User Research in Human-Computer Interaction: Analyzing users' Expectations and Interactions to Improve their Experience on Websites

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by
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Statement of Authorship

I.   I, Silvia Heinz, hereby declare that I have written the submitted doctoral thesis "User Research in Human-Computer Interaction: Analyzing users' Expectations and Interactions to Improve their Experience on Websites" without any assistance from third parties not indicated.

II. I only used the resources indicated.

III. I marked all the citations.

IV. My cumulative dissertation is mainly based on five manuscripts, whereas four manuscripts are already published, and one manuscript is submitted. I certify here that the articles in this dissertation concern original work.
     I contributed substantially and independently to all manuscripts in this dissertation. I have been jointly responsible for the idea, conception, data collection, analyses, and writing of all manuscripts.
     This characterization of my contributions is in agreement with my co-authors' views.

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Abstract

Research within the field of human-computer interaction (HCI) and website design aims at improving the users' overall experience on websites. Knowing users' expectations has turned out to be one of the important factors to design satisfying and successful websites. These expectations are often translated into design recommendations and summarized in usability guidelines. The aim of the present cumulative dissertation is to contribute with empirical studies to the knowledge on how to improve the overall user experience by exploring users' expectations and analyzing their behavior on websites.

The first set of manuscripts outlines a research project assessing users' mental representations of different website types. We were interested to see which interface elements users currently expect to be on an online shop, an online newspaper and a company website and where they expect these elements to be located. Results indicate that these mental representations are dynamic and to a certain extent reflect changed in website design.

In a second study, we examine which characteristics of a website determine whether an experience is judged as trustful or distrustful. In this exploratory study, we analyzed users' reports of a previous visit to a website and identified characteristics enhancing trust or causing distrust. Our data suggests, that complex overall designs and aspects of structural design such as usability issues are related to distrust whereas content design aspects such as the display of security signs and personal and social proof are important in enhancing trust.

Within the last set of studies, we explore the impact of usability guidelines for web forms. A set of 20 guidelines was applied to web forms, and these forms compared to the original ones. On all three improved registration forms, users were able to perform their task faster, experienced fewer problems when submitting the form and were more satisfied. The open comments further suggested a clear layout and structure of the web form to be important to users.

All studies conducted within the present thesis contribute to the existing research in several ways. We collected data on (1) which interface elements users expect to be found on different types of websites and how these elements need to be arranged to meet their expectations, we further (2) investigated which characteristics of websites enhance trust or cause distrust and we (3) determined the impact of guidelines applied to web forms on users' experience. In a final section of this thesis I discuss the results of the studies, draw conclusions and suggest how our findings can be beneficial to the design of websites and improve the overall user experience.

Contents

Introduction

In our digitalized world, we often opt for an online alternative such as online shopping instead of heading to the shop in the city. Although using a website may appear to be the easier and hassle-free way of shopping, there are several pitfalls that can lead to the online shopping experience ending in considerable annoyance. For example, when after spending a substantial amount of time selecting items to put in the shopping cart, one fails to locate the icon leading to the shopping cart and checkout process. Or if, after locating the shopping cart, one feels uneasy and does not trust the website to handle the credit card details with care. Or if the checkout process is not user-friendly. Any of these scenarios can lead to giving up, not buying anything and most likely not returning to this particular website in the future.

Research in human-computer interaction (HCI) examines the extent to which a product can be used by specified users to achieve a specified goal efficiently, effectively and with satisfaction (International Organization for Standardization, 2010). For a long time, the focus has been predominantly on studying the efficiency and effectiveness of an interface and the users' satisfaction (International Organization for Standardization, 1998, 2010). Over the last few decades, however, a more holistic view of the overall user experience has been promoted. This encompasses the emotional, subjective and temporal aspects of the interaction with a product, along with the more traditional and functional aspects of usability. Amongst the first to use this term were Norman, Miller and Henderson (1995), as usability seemed too narrow to them to account for their holistic vision of HCI. User experience is defined as a person's perceptions and responses that result from the use and/or anticipated use of a product, system or service (International Organization for Standardization, 2010). Within this thesis, I am going to present studies that cover three important aspects of the overall user experience in the Internet, namely expectations, experiences of trust and usability of web forms.

