Preventing Decision Fatigue with Aesthetically Engaging Information Buttons

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Abstract. In many different kinds of complex forms (financial, job applications, etc.), information button widgets are used to give context-specific information to enable users to fill out forms completely. However, in longer forms, "decision fatigue" can set in, leading to the user not absorbing these helpful tips but rather rushing through and possibly making errors. This research seeks to identify if using a more engaging version of the traditional information button widgets will reduce decision fatigue, preventing errors and increasing information retention. The research experiment involved a user study asking participants to fill out a tax form with information provided to them about a fictional person, with one group of participants given a form with traditional information widgets and another group being given a form with more engaging information button widgets. The results of this experiment show that the information button has no effect on the completion of financial forms or in reducing decision fatigue associated with filling out forms.

Keywords: Human-computer interaction · Finance · Information Buttons · Decision Fatigue.

1 Introduction

As the internet has grown and become accessible to people of all backgrounds and education levels, information overload has become an increasingly challenging problem. When looking for information on complex topics in a domain unfamiliar to the user, it can be difficult or even impossible to find the specific information relevant to the problem at hand. That is why on many complex online forms, such as banking applications or tax documents, companies include information widgets for difficult terminology or questions. These widgets are often a useful addition to the form, allowing the user to get context-specific information right inline with difficult questions being asked. However, when forms are particularly long and complicated, decision fatigue can occur, resulting in

users rushing through, making mistakes, and not using the handy information buttons. Therefore, we explore using engagement to reduce decision fatigue using human-computer interaction (HCI) and user interface design principles.

This proposed research strives to find a way to make information buttons more appealing in order to reduce errors in forms and increase the speed at which these forms can be done. At first glance, it would seem that the primary beneficiaries of this research would be large banking and financial companies that use these complicated forms as a way to get more accurate results and reduce overhead screening on form answers. However, this research also benefits the end user of these forms who will have their decision fatigue reduced, allowing for more energy to be spent on other things and to reduce errors. In this paper, we seek to answer whether or not more engaging information widgets result in a more accurate form fill out, changes in clicks for the information widgets, and more confidence in the answers given to the form.

The rest of this paper is structured as follows: in Section 2 we cover the background surrounding the use of aesthetics and engagement to improve performance on user interfaces and our method to undertake this work. We outline our user study setup in Section 3 and the results we found are presented in Section 4. Our work contributes to the argument that visual engagement and aesthetics of information buttons do not make a noticeable difference in the performance of tasks.

2 Background and Related Works

It is well known to anyone familiar with the field of HCI that the visual aesthetics of user interfaces is a topic with much research and debate. Designing websites, apps, and products that look good and provide good usability is a goal shared by UX designers and product developers; however there is still much debate in the community both on how to accomplish these goals and how effective increasing one to influence the other is. There is some argument that rather than the maxim of "what is beautiful is usable", the opposite is true and that usability makes things seem more attractive [11], and this is backed up by research noting that users' perception of the important part of a website changes as they use it. It is noted that before using a website, users most prioritize the visual aesthetic of it, but after use they weight aesthetic and usability equally [13].

Nonetheless, many studies have been done on the effect of aesthetic differences on users. One aspect of aesthetics that has been notably studied to mixed results is color, with some studies finding a difference depending on aesthetic [2] and others finding that aesthetic design has little to no effect on the actual message of the program [7]. Studies testing if aesthetics improve performance on tasks or in learning have been run as early as the turn of the century, and there are many claims of the advantages of better aesthetics. Researchers claim that better aesthetics can result in better information retention [6], increased readability, higher intent to purchase [10], enhanced performance on low-usability products [16], ability to find complex icons in large search environments [19],

and learning more effectively [15]. Additionally, studies have found that mobile devices that look better improve the efficiency of completing tasks on the phone [20]. These studies reinforce the idea that visual aesthetics can affect the way humans interact with computers subconsciously and that better aesthetics improves performance.

