The Action Line Effect
Digital nudging through button positioning

Group

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Abstract

An increasing amount of decisions have to be made online while an overload of information challenges our cognitive capacities. Digital companies interested in the choices we make are able to utilize user interface design elements to guide our behavior in a predictable manner. These nudges are omnipresent in digital environments and can significantly influence our decisions and judgments. This study investigated one nudge, in particular, the action line effect. We based our hypothesis on the portrayal by TechCrunch, which described the action line effect as being able to distract users from certain content by employing a specific button positioning. The user would scan the web page from the top downwards until they reached the button and when clicking the button miss out on potentially important information positioned below. We tested the effect by using an app that presented participants with different button-text arrangements in an inconspicuous context. As a measure of attention towards the critical text components, we used the time participants took to press the button. This study was not able to provide conclusive evidence for an action line effect. Interestingly, we observed a significant effect of the button positioning, when participants had seen the text components before, as expected by the action line effect. When comparing the proportions participants spend on the first and the second condition pages there was only a tendency observable. Therefore, further research is necessary to prove the existence of an action line effect.

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1 Introduction

1.1 Nudges

An important term connected to nudging is 'choice environment'. A choice environment encompasses the choices that are presented to us and how they are presented [1]. As our cognitive capacities are limited, cognitive heuristics and biases have the purpose to decrease our cognitive effort and enable fast and automatic decision-making [1][2]. But they can also lead to errors and sub-optimal solutions [1]. Nudges take advantage of these heuristics and biases to

guide people's behavior[3]. They are usually hard to understand and detect by the users [3] and work on a subconscious level [1]. Sunstein describes nudges as "liberty-preserving approaches that steer people in particular directions, but that also allow them to go their own way"[4], as their effect is choice preserving and works stochastic, rather than deterministic. An example of nudging in supermarkets is the positioning of certain products at eye level to increase their visibility for the customers [5].

1.1.1 Digital nudges

Digital choice environments are often called choice architectures [3] and require us to make an increasing amount of decisions and judgments [6]. Digital nudges are the way the user interface design elements are used to guide our behavior in a predictable manner [1]. Designers who build these user interfaces can be called choice architects correspondingly [3]. As with analog choice environments, for digital choice architectures, there exist no neutral cases. The design of the interface always has a kind of influence on the user, either intended or unintentional.

Examples of digital nudges are the decoy effect, the middle-option bias, and the scarcity effect. The decoy effect happens when an unattractive product (the decoy) can make another product seem more attractive. The scarcity effect makes scarce products more desirable and the middle-option bias describes how people tend to choose a product placed in the middle of products ordered by price[5].

1.2 Digital reading behaviour

In the last decades, digital media has contributed to a shift in reading behavior towards a screen-based reading behavior [7]. Digital reading is described as a non-linear reading of hypertext, texts that contain multiple links and are thereby interconnected. In contrast to printed text, hypertext does not have a predefined order. Readers have to build their own text base individually by navigating between web pages in a self-chosen order [6][8]. The screen-based reading behavior is characterized by various techniques, such as skimming, scanning, browsing, keyword spotting, shallow reading, and fragmented non-linear reading. They are strategies to cope with an overload of information in digital environments [7][9]. As time and attention are limited resources and web pages are competing for the reader's attention, they are required to make efficient decisions about what to read, how to read, which link to follow, and which pages to further process [7][8].

1.3 Present study

1.3.1 Action line and Research Question

TechCrunch introduces the term "action line", which they state can make parts of a web page "transparent" to the user. Specifically, a button calling for action interrupts the user in their further scanning of the web page and will make them focus on and click the button. As the readers scan the web page from top to bottom, anything below this action line, a virtual horizontal line positioned at the height of the button, will not be attended[10]. This effect can be used to hide unfavorable information in plain sight.

The action line effect counts as a digital nudge, as it is achieved through the design of the user interface and decreases the probability of the user reading any text below the button, without taking away the option to do so.

The aim of the current study is to test the existence of the action line effect. Based on this we formulate our research question as follows:

> *RQ: Can the vertical order of button and text elements of a user interface influence the attention of the user, such that less attention is directed towards the text if the button is positioned above?*

1.3.2 Related literature

First of all, we could not find additional literature specifically about the action line effect, but other literature related to the topic.