When users' expectations are confirmed, they will be satisfied (Hassenzahl, 2003). Before or when they initially open a website, they seem to activate a mental representation about this type of website. These representations are often described in the literature as users' mental models of a website. Users' mental models and expectations are the first research topic addressed in this thesis. When websites are consistent with users' expectations, studies show different benefits, such as that users better orient themselves during a first-time visit to a website if the layout corresponded to their expectations of a prototypical website (Oulasvirta, Kärkkäinen, & Laarni, 2005). Participants were able to locate a given interface element faster and their eye movements were already shifting towards the expected location upon prompting with the name of a interface element (Roth, Tuch, Mekler, Bargas-Avila, & Opwis, 2013). Additionally, when a website is built according to users' expectations, it has a positive impact on user satisfaction (Bhattacherjee, 2001) and users are less frustrated (Cassidy & Hamilton, 2014). In 2010 a study was published that which assessed users' expectations of interface elements on three different website types (Roth, Schmutz, Pauwels, Bargas-Avila, & Opwis, 2010). However, new powerful technologies such as autosuggest functionalities impact the design of websites, and thereafter the arrangement of interface elements on websites. As a consequence, certain interface element are nowadays often found in different areas of the website. It is yet unclear if users' mental representations have adjusted accordingly. To our

knowledge no study has systematically analyzed the dynamics and robustness of users' mental representations and highlighted differences over time. Therefore our first study was conducted to assess users' current mental representations of websites and the expected location of different interface elements.

Trust has been shown to be another important aspect of user experience, influencing users' satisfaction with the website, their intent to revisit a website and customers' e-loyalty (Cyr, 2013). It is important that users trust a websites. When they have to provide information such as personal data or payment details to a third party, it is especially important that they can trust the website and the appended company. In the Internet trust is even more important, as companies sometimes do not have an offline presence and cannot be visited in real-life. But what is it important to consider when designing a website that evokes trust? So far, studies often had users evaluate their experiences with one specific type of website such as only e-commerce websites. Further, the impact of predefined website characteristics, such as usability issues or content quality, has been explored (Andrade, Lopes, & Novais, 2012). Little research exists on the antecedents of experiences on websites that are judged as trustful or distrustful and the associated website characteristics. Furthermore, it is unclear whether trust and distrust are independent of each other or how trustful and distrustful experiences are connected. Our second study investigates this aspect contributes to the whole user experience and shows that trustful and distrustful experiences differ regarding their antecedents.

Yet, users not only search for information on websites, they also want to perform tasks with websites, such as subscribing for a service, registering to download documents or using a provided service such as a tax calculator where they are required to input personal data to get the information. Web forms on websites often are the only interface between users and the company (Seckler, Tuch, Opwis, & Bargas-Avila, 2012). Therefore it is important that these interactions are effortless and easy, as this leads to more satisfied users (Bargas-Avila et al., 2010). Users' interaction with web forms is the third research topic in this thesis. There is extensive research on how to improve the interaction on web forms (Bargas-Avila et al., 2010; Jarrett & Gaffney, 2009; Seckler et al., 2012; Wroblewski, 2008). From prior experience on other websites, users expect that the website will react in certain ways, for example that they need to submit a form or save information and will afterwards receive feedback either as a prompt on the website or in an email. Best practices, findings and recommendations on how to improve web forms have been compiled in different form guidelines. One set of 20 guidelines is provided by Bargas-Avila et al. (2010). The majority of the included guidelines have been individually empirically validated: however, no holistic evaluation of the impact of these combined guidelines on users' overall experience and satisfaction has taken place. We therefore applied this set of guidelines to three existing web forms and compared the improved version to the original ones in a multi-method approach.

For this cumulative thesis, I collected and analyzed user data in these aforementioned fields to add knowledge to these important aspects of user experience but also to provide valuable help to web designer to create better website. Websites should be intuitive, efficient to navigate, error tolerant, pleasant to look at and adhere to standards.

To sum up, the following research questions related to the aforementioned gaps in research are addressed: (1) Which interface elements do users expect to be on websites and where do they expect these interface elements to be located within the interface? (2) Which interface elements and characteristics of websites enhance trust or cause distrust? And (3)

when users interact with web forms, can we improve their experience by applying a set of 20 simple form guidelines?

Manuscripts included in this thesis

The following manuscripts are the basis for my thesis. The first two manuscripts cover the aspects of assessing users' expectations on the location of different interface elements such as *logo, search box* or *legal information*.