The other side of aesthetics research, however, disagrees with some of those claims. Studies have found that better aesthetics have no effect on performance during experiments [5], and more to the point, some studies claim that better aesthetics only improve the perception of usability without improving user performance [12][21]. It is also worth considering that the idea of aesthetics is culturally dependent [17] and can either have a good effect if designed with the cultural target in mind or have little to no effect otherwise [18]. Also, culturally appropriate aesthetics can have an effect on trust in a website [4].

Despite the null hypothesis predicted in some studies, the general consensus is that aesthetics can have a noticeable effect on performance in HCI. A large literature survey of aesthetically-based papers [22] calculated that overall aesthetics could and have mattered in user studies. That is why we have decided to proceed with this research; because of information buttons being a widely used tool it is important to evaluate how to improve them. Many kinds of information buttons currently exist, such as information buttons that open a dialog on the screen a user is on (an example of which can be found on the Bank of America account application form [1]), information buttons that open information in another window (as seen on the Free Application for Federal Student Aid [23]), or information buttons that only pull up a tooltip (as in a Citi Bank credit card application [3]). However it is worth noting that aesthetics are not solely related to beauty and color [9], they can also relate to reflectivity, representation, meaning [14], and engagement. Our study focuses not only on the beauty of the information buttons, but their engagement and its effect on performance.

3 Methodology

The experiment involved a user study asking participants to fill out a new tax form with information provided to them about a fictional person. The information was given in the documents shown in Figure 1 that the participant had to decipher into a complex form with niche terminology (that the participants will likely never have been exposed to prior to this point). Two groups of participants were a part of the user study. A control group was given a form using standard (non-engaging) information widgets, and an experimental group was given a form using the engaging information widgets. Then a comparison was made between the two groups using metrics such as amount of errors made, speed of completion, information widgets clicks, and confidence in the information in the form. Using these metrics we indirectly measured the effects of engaging information buttons on decision fatigue while completing complicated forms.

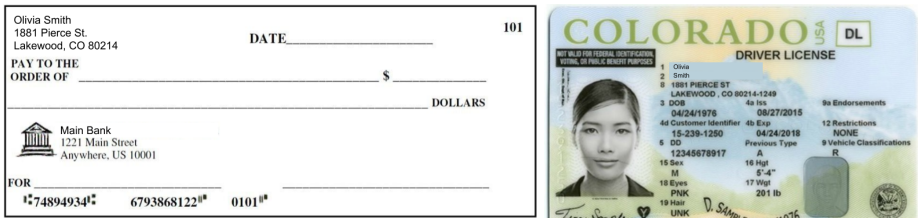

Fig. 1. Documents describing the person the user is filling out the tax form for, a fictional person named Olivia Smith. Original unedited image credit to the Colorado Department of Motor Vehicles and moneyinstructor.com.

3.1 Participants

For this user study, we aimed to primarily recruit participants with a limited knowledge of tax and financial information. That way, when encountering difficult terminology, the users needed to rely on provided information rather than previous knowledge. To that end, we recruited college students and young graduates (mostly within the ages of 18 to 24) from the nearby campus of the University of Nevada, Reno. In order to recruit people, we sent out emails and text messages to university students either individually using a network of known students or as a group via an email list. We expected based on the established difficulty that college students have with financial forms [8] that these participants were a good option for gauging the benefits of engagement on complex forms.

3.2 Apparatus

Due to the COVID-19 pandemic, all user studies for this research were done remotely. Using the video messaging app Zoom [24] users were able to remote access a testing desktop that had the form available to fill out. This form involved fairly complicated tax information accompanied by information buttons, either engaging or not. Figure 2 shows an example of a more engaging information button (next to the normal button) that was used to increase the involvement of the users. This button is brightly colored, and allows for both clicking and hovering. When the participants want quick information without pulling them away from the screen they are on, they can hover over the information widget in order to get a short blurb with the most important information. If they need more information, the participants can then click on the button for a pop up with detailed info.