Secondly, regarding web page scanning, Shrestha et al. found that for text-based web pages, people's scanning behavior can be approximated by the shape of the letter 'F'. When the participants were searching and browsing the web pages, most visual attention was spent on a vertical bar-shaped area on the left side, a horizontal bar-shaped area at the top, and another horizontal bar-shaped area below the top area, forming the shape of an 'F'. Their findings also suggest that indeed scanning starts at the top and goes downward from there. For image-based web pages, they found that participants scanning behavior would follow a unique and random path. In this study, we will therefore focus on the action line effect for text-based pages[11].

Next, the vampire effect mentioned by Manhartsberger et al. similarly involves user interface design elements that capture the user's attention. Different from the action line effect this is usually achieved by flashy banners, animations, or emotional pictures [12]. In contrast, the action line effect seems to be mostly dependent on the button being actionable, and therefore being the object of the user's interest. Possibly, the vampire effect could be used to enhance the action line effect by designing the button in a way that grabs the user's attention even more. For example, this could be achieved with the color, size, or animation of the button.

Further, there seems to be a connection between the action line effect and screen-based reading behavior. The action line effect depends on the user to decide against further processing of the web page in favor of clicking the button. This non-linear, fragmented reading and requirement to make decisions about how to spend their limited time and attention matches the screen-based reading behavior. With the positioning of the button, the action line effect influences a choice, readers of hypertext must make repeatedly in a digital environment.

Galesic et al. found that in a questionnaire with multiple displayed answer options, participants tend to choose options from the top half. Mechanisms underlying this phenomenon are (1) participants skipping the bottom options after having found acceptable options in the top half or (2) participants visually attending the lower options as well but spending less cognitive resources on them [13]. Additionally, the observed behavior is also similar to screen-based reading techniques, as it involves skimming and skipping parts of the text. It seems to follow the same motivation to reduce cognitive effort, attention, and time spent on reading. Furthermore, Galesic et al. also found that an increased length of the response options list would enhance the observed mechanisms. The amount of text above or below the button might therefore also influence the performance of the action line effect.

1.3.3 Motivation

The research topic of this paper is relevant for multiple reasons.

First of all, as there are no neutral interface designs, unintended nudges can easily occur as well [1][3][5]. Therefore broad research about nudges is important and necessary to avoid accidental and unwanted effects.

Secondly, Nudges are generally ethically debatable, for them usually being nontransparent, affecting individual autonomy [6], and possibly being used against the best interest of the user [1]. Research should provide comprehensive information about the functioning of nudges to enable informed ethical debates.

Most importantly, we argue that the action line nudge is especially problematic as it is capable of affecting informed consent. Information regarding the consequences, terms, and conditions of the services users might agree to, when clicking the button, might be positioned below the action line. If the nudge is then decreasing the probability of people reading the information, it is decreasing the informed consent. Respectively, this nudge could be utilized to increase informed consent by positioning important information above the virtual action line. Holzer et al. found that while regulations force online companies to acquire informed consent before collecting data from the user, many users are not informed when they agree to the terms and conditions [14][15][16]. In addition, they found that different framing and adding summaries can encourage informed consent [16].

As a result of this research, we hope to contribute to the available strategies that encourage informed consent in digital environments.

