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User Experience Measurement of a Static Website Compared to a Responsive Website Using AttrakDiff Mini

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Abstract

The increasing use of mobile devices with internet access poses new challenges to website design. Because of the frequent introduction of new devices and the variety of their respective form factors, the website's quality of experience can hardly be maintained across the range of devices. A promising solution to this problem is responsive web design. Responsive websites adapt to the display resolution of the currently used device. While responsive design has been embraced by the engineering community, its benefits regarding user experience are still lacking empirical evidence. This paper presents a user study that sheds light on the effect of a responsive redesign of a large company's website on its quality of experience.

Index Terms: user experience, responsive web design, human-computer interaction

1. Introduction

The success of a website is significantly influenced by the quality of its user interface [1]. For a website's success, user experience is also an important factor. Especially when the website is designed for mobile devices it is even more important to focus on user experience. A study in the year 2014 by the Statistisches Bundesamt showed that 63% of german private households using mobile devices like smartphone and tablets [2]. Static websites often tend to cause problems and difficulties when operated on mobile touch devices like smartphone and tablets. The use of multi-touch gestures like pinch-to-zoom are inconvenient for users and can interrupt the reception of information. Small navigation buttons considerably impede the input with fingers. Static website are mostly developed for desktop applications as well as broadband internet connections and not optimized for smartphones or tablets. This may lead to a significantly slower load speed. There are also websites based on a static design which are especially designed for mobile application. The variety of modern device's display resolutions may result in a imperfect representation of those websites. Also these factors can result in a deterioration of a website's quality and user experience [3].

2. Responsive Web Design

Responsive web design, which was first mentioned a few years ago by Ethan Marcotte, aims to address these limitations [4]. It is a modern approach of developing a website regardless of the device's display size. The website's content should perfectly fit any display resolution and device and should allow easy touch operation. Additionally, the underlying technologies (HTML5/CSS3/JavaScript) enable developers to perfectly optimize the content for devices with weaker performance and slower internet connection. Although the implementation of a responsive layout compared to a conventional fixed layout is more complex because it has to support more devices and screen resolutions, there are numerous advantages. For example, no separate mobile website needs to be developed and maintained, which can be an immense cost factor.

3. User Study

We are presenting a user study that accompanied the responsive re-design of a major company website (more than 1.2 million visits/month). The study investigates the user experience of the website's registration process with a static design compared to a newly developed responsive variant on different devices. While the static website was developed for desktop and mouse, keyboard operation only, the new responsive one uses modern web technologies to achieve a high compatibility with tablets and smartphones of any display size. Additionally, the redesign was focused to a high level of user experience. In addition to changes regarding the website's fluid layout, also modifications to the color scheme and the interaction elements like buttons were made. Furthermore, the responsive registration process mainly uses AJAX to reload just necessary parts of the website.

It should be noted that this user study is not a classical laboratory experiment because the test participants were observed in a productive field environment. Therefore, a precise separation of the independent variables (e.g., chronological sequence of measurement and design version) was not possible. However, field experiments like the one reported here can provide more practical and realistic results than controlled laboratory experiments [5].

First part of the study was the investigation of task completion times within the non-responsive and responsive design. Therefore every user had to finish a website registration process via email and Facebook-Login. To measure accurate task completion times, especially for the touch based devices, a system with a Raspberry Pi, camera module and clamp was developed to record the user input directly from the screen. To measure the user experience the AttrakDiff Mini questionnaire was used. AttrakDiff was developed by Marc Hassenzahl and is especially designed for interactive software primarily measuring aspects of quality and satisfaction [6, pp. 187–196]. The AttrakDiff Mini questionnaire contains 10 items which must be assessed by a 7-point Likert scale [7, pp. 78–82].