3.3 Procedure

The user studies were performed by two different study administrators, and so to keep inconsistencies between studies a testing script was used. The script followed a procedure that performed the following steps in order:

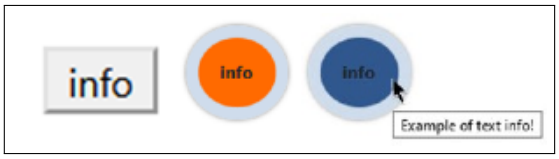

Fig. 2. An example of what a normal information button (left) looks like, compared with what a more engaging information button looks like (right). The two buttons on the right are the same, wherein the one on the far right displays what happens when the cursor touches the orange button. The text box seen on the far right button is called a tooltip.

1. The participant filled out a pre-survey with a meaningfully generated participant ID
2. The participant joined a Zoom call with the study administrator
3. The premise and purpose of the study were briefly explained
4. The participant was asked to sign a consent form
5. The participant was given supplementary materials on Olivia Smith, the person the information needed to be filled out for
6. The testing machine screen was shared with the tax form visible on the screen
7. The participant was given remote access to the testing machine
8. The participant filled out the tax form to the best of their abilities
9. The Zoom call was ended
10. The participant filled out a post-survey

The pre-survey participants filled out contained mostly demographic information like their age or gender, as well as their level of familiarity with personal finance and tax information. The tax form included questions on banking information, identification information, and tax deductions; though it is worth reiterating that they did not fill out this form with their own information, only sample information for a fictional person. The post-survey asked the participants how confident they felt in the answers they gave to the form and how they enjoyed the feel of the information buttons.

3.4 Design

Independent variable: The information buttons changed between groups
Name: Information Button Engagement
Levels: Engaging, Standard

Dependent variables: Speed, accuracy, information button clicks, time until first information button click, confidence in results, self-assessed confidence in results, overall assessment of information buttons, and assessed engagement of information buttons