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2 Methods

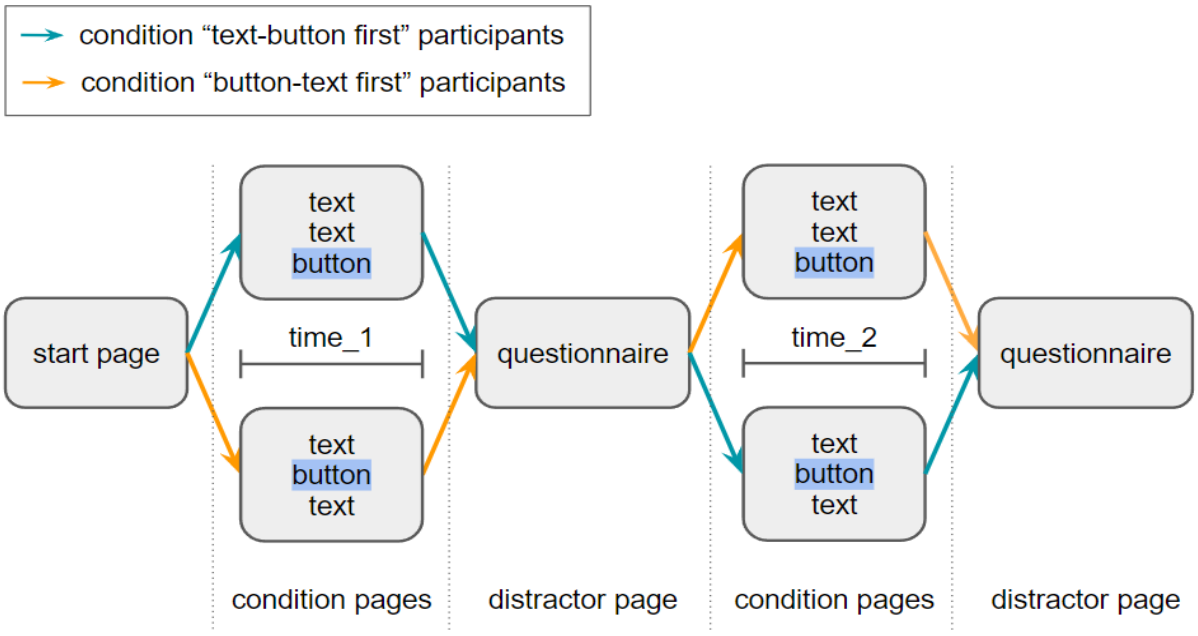

Figure 1: Schema of the app displaying the structure of the experiment. Participants are split into two groups, the "text-button first condition (displayed in blue) and the "button-text first" condition (displayed in orange) depending on their group they have different condition pages. After each condition page followed a distractor page containing a questionnaire, which was similar for both conditions. The button-text arrangements on the condition pages are schematically represented in the figure.

2.1 Procedure

To test the action line effect, we have built an app with two different condition pages and two different distractor questionnaires. Each condition page would contain a text component announcing the following questionnaire, a text component telling the participant how to answer the questions, and a button with the label “Proceed”. The button would lead the user to the first distractor page with the first questionnaire. After submitting the first questionnaire, the user would be on the second condition page which then correspondingly would lead to the second distractor page with the second questionnaire. For the structure, see Figure 1.

At the start of the experiment, participants are randomly assigned to either condition "text-button first" or "button-text first". In condition "text-button first", on the first condition page the button would be positioned below both text components, while on the second condition page, the button would be positioned between both text components. For participants of the "button-text first" condition, the condition slides would have the opposite order. For a screenshot of the condition pages, see Figure 2.

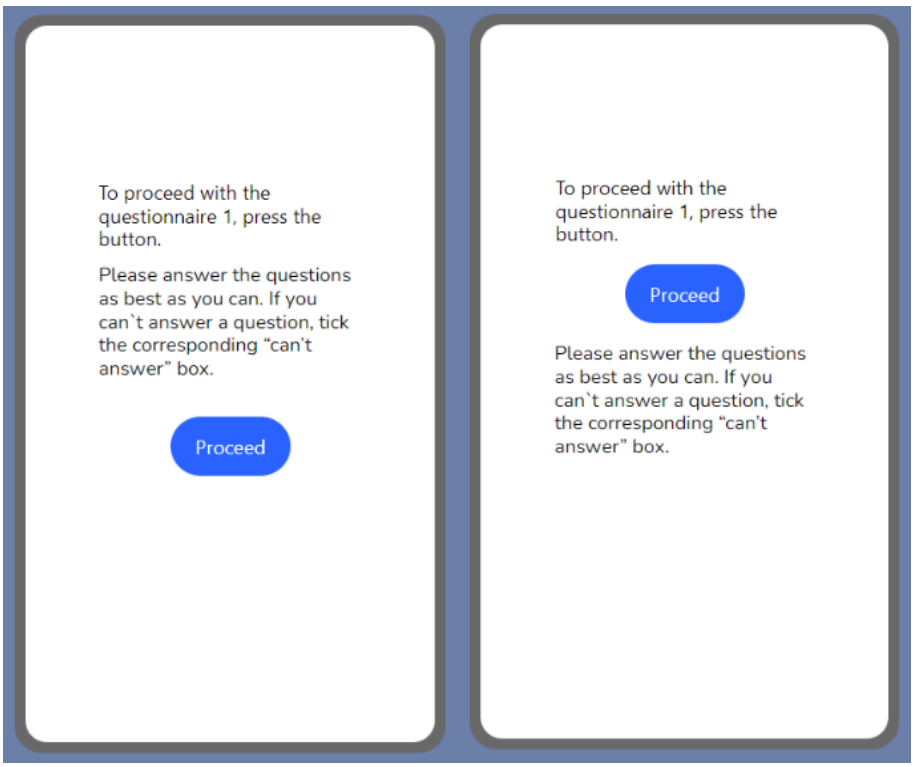

Figure 2: Screenshots of the condition pages for the first time measurement. On the left side is the first condition page of the "text-button first" condition, and on the right side for the corresponding "button-text first" condition. They differ in the positioning of the button, while the text is the same.

