of Economic Psychology*, 65(February), pp. 41–59. doi: 10.1016/j.joep.2018.02.002.

Cialdini, R. (2007) 'Influence The Psychology of Persuasion byCialdini', *Harpar Business (Revision Edition)*, (14), p. 320.

Congiu, L. and Moscati, I. (2022) ‘A review of nudges: Definitions, justifications, effectiveness’, *Journal of Economic Surveys*, 36(1), pp. 188–213. doi: 10.1111/joes.12453.

Costello, F. J., Yun, J. H. and Lee, K. C. (2022) ‘Digital Dark Nudge: An Exploration of When Digital Nudges Unethically Depart’, *Proceedings of the Annual Hawaii International Conference on System Sciences*, 2022-Janua, pp. 4348–4357. doi: 10.24251/hicss.2022.531.

Elbabour, F., Alhadreti, O. and Mayhew, P. (2017) ‘Eye Tracking in Retrospective Think-Aloud Usability Testing: Is There Added Value?’, *Journal of Usability Studies*, 12(3), pp. 95–110.

Farkas, B. (2021) *A közgazdasági gondolkodás rövid története*. Budapest: Akadémiai Kiadó.

Gallino, S., Karacaoglu, N. and Moreno, A. (2023) ‘Need for Speed: The Impact of In-Process Delays on Customer Behavior in Online Retail’, *Operations Research*, 71(3), pp. 876–894. doi: 10.1287/opre.2022.2262.

Garrett, J. J. (2011) *The Elements of User Experience: User-Centered Design for the Web and Beyond*, *User Experience Innovation*. doi: 10.1007/978-1-4302-4150-8_1.

Godse, M. and Mulik, S. (2009) ‘An approach for selecting Software-as-a-Service (SaaS) product’, *CLOUD 2009 - 2009 IEEE International Conference on Cloud Computing*, pp. 155–158. doi: 10.1109/CLOUD.2009.74.

Gyulai, Z. and Révész, B. (2023) ‘Digitális Nudge-ok: átfogó helyzetkép és szisztematikus irodalomelemzés’, in Révész, B. and Gyulai, Z. (eds) *Reziliens Marketing - Válaszok Változó Kihívásokra*. Egyesület a Marketing Oktatásért és Kutatásért - XXIX. Nemzetközi Konferencia.

Halvorsrud, R., Kvale, K. and Følstad, A. (2016) ‘Improving service quality through customer journey analysis’, *Journal of Service Theory and Practice*, 26(6), pp. 840–867. doi: 10.1108/JSTP-05-2015-0111.

Ioannou, A. *et al.* (2021) ‘Privacy nudges for disclosure of personal information: A systematic literature review and meta-analysis’, *PLoS ONE*, 16(8 August), pp. 1–29. doi: 10.1371/journal.pone.0256822.

Jesse, M. and Jannach, D. (2021) ‘Digital nudging with recommender systems: Survey and future directions’, *Computers in Human Behavior Reports*. Elsevier Ltd, 3(January), p. 100052. doi: 10.1016/j.chbr.2020.100052.

Ju, J. *et al.* (2010a) ‘Research on key technology in SaaS’, *Proceedings - 2010 International Conference on Intelligent Computing and Cognitive Informatics, ICICCI 2010*. IEEE, pp. 384–387. doi: 10.1109/ICICCI.2010.120.

Ju, J. *et al.* (2010b) ‘Research on key technology in SaaS’, in *Proceedings - 2010 International Conference on Intelligent Computing and Cognitive Informatics, ICICCI 2010*, pp. 384–387. doi: 10.1109/ICICCI.2010.120.

Juviler, J. (2023) ‘16 Website Metrics to Track for Growth in 2023 and Beyond’, January.

Koch, O. F. (2017) *Nudges as Conversion Funnel Enhancers in Digital Business Models by*. Darmstadt University of Technology in.

Koltay, G. and Vincze, J. (2009) ‘Fogyasztói döntések a viselkedési közgazdaságtan szempontjából’, *Közgazdasági Szemle*, LVI(6), pp. 495–525. Available at: http://www.kszemle.hu/tartalom/cikk.php?id=1101%0Ahttp://epa.oszk.hu/00000/00017/00160/pdf/02koltay_vincze.pdf.

Kuyer, P. and Gordijn, B. (2023) ‘Nudge in perspective: A systematic literature review on the ethical issues with nudging’, *Rationality and Society*, 35(2), pp. 191–230. doi: 10.1177/10434631231155005.

Lázár, E. and Szűcs, K. (2020) ‘A neuromarketing aktuális helyzete és a mintaelemszámra vonatkozó kihívásai, különös tekintettel a szemkamerás mérésekre’, *Vezetéstudomány / Budapest Management Review*, 51(3), pp. 79–88. doi: 10.14267/veztud.2020.03.08.

Lemken, D. (2021) ‘Options to design more ethical and still successful default nudges: a review and recommendations’, *Behavioural Public Policy*, pp. 1–33. doi: 10.1017/bpp.2021.33.

Lemon, K. N. and Verhoef, P. C. (2016) ‘Understanding customer experience throughout the customer journey’, *Journal of Marketing*, 80(6), pp. 69–96. doi: 10.1509/jm.15.0420.

Liao, H. (2010) ‘SaaS business model for software enterprise’, *ICIME 2010 - 2010 2nd IEEE International Conference on Information Management and Engineering*, 2, pp. 604–607. doi: 10.1109/ICIME.2010.5477915.