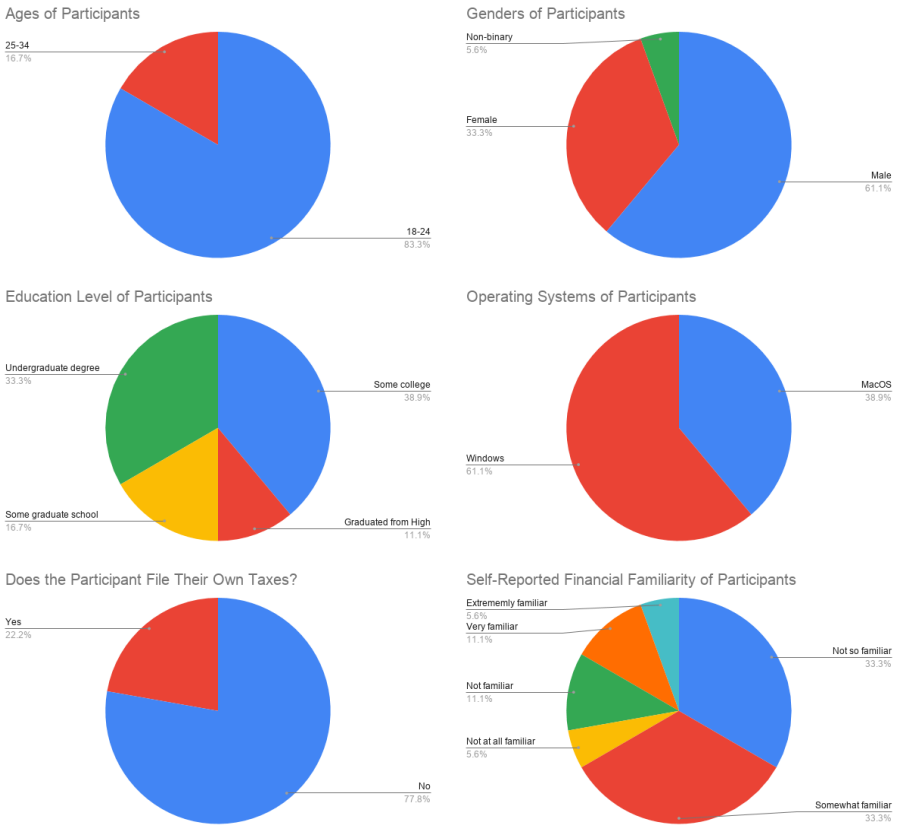

Fig. 3. Pie charts representing the demographics of the study participants based on answers to the pre-survey.

In this user study the independent variable tested was Information Button Engagement (IBE) which had two levels, engaging and standard. These levels should impact the dependent variables of speed, accuracy, information button clicks, acceleration, and retention. The conditions included a random variable as due to the remote nature of the user study, we had no control over the environment the user was in, only control over the computer they remotely accessed.

The experiment was a 10 x 2 between-subjects design. The amount of entry was 9 participants x 2 IBE levels = 18 phrases.

4 Experimental Results

Overall, we have managed to involve 18 participants, with nine being part of the control group and nine being given the engaging form. For each of these 18 participants information on eight dependent variables was collected and analyzed. The results were inconclusive and none of the dependent variables were

Participant	Form Completion Time (minutes)	IBE Level
1	12	Standard
2	14	Standard
3	7	Standard
4	9	Standard
5	10	Standard
6	8	Standard
7	8	Standard
8	7	Standard
9	8	Standard
10	9	Engaging
11	8	Engaging
12	11	Engaging
13	9	Engaging
14	14	Engaging
15	10	Engaging
16	7	Engaging
17	14	Engaging
18	16	Engaging
Mean	10.06	
SD	2.82	

IBE Level	Form Completion Time (minutes)	
	Mean	*SD*
Standard	9.22	2.39
Engaging	10.89	3.10

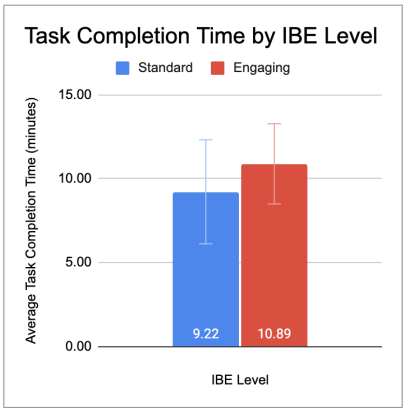

Fig. 4. Detailed information on task completion time. The table on the left shows individual participants completion times and related mean and standard deviation. The table on the right shows mean and standard deviation by level. The column chart compares the two levels.

statistically significant enough to disprove the null hypothesis. Regarding the participant demographics, as expected most of those involved were in the 18-24 range with limited knowledge of finances, as shown in Figure 3.

4.1 Dependent Variable Analysis

We analyzed eight dependent variables, four of which were from watching the user study and four of which were from the post-survey. We performed analysis of variance (ANOVA) on each of the eight dependent variables and found none were significant. The four variables from the actual user study were time in minutes to complete the form, errors submitted in the form, amount of times the information button was clicked, and time until the first information button was clicked. The four variables from the post-survey questionnaire were the indirectly assessed confidence in results, self-assessed confidence in results, overall assessment of information buttons, and engagement assessment of information buttons.

While none of these dependent variables proved statistically significant after ANOVA analysis, we have selected four to show in more detail in this paper. The first dependent variable that is relevant is the time taken to complete the form in minutes. As shown in Figure 4, the average time it took for all users to complete the form was 10.06 minutes, with IBE level Standard participants taking 9.22 minutes and IBE level Engaging participants taking 18% longer at 10.89 minute. This difference was not statistically significant ($p > .05$, ns).