The distractor pages contained a questionnaire with 10 questions each. The purpose of these questionnaires was to distract from the true purpose of the experiment, such that participants did not pay special attention to the condition pages. The topic of the questions was individual use of different technologies such as smartphone, smartwatch, and laptops/computers in their free time, their work, and studying.

At the beginning of the experiment, the participants were informed that the experiment was part of the research field of human-computer interaction and that the experiment contained two questionnaires. It was taken special care, not to prime participants about the exact topic of the experiment.

The participants performed the experiment on different smartphones that were either their own property or were provided by the experimenter. The app was programmed with thunkable. For the original formulation of the questionnaire questions, see the data availability statement.

2.2 Measures and Hypotheses

Firstly, as a measure for the action line effect, we took the time participants spent on the condition pages until they clicked the button. For two condition pages per participant, this makes two measures per participant, time_1, and time_2.

Further, we assume that a longer time spend on the condition page before clicking the button correlates with the amount of attention directed toward the second text component. That makes the time a suitable measure to test the action line effect.

Specifically, we expect that the time measured when the button is positioned above the second text component will be shorter compared to when the button is positioned below the second text component. This is due to the action line effect, as participants will be nudged to interrupt further processing of the second text component if it is positioned below the button. For the first time measure, the time spent will be shorter for the participants of the "button-text first" condition. For the second time measure, the time will be shorter for the participants of the "text-button first" condition, as the order of the button and text, segment switches for the second condition page.

> *H1: Time_1 is smaller in the "button-text first" condition compared to the "text-button first" condition. H2: Time_2 is smaller in the "text-button first" condition compared to the "button-text first" condition.*

Because the text of the text components is almost the same for both condition pages, we expect the participants to spend less attention on the text components. Therefore, we hypothesized the second time measure will be shorter than the first for both conditions.

> *H3: Time_2 is smaller than time_1 for both conditions*

Lastly, we chose to use the proportion of how long participants took for the first time measure to how long they took for both together. This should neutralize differences in reading speed between participants, which our small number of participants might not be able to compensate for. Coherent with the action line effect, we expected a greater time proportion spend on the first condition page in the "text-button first" condition than in the "button-text first" condition.

> *H4: The Proportion value in the "button-text first" condition is smaller than in the "text-button first" condition.*

$$proportion = \frac{time_1}{time_1 + time_2} \tag{1}$$

2.3 Participants

The data we gathered originates from people in our personal surroundings due to a lack of resources. We reached a number of 31 participants in total with the age varying between 20-54 years of age, whereas most of them are in their twenties. See Table 2.

Participants(total)	20-29	30-39	40-49	50+
31	23	3	3	2

Table 1: Age of Participants.

2.4 Data Analysis

To improve the validity of our data analysis, we have chosen to apply two different approaches to set up our data. The first is the total times taken by a participant per condition page (time_1 and time_2), and the second is the time used for the first condition page proportional to the time used for both condition pages per participant:

$$proportion = \frac{time_1}{time_1 + time_2} \tag{2}$$

Additionally, we handled outliers performing the Rossner-Test on our data which potentially had a slightly different outcome depending on our data setup. The z-value is the amount of standard deviations above and below the mean of the data using the following formula:

$$Z = \frac{X - \mu}{\sigma} \tag{3}$$

X represents the data point and μ and σ denote the mean and standard deviation. By removing

condition	Participants(total)	Total time	Proportional time
con1	15	14	14
con2	16	16	15

Table 2: Number of participants after removing Outliers in each data set

entries with z-values >= 3 iteratively until no changes occur, we removed 1 participant for the total time measures and 2 participants for the proportional time measures (see Table 2). Reasons for outliers could be an interruption in the experiment or struggling with the English language. The latter might be an example that more likely is thrown out by the setup using the total values. With our processed data, we created two kind of plots by using the Python package "Matplotlib". We used bar plots to represent the data including the mean in each condition per time slot and the std-error (see Figure 5, Figure 3). The second kind is a box plot including the median, the lower and upper quartile of values, and the whole range in each condition (see Figure 4). In our last step, we calculated the p-values using the "scipy" package from python for both setups to determine if the difference between the conditions is statistically significant assuming a common p-value of $\alpha = 0.05$. P-values help to determine whether to reject the null hypothesis or not. To clarify a non-significant result with a p-value higher than α is not treated as evidence in favor of the null hypothesis. We want to stress the mean age difference of approximatly 2.3 years and 2.7 years between both data sets. We decided to value the impact of participants' age as insignificant.