(1a) Linxen, S., Heinz, S., Müller, L. J., Tuch, A. N., & Opwis, K. (2014, April). Mental models for web objects in different cultural settings. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems* (pp. 2557-2562). ACM. doi: 10.1145/2559206.2581209

(1b) Heinz, S., Linxen, S., Fraßeck, L., Tuch, A. N., & Opwis, K. (submitted for publication). Is it still there where I expect it? – Users' current expectations of interface elements on the most frequent types of websites. [submitted to *Interacting with Computers*]

In manuscript 2 we investigate which website characteristics influence users perception to experience websites as either trustful or distrustful. We therefore assess website characteristics for trustful and distrustful experiences.

(2) Seckler, M., Heinz, S., Forde, S., Tuch, A. N., & Opwis, K. (2015). Trust and distrust on the web: User experiences and website characteristics. *Computers in Human Behavior*, 45, 39-50. doi: 10.1016/j.chb.2014.11.064

In the third set of manuscripts we analyze users' behavior on websites by optimizing web forms. These manuscripts have been published as work in progress and as a full paper.

(3a) Seckler, M., Heinz, S., Bargas-Avila, J. A., Opwis, K., & Tuch, A. N. (2013, April). Empirical evaluation of 20 web form optimization guidelines. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems* (pp. 1893-1898). ACM. doi: 10.1145/2468356.2468695

(3b) Seckler, M., Heinz, S., Bargas-Avila, J. A., Opwis, K., & Tuch, A. N. (2014, April). Designing usable web forms: empirical evaluation of web form improvement guidelines. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems* (pp. 1275-1284). ACM. doi: 10.1145/2556288.2557265

This thesis is organized as follows: For each of the three research topics I will first present the theoretical background and current state of research and then summaries of the corresponding manuscripts. In the concluding section, I discuss the results of the studies and their implications for research and practitioners and give an outlook for future research.

User Experience and Expectations

One fundamental challenge to the design of successful websites is to create a positive user experience (UX). UX is defined as people's perceptions and responses resulting from the use or the anticipated use of a product, system or services (International Organization for Standardization, 2010). Users' internal state, their predispositions, needs and expectations are important as well as the purpose of the system with which they interact and its characteristics, such as functionality and usability. Furthermore, the context in which the user fulfills the task has become equally important. The physical context and the social setting (e.g. work or leisure) influence the overall experience, but also the voluntariness of the interaction (Hassenzahl & Tractinsky, 2006). Consequently the more pragmatic and instrumental aspects of usability (efficiency, efficacy and satisfaction) have been extended with emotions and aesthetical aspects to result in a more holistic view on the users' experience (Bargas-Avila & Hornbæk, 2011). To provide users with an efficient and easy-to-use website and that creates satisfying experiences it is necessary to gather information about the user. We will now focus on three aspects where the overall user experience can be improved.

In the first section, expectations and the anticipated use of a product are investigated. The influence of expectations on consumer satisfaction has been shown (Raita & Oulasvirta, 2011); however, we concentrate on the importance of knowing users' expectations and their mental representations of websites for web design. Interfaces that conform with users' expectations are defined as "predictable […] user concerns, emerging from the applicational context and in accordance with generally accepted conventions" (International Organization for Standardization, 2006).

In a second section of this thesis we explore characteristics of a website that influence users' perception. Research suggests that for example within the online banking environment, design quality had an impact on usage behavior of customers (Al-Qeisi, Dennis, Alamanos, & Jayawardhena, 2014). The design of websites, specific interface characteristics and functional aspects of other types of websites might be also factors attributing to users' perception of trustworthiness – the judgment whether a website is perceived as trustful or distrustful.

Last, but not least, users' evaluation of pragmatic and functional aspects of a website are examined in the third section of this thesis, as we analyze the impact of usability guidelines for web forms on users' overall experience. These more pragmatic and functional aspects of an interface are often measured by the extent to which users can conduct their tasks with technical systems or on websites or systems efficiently, effectively and with satisfaction (International Organization for Standardization, 2010).

Expectations about the Location of Interface Elements
Mental Representations of Websites

On their first visit to a website, users decide whether they want to engage with this website. They often get to a website with a certain goal and therefore have to orient themselves as fast as possible on a website. They need to understand the website and to achieve this, three aspects are relevant: users' expectations, their mental models and their experience with this or similar systems (Slone, 2002).