The second dependent variable of note is the amount of errors made and submitted on the form during the test. In Figure 5 we see a similar pattern, with the average amount of errors made by all participants being 2.83 and IBE level Standard participants submitting an average of 2.44 errors and IBE level Engaging participants submitting 31% more errors at 3.22 on average. This difference was not statistically significant ($p > .05$, ns).

Participant	Amount of Errors	IBE Level
1	2	Standard
2	3	Standard
3	2	Standard
4	4	Standard
5	0	Standard
6	3	Standard
7	2	Standard
8	3	Standard
9	3	Standard
10	2	Engaging
11	3	Engaging
12	1	Engaging
13	5	Engaging
14	4	Engaging
15	2	Engaging
16	3	Engaging
17	6	Engaging
18	3	Engaging
Mean	2.83	
SD	1.38	

IBE Level	Amount of Errors	
	Mean	*SD*
Standard	2.44	1.13
Engaging	3.22	1.56

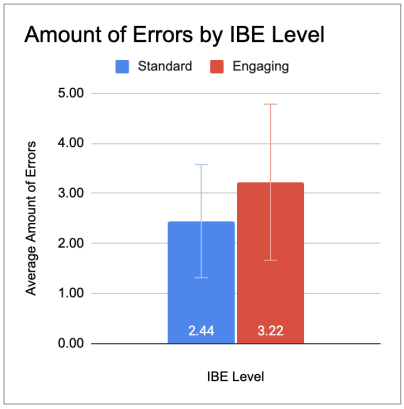

Fig. 5. Detailed information on errors submitted while completing the task. The table on the left shows individual participants errors and related mean and standard deviation. The table on the right shows mean and standard deviation by level. The column chart compares the two levels.

The third significant dependent variable we describe here is the amount of time until the first time a user pressed an information button in seconds. This variable was unique and could measure the ease of discovery of the information buttons. The average time until the first information button was clicked was on average 153.06 seconds, or a little over two minutes, as shown in Figure 6. Interestingly, participants took slightly longer to click the engaging buttons than the standard buttons, even when the outlier participant 17 is removed from the data, though it is worth noting that this is a difference of seconds and not statistically significant. Standard level participants took an average of 91.89 seconds to click an information button, and Engaging level participants took 133% longer (mostly due to the outlier, participant 17) at 214.22 seconds on average. This difference was not statistically significant ($p >.05$, ns).

The fourth dependent variable was the indirectly assessed confidence in results, which came from the post-survey. This value is based on the answer to several questions asking participants whether they think they had completed the

Participant	Time To First IB Use (seconds)	IBE Level
1	80	Standard
2	25	Standard
3	13	Standard
4	147	Standard
5	89	Standard
6	79	Standard
7	90	Standard
8	119	Standard
9	185	Standard
10	36	Engaging
11	87	Engaging
12	76	Engaging
13	31	Engaging
14	228	Engaging
15	95	Engaging
16	301	Engaging
17	737	Engaging
18	337	Engaging
Mean	153.06	
SD	171.80	

IBE Level	Time To FIrst IB Use (seconds)	
	Mean	*SD*
Standard	91.89	54.15
Engaging	214.22	226.64

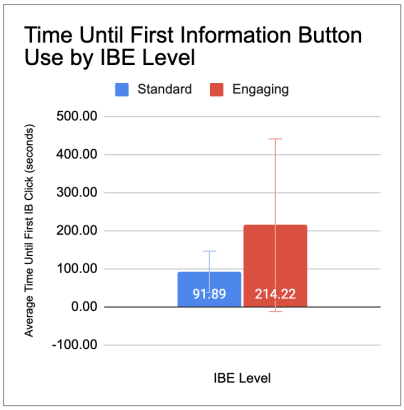

Fig. 6. Detailed information on the time it took to click an information button for the first time. The table on the left shows individual participants time until the first click and related mean and standard deviation. The table on the right shows mean and standard deviation by level. The column chart compares the two levels.