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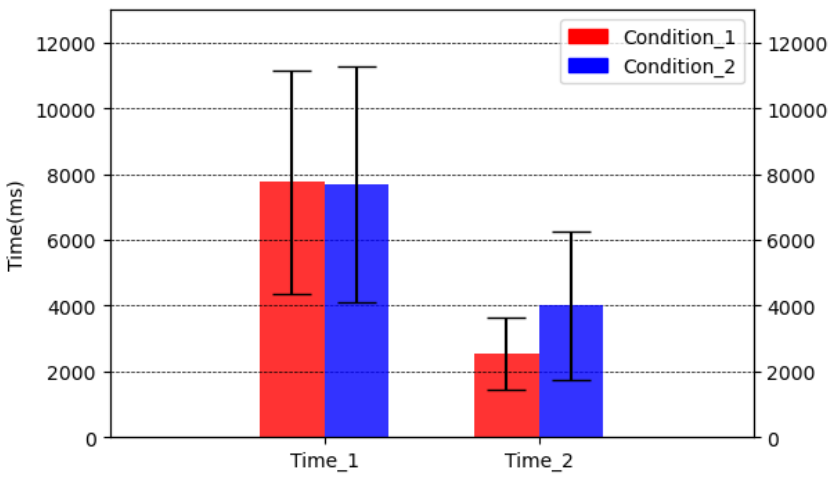
3 Results

3.1 Hypotheses 1 and 2: comparing conditions per time measure

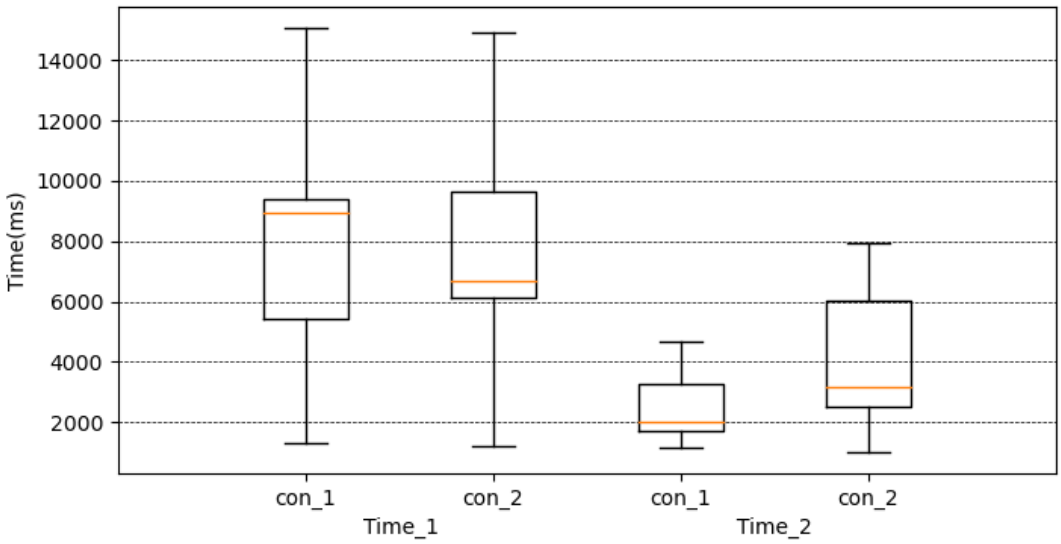
Starting with hypothesis 1 comparing the conditions for each time measurement, we reach a p-value of 0.96 for time_1. Different from hypothesis 1, we can not observe a significant difference between the conditions. For time_2, a p-value below α is reached, indicating a significant difference between conditions in favor of hypothesis 2. (See Table 3).
Additionally, taking the median displayed in the box plot in Figure 4 into account, we notice that the median of the Button-Text page clearly lies below the one of the Text-Button page in

Figure 3: Comparative figure displaying the mean for each time measure per condition including standard deviation. In time_1 , Condition_1 being text-button first, Condition_2 being button-text first and vice versa in time_2.



both cases. This is expected according to hypothesis 1. Surprising are the similar ranges and quartiles between conditions for time_1.