3.1. Design, Procedure and Materials

The study had a sample of n=18. Every participant was asked to schedule two separate dates to perform the experiment. On

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Figure 1: *Startscreen of the old static website registration process (lower picture) compared to the responsive registration process (upper picture).*

the first date, the participants had to complete the registration process on the old static registration process via email and also via Facebook on three different devices (10“ Android Tablet, 8“ iPad Mini and PC). The registration process was performed with predefined registration data which had been provided to each participant. During the registration via Facebook, a login form supplied by Facebook itself had to be filled in and the terms of use had to be confirmed. The email registration additionally required the input of a nickname. Afterwards, the participant received a double-opt-in email containing a confirmation link in order to activate the account. In contrast to the old static design the email registration of the responsive registration process (on the second date) didn't require the user to repeatedly input their email address and password. Additionally, a registration via Facebook no longer requires the input of a nickname. Instead the user's first name will be automatically imported by Facebook. After finishing the registrations, the participants filled in the AttrakDiff Mini questionnaire conducted with the software LimeSurvey [8].

On the second date, the experiment was repeated with the new responsive registration process and the AttrakDiff Mini questionnaire was applied again. The experiment itself was performed in a closed environment. First, it was necessary to establish a LAN/Wi-Fi network (with an independent internet connection) which was separated from the company's network. This setup allowed an error-free connection between all devices and stable access to the static and responsive website registration process over the internet. All test devices were connected wirelessly, and the Raspberry Pis and computers used for video recording had a wired connection.

3.2. Results

To work out the task completion times, all video sequences were imported into Final Cut Pro X. With the help of timeline markers it was possible to get precise task completion times from every participant. The data was transferred to SPSS in separate variables for every test device and registration type.

3.2.1. Task Completion Time

The descriptive evaluation of the data derived from the experiment shows, that average task completion time on Tablet devices (iPad and Android) are very similar within the static webdesign of the experiment. The email registration on the iPad had an arithmetic mean time M of 99.84 s in the old static design. However, the participants performed around 10 seconds slower on the Android Tablet ($M = 110.88$ s). The Facebook registration was performed faster on both devices, $M = 56$ s on the iPad, $M = 70.89$ s on the Android Tablet. The task completion times were even faster on the PC than on the other devices ($M = 78.4$ s for email registration and $M = 44.14$ s via Facebook).

The new responsive registration process was completed faster overall by the participants. The email registration with $M = 58.67$ s on the iPad and $M = 53.82$ s on the Android Tablet was much faster than the task completion times of the static webdesign. The same applies to the Facebook registration on the iPad ($M = 48.71$ s) and Android Tablet ($M = 39.40$ s). In comparison to Tablet devices, the participants performed the email registration slightly slower on the PC with ($M = 60.76$ s). In contrast on the new webdesign, the registration via Facebook was completed in record time on the PC ($M = 43.47$ s).

Table 1: *ANOVA results for task completion times*

Factor	df_n	df_d	F	p	η^2_G
Device	2	32	8.3	<.001	.106
Design	1	16	188.9	<.001	.430
Interaction	2	32	14.9	<.001	.199

Referring to the process and visual changes we expected that the task completion time of the responsive webdesign is significantly shorter than the static one. The statistical determination was performed with repeated measures analysis of variance. The result of the ANOVA indicates that the mean difference between the static webdesign and the responsive webdesign is highly significant (see Figure 2 and Table 1, η^2_G are generalized eta squared [9]).

3.2.2. User Experience Questionnaire

Before starting to analyse the questionnaire data, all items had to be transferred into 4 scales: pragmatic quality, attractiveness, hedonic quality (stimulation), hedonic quality (identity). Subsequently, the arithmetic mean of these scales was determined. Subsequently we expected improved quality ratings for the new design. This hypothesis implies that there is a significant difference between the static and the responsive registration process regarding its hedonic, pragmatic quality and attractiveness. For this determination, a pairwise t-Test was performed [10].