form accurately, whether they felt they knew more about taxes than they did before, whether they could perform better on this kind of form if they had to use it again, and other similar questions assessing confidence in results. These questions were all on the five point Likert scale and thus this dependent variable is an average of the answers to those questions on a scale of one to five, where one is low confidence and five is high confidence. Figure 7 shows that the average of the indirectly assessed confidence was close to four, which on our scale was to "Agree" with statements saying they felt confidence. The average of all participants was 3.98 with Standard participants rating their confidence at 4.09, 5% higher than the Engaging participants at an average of 3.87. However, this difference was again not statistically significant (F=0.67, ns).

The other variables not analyzed in depth showed the same pattern of Standard participants performing slightly better and using information buttons slightly more than Engaging participants, but not in a statistically significant manner. The average amount of information button clicks users made was 18.27 with IBE level Standard participants clicking an average of 20.11 times and IBE level engaging participants clicking an average of 16.44 times. Participants' self-assessed confidence in results on a five point scale was an average of 3.78, with Standard participants rating their confidence on average 3.89 and Engaging participants rating their confidence on average 3.67. The overall assessment of the information buttons, which was calculated using Likert scale assessments similar to those for the indirectly assessed confidence, was on average 3.93 with IBE level Stan-

Participant	Indirect Confidence in Results	IBE Level
1	4.33	Standard
2	4.33	Standard
3	4.67	Standard
4	2.83	Standard
5	3.83	Standard
6	4.33	Standard
7	4.17	Standard
8	4.17	Standard
9	4.17	Standard
10	4.17	Engaging
11	4.17	Engaging
12	4	Engaging
13	4	Engaging
14	2.67	Engaging
15	3	Engaging
16	4.5	Engaging
17	4	Engaging
18	4.33	Engaging
Mean	3.98	
SD	0.57	

IBE Level	Indirect Confidence in Results	
	Mean	*SD*
Standard	4.09	0.52
Engaging	3.87	0.62

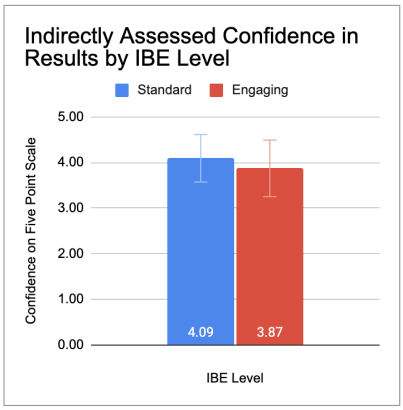

Fig. 7. Detailed information on the indirectly assessed confidence. The table on the left shows individual participants' confidence scores and related mean and standard deviation. The table on the right shows mean and standard deviation by level. The column chart compares the two levels.

dard participants ranking the buttons on average 3.78 and IBE level Engaging participants ranking the buttons on average 4.08. Lastly, we also asked participants to directly rate the engagement of the information buttons on a five point scale with a total average engagement score of 4.00, where both sets of IBE level participants rated the engagement 4.00 on average. None of these results were statistically significant ($p > .05$, ns).

5 Conclusion and Future Works

Our research has failed to show any difference in performance based on the style and engagement of the information buttons, however that in itself is a valuable addition to the debate on the extent aesthetics can subconsciously change how we interact with software and computers. Future work could be done to establish why this does not affect performance. Some avenues to consider include examining how small a difference can be and still change performance, or to check if modifications in aesthetics are only able to produce changes if they are part of the entire theme of the software. Additionally, it would be interesting to repeat this experiment with a within-subjects design to see if users who are aware of the differences have different opinions on the buttons. This work has laid the foundation for a deeper exploration of the aesthetics of individual widgets and their influence on improving user performance.

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