Figure 4: Comparative figure displaying a boxplot containing used time in total per participant per condition page. The boxplot contains the median represented by the yellow line, the lower to upper quartile values of the data, the total range and outliers



Time	condition	mean	std	median	p-value
1	1	7754	3384	8934	0.9594
	2	7687	3590	6696	
2	1	2532	1092	2027	0.0379
	2	3996	2274	3179	

Table 3: Values used in Fig3&4.

3.2 Hypothesis 3: comparing time_1 and time_2

As expected by hypothesis 3, time_2 is significantly lower with p_values of 9.198^{-6} and 0.002 compared to time_1, for both conditions.

3.3 Hypothesis 4: comparing proportions between conditions

Finally, we compared the proportion value (see Equation 2) between both conditions. Figure 5 reveals a tendency toward what hypothesis 4 predicted. Nevertheless, p-value Table 4 of 0.10 is higher than our α and therefore the difference is statically not significant. Considering both, the mean values and the median values, the pages with the button positioned between the texts seem generally faster done than those with the button below both texts.

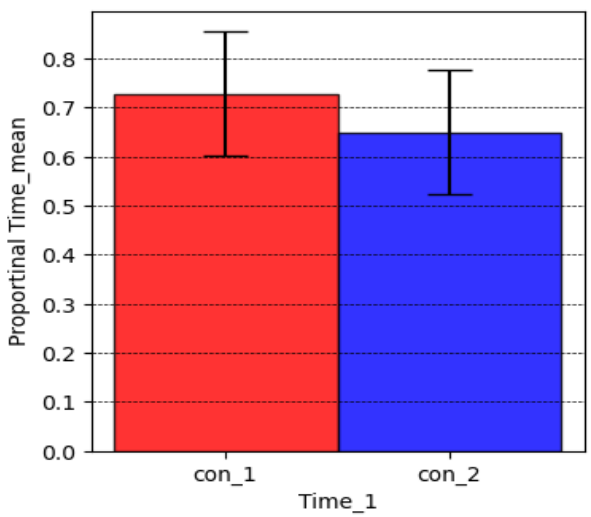


Figure 5: Comparative figure displaying the mean in each time slot per condition including standard deviation. The mean containing values are proportional to the time used per participant in total.

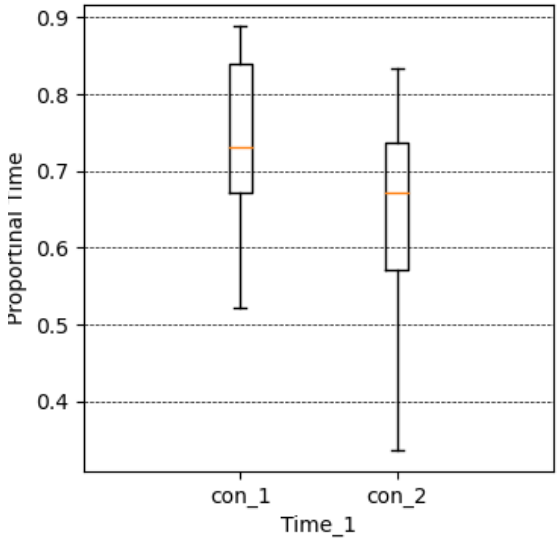


Figure 6: Comparative figure displaying a boxplot containing the proportion of time_1 to total time measured per participant. The boxplot contains the median represented by the yellow line, the lower to upper quartile values of the data, the total range and outliers.

Time	condition	mean	std	p-value	median
1	1	0.7281	0.1267	0.0978	0.7306
	2	0.6493	0.1248		0.6713

Table 4: Values used in Fig5&6.

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4 Discussion

To summarize, in this study, we investigated the existence of the action line effect. The digital nudge could be used to interrupt the users scanning of the page and thereby "hide" information below the virtual action. As scanning starts from the top and goes downwards, clicking the button when it is reached would lead to the user missing to attend content below the button (below the virtual action line) [10].

Therefore, this effect might be used to distract users from valuable information about the service they might agree to when clicking the button and therefore compromise informed consent. For that matter, we hope to increase awareness, contribute to an informed and responsible use of nudges in digital environments, and enable ethical debates about this topic.