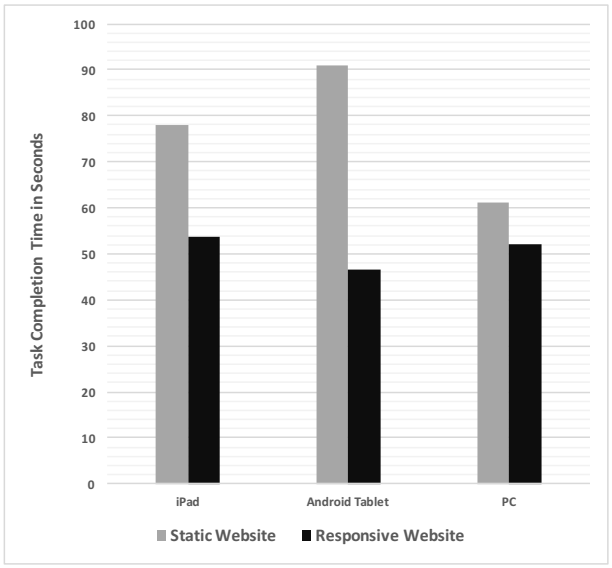

Figure 2: *Comparison of the arithmetic mean within the devices between the old static webdesign and the new responsive webdesign.*

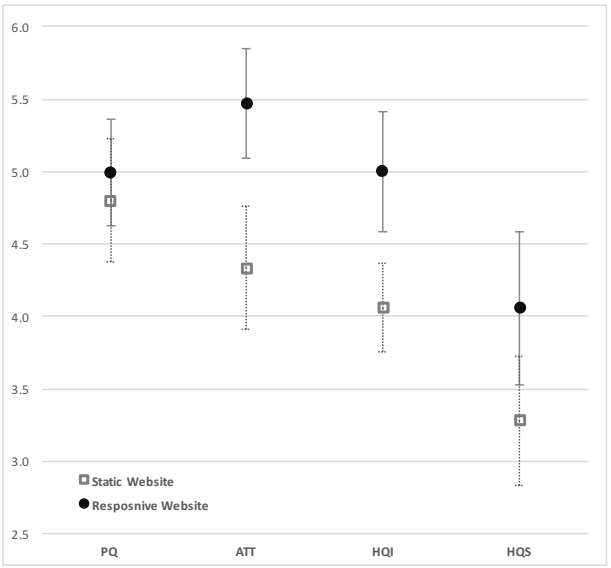

Figure 3: *Mean quality ratings of the static web design and responsive web design.* PQ: Pragmatic Quality; ATT: ATTractiveness; HQI: Hedonic Quality (Identity); HQS: Hedonic Quality (Stimulation)

The result of the pragmatic quality with 4.8 for the static design are below the maximum of 7. The responsive registration process performs slightly better with 5.0 ($t_{17} = 0.64, p = .534$). The hedonic quality (identity) was assessed by the subjects with 4.06 for the static design and 5.0 for the responsive one, which is a significant difference ($t_{17} = -4.27, p = .001$). The same applies for the hedonic quality (stimulation) with 3.28 for the static design and 4.06 for the responsive registration process ($t_{17} = -2.23, p = .039$). The attractiveness has also increased from 4.33 to 5.48 for the responsive design ($t_{17} = -4.85, p < .001$). In summary, it can be said that the responsive redesign of the registration process led to a significant improved user experience.

4. Discussion

The analysis of the task completion times reveals several important properties about the two designs. First, the responsive design is much faster (about 30%) than the static one. Second, while there is a main effect of device (PC vs. tablets), the interaction between device and design is more pronounced (i.e., its effect size η_G^2 is nearly twice as large). A visual inspection of the means shows that the difference between the devices ist largely diminished in the responsive design (see Figure 2), which is the main intention behind it.

The questionnaire results show that the application of responsive design has strong advantages over static web design even when taking the medium sample size into consideration. The responsive redesign resulted in an overall better user experience of the registration process. However, it should be noted that the user interface of the registration process has also been adjusted regarding color design and layout during the redesigning process.

It is worth noting that while the responsive website proved much more efficient (with respect to task completion times), this change was not reflected in the perceived pragmatic quality ratings. This is consistent with previous research that did only find very small correlations between objectively measured task completion time and perceived usability [11, 12]. The subjectively perceived task completion time might by a more valid criterion, instead [13].

5. Conclusions

Although the results have been produced using a small section of the website, they are valuable for future development plans of the website as a responsive web design enhances the usability on a wide range of modern devices. From the engineering perspective, a responsive solution can also dramatically reduce the maintenance cost compared to an approach with dedicated desktop and adaptive mobile versions [14].

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