Malkin, N. *et al.* (2017) ‘Personalized Security Messaging: Nudges for Compliance with Browser Warnings’, in *2nd european workshop on usable security. internet society*. doi: 10.14722/eurousec.2017.23008.

Meske, C. and Amojo, I. (2020) ‘Ethical Guidelines for the Construction of Digital Nudges’, in *Proceedings of the 53rd Hawaii International Conference on System Sciences*, pp. 3928–3937. doi: 10.24251/hicss.2020.480.

Mirsch, T., Lehrer, C. and Jung, R. (2018) ‘Making digital nudging applicable: The

digital nudge design method', *International Conference on Information Systems 2018, ICIS 2018*, (2009), pp. 1–16.

Neulinger, Á. (2016) 'Több-módszertanú és vegyes módszertanú kutatások', *Vezetéstudomány*, 47(4), pp. 63–66.

Newall, P. W. S. *et al.* (2022) 'Nudge versus sludge in gambling warning labels: How the effectiveness of a consumer protection measure can be undermined', *Behavioral Science and Policy*, 8(1), pp. 17–23. doi: 10.1177/237946152200800103.

Norman, D. (2013) *he design of everyday things: Revised and expanded edition.* Basic Books.

Osterwalder, A. and Pigneur, Y. (2010) *Business Model Generation*. 2010th edn. Edited by T. Clark. John Wiley & Sons, Inc. Available at: https://tudelft.openresearch.net/image/2015/10/28/business_model_generation.pdf.

Özdemir, Ş. (2020) 'Digital nudges and dark patterns: The angels and the archfiends of digital communication', *Digital Scholarship in the Humanities*, 35(2), pp. 417–428. doi: 10.1093/LLC/FQZ014.

Schmidt, A. T. and Engelen, B. (2020) 'The ethics of nudging: An overview', *Philosophy Compass*, 15(4), pp. 1–13. doi: 10.1111/phc3.12658.

Schneider, D. (2017) 'Rewarding prosociality on non-commercial online sharing platforms', *Proceedings of the 25th European Conference on Information Systems, ECIS 2017*, 2017, pp. 2269–2284.

Schneider, D. *et al.* (2018) 'Nudging Users Into Online Verification: The Case of Carsharing Platforms', *ICIS 2017: Transforming Society with Digital Innovation*, (December).

Schneider, D. (2021) *Digital Nudges as Conversion Enhancers in Profit-Oriented and Non-Profit Oriented Digital Business Models Dissertation*. Technische Universitat Darmstadt.

Smith, N. C., Goldstein, D. G. and Johnson, E. J. (2013) 'Choice without awareness: Ethical and policy implications of defaults', *Journal of Public Policy and Marketing*, 32(2), pp. 159–172. doi: 10.1509/jppm.10.114.

SUNSTEIN, C. R. (2017) 'Nudges that fail', *Behavioural Public Policy*, 1(1), pp. 4–25. doi: 10.1017/bpp.2016.3.

Thaler, R. H. and Sunstein, C. R. (2008) *Nudge: Improving Decisions about Health, Wealth and Happiness*. New Haven: Yale University Press.

Thunström, L. (2019) 'Welfare effects of nudges: The emotional tax of calorie menu labeling', *Judgment and Decision Making*, 14(1), pp. 11–25. doi: 10.1017/s1930297500002874.

Thunström, L., Gilbert, B. and Ritten, C. J. (2018) 'Nudges that hurt those already hurting – distributional and unintended effects of salience nudges*', *Journal of Economic Behavior and Organization*. Elsevier B.V., 153, pp. 267–282. doi: 10.1016/j.jebo.2018.07.005.

Tversky, A. and Kahneman, D. (1974) 'Judgment Under Uncertainty: Heuristics and Biases', *Science*, 185(4157), pp. 1124-1131. doi: 10.1021/ac60205a032.

Weinmann, M., Schneider, C. and Brocke, J. vom (2016) 'Digital Nudging', *Business and Information Systems Engineering*. Springer Fachmedien Wiesbaden, 58(6), pp. 433–436. doi: 10.1007/s12599-016-0453-1.

Wu, A. X., Taneja, H. and Webster, J. G. (2021) 'Going with the flow: Nudging attention online', *New Media and Society*, 23(10), pp. 2979–2998. doi: 10.1177/1461444820941183.

11. Own publications in the field of the thesis

Gyulai, Zs. (2022): Digitális nudge-ok hatása a szolgáltatott szoftver felhasználókra. *Marketing & Menedzsment* 57. EMOK Különszám, pp.41-48.

Gyulai, Zs., (2024): From freemium to premium: The conversion capability of digital nudges. *Ekonomická revue – Central European Review of Economic Issues* (Megjelenés alatt)

Gyulai, Zs. and Révész, B. (2021) 'A digitális nudge-ok észlelése és értékelése' EMOK - Poszttraumás marketing: virtualitás és realitás. *Proceedings of the EMOK 2021 International Conference - Post-Traumatic marketing: virtuality and reality,* Budapest 336-345.o.

Gyulai, Zs., Kéri, A. and Revesz, B. (2022): Nudge mystery–Are consumers aware and consciously affected?. *Proceedings of the European Marketing Academy,* Budapest

Gyulai, Zs. and Révész, B. (2023): Nudging in the Digital World: An Up-to-Date Systematic Literature Review. *Proceedings of the European Marketing Academy,* Athén

Gyulai, Zs. and Révész, B. (2023): Digitális Nudge-ok: átfogó helyzetkép és szisztematikus irodalomelemzés. *EMOK - Reziliens Marketing - Válaszok Változó Kihívásokra. Proceedings of the EMOK 2023 International Conference,* Szeged