Moreover, we tested the effect using an app that contained pages with different text-button arrangements and distractor pages to hide the true purpose of the experiment. The button was either placed below both texts or in between. For each participant, we took two measurements: how long they took for each case (time_1 and time_2). We assume the time to be an appropriate measure as it should correlate with the attention directed toward the second text component. The participants were each assigned to one of two conditions, such that they would either start with the text-button-text arrangement or the text-text-button arrangement and have the respective remaining arrangement second ("text-button first" and "button-text first" condition).

In conclusion, our results could not provide conclusive evidence for an action line effect. As hypothesized we found that participants would click the button earlier if it was positioned above the second text, but In conclusion, our results could not provide conclusive evidence for an action line effect. As hypothesized, we found that participants would click the button earlier if it was positioned above the second text, but the difference was only significant for the second time measure.

The reason we did not find an effect in the first measurement could be that the experimental context would encourage participants to read all displayed information carefully and thereby work against the action line effect. As the text was the same for the second measurement, the participants would not feel further responsibility to read the texts a second time and therefore this counteracting effect would not hold anymore. This might be the reason why we did find the expected effect for the second but not for the first measurement.

To sum up, our results are in line with hypothesis 3, about the difference between the first and the second measurement. As expected the participants of both conditions spend less time on the second condition page. We explain this as they don't have to process the text thoroughly again but recognize the page from earlier with only a difference in the placement of the button.

Lastly, using the proportion as a measure we could find a tendency towards the action line effect but no statistically significant difference between conditions. Our hope was to neutralize the effects of differing reading speeds of the individual participants by using a proportion instead of the total times. But as the results are inconclusive we can not conclude whether the action line effect exists or not. More research has to be done to obtain sound evidence.

4.1 Limitations

Our study has multiple limitations that should be noted. First of all our experimental conditions were quite different from realistic scenarios on the web. The condition pages had very little content, and we tested on smartphones, so the formatting of the screen was different from the usual computer screens. The different formats and sizes of the pages might influence the scanning behavior, which could be an important part of the action line effect. Also, the task was quite different from people's usual searching and browsing behavior on the web. Instead, taking part in an experiment might motivate people to be more attentive and thereby reduce the effectiveness of an action line effect. Different was also that the app had an almost linear structure. Non-linearity was only suggested by the button when it was positioned in between text components, which makes our experiment different from the hypertext usually present in digital environments. Also, a major part of the action line effect might be how the button represents a certain desired action. Therefore, the "Proceed"-button might not be a good substitute for web pages that offer extensive services connected to the click of a button. Another aspect that might influence the action line effect, was the content of the text components. In both condition pages, the content of the text components was similar, which most likely decreases the motivation of the participant to read the text again. In addition, we did not control for differences in reading speed and english language skills, which could also affect the time they spend on the condition pages. Even though we tried to handle this by using the proportion values, we can argue that this would have just a minor impact and assumes a constant reading speed without other possible influences related to attention.

4.2 Further research suggestions

As our study showed inconclusive results we suggest further research which avoids the limitations we mentioned about our study. Therefore, we suggest testing the nudge on actual web pages. Also, a larger number of participants would be beneficial to account for individual differences in reading speed and other uncontrolled influences. Our study only focused on the effects of an action line nudge and did not investigate the underlying mechanisms. To investigate not only if the nudge can lead people to spend more time on the web page, but also how they spend that time, we suggest the use of eye-tracking technology. Eye tracking is one of the most effective techniques to test which texts are read on a screen [12]. It could be investigated whether people are nudged to skip the text below the action line entirely like TechCrunch suggested [10], or if the attention directed toward the text is only reduced. Another way to investigate this might be a recall test, testing if the text below the action line is remembered, though eye-tracking technology will probably provide more detailed results. Other interesting research aspects might be how the reading direction influences the nudge and if it also works for image-based web pages, which support a different scanning behavior.

Generally, there seems to be no literature available yet about this possible nudge except for the web page by TechCrunch [10]. Therefore we strongly suggest more research connected to a possible action line effect.

5 Data availability statement

We uploaded the collected data, the plots, the questionnaire formulations, the thunkable-app we used and a jupyter Notebook containing the Data analysis to a GitHub-Repository:
`https://github.com/Kirschberg32/HCI_ActionLine`

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