Expectations are the unconscious predictions of humans being constantly made to model the world around us to predict and judge our environment (Jonassen & Henning, 1996;

Norman, 1983). They are helpful to make sense of the world around us and help us to anticipate events such as estimating the speed of an approaching car when crossing the street, but also to prepare for system reactions when interacting with technology.

Mental models are a second important aspect to understand a system (Slone, 2002). In cognitive psychology, mental models are knowledge representations (Gentner & Stevens, 1983; Johnson-Laird, 1983). The early work of Craik (1943) defines them as internal working models for external events. Mental models have predictive functions to understand how our environment, including technology, works; they are subject to change and are often formed on the fly (Davidson, Dove, & Weltz, 1999). According to Ross, Lynam, Perez and Leitch (2011), who differentiated between mental models and schemata, schemata would be the more appropriate term to describe the mental representations of websites. This because mental models are built on the fly and can be flexibly adapted, whereas schemata are more stable cognitive constructs and develop from the generalized abstraction of different mental models (Dörr, Seel, & Strittmatter, 1986; Hanke, 2006; Seel & Hanke, 2015).

The term 'mental model' however was also used to describe users' mental representations of websites (Bernard & Sheshadri, 2004; Davidson et al., 1999; Slone, 2002). Norman (1983) and Nielsen (1999) adapted the term 'mental model' in the early HCI research to describe the user's simplified internal representation. This working model represents how complex and complicated objects and functions of a computer system work (Jonassen & Henning, 1996). Furthermore, the differing mental models of user and designer were used to explain how some of the usability problems develop. As represented in Figure 1, a designer creates a website relying on and implementing his mental model of the system, whereas the user might have a different mental model. Therefore the system – including its appearance, structure but also functionalities – might not meet users' expectations and needs. Usability errors are the consequence, beginning from lack of affordance to insufficient error prevention or error recovery (Norman, 1983).
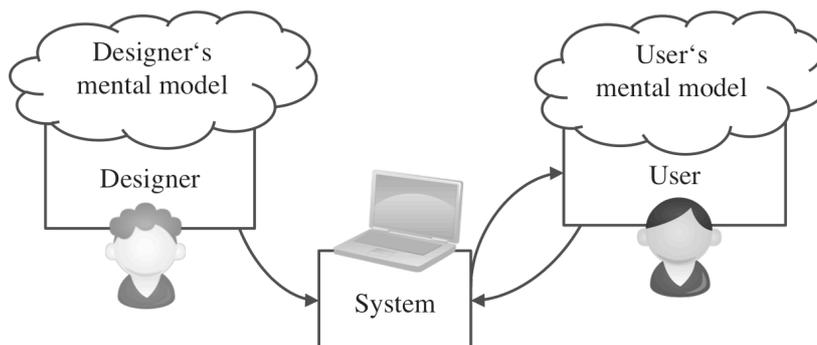
Figure 1. Designer's and user's mental models (Figure adapted from Norman, 1983)

Benefits of Knowing Users' Mental Models

Users also seem to have formed expectations regarding websites based on their experience with different sites (Bernard, 2001b; Roth et al., 2010). These mental representations are understood to be a users' 'mental blueprint' of a website, encompassing information such as the general structure of a website and the spatial location of its interface elements (Di Nocera, Capponi, & Ferlazzo, 2004; Owens, 2013; Rapp, 2005). Palmer (2002) investigated the placement and arrangement of interface elements such as where to place the

logo and were able to show that location of certain content on a webpage seems to be as important as the structure of a website as a whole.

These mental blueprints of websites are activated quickly: because even when websites were shown for milliseconds only, participants were able to correctly categorize them (Owens, 2013). Research has shown that first impressions of websites are formed in very short periods of time (Lindgaard, Fernandes, Dudek, & Brown, 2006) and the overall layout of a website seems to be relevant from the first second (Lindgaard, Dudek, Sen, Sumegi, & Noonan, 2011). Also, when presented screenshots of websites corresponded to a prototypical layout, users gave favorable aesthetic ratings (Tuch, Presslaber, Stöcklin, Opwis, & Bargas-Avila, 2012).

To design successful websites, either websites are adapted to users' mental models by optimizing the layout and positioning information where users expect it to be or they improve users' mental models by explaining or providing additional information (Nielsen, 2010). One possibility to guide designers when trying to create websites according to users' expectations are recommendations and guidelines, as well as best practices.

Regarding the layout of websites certain interface design conventions have been established over the last decades. The organization of the content on a website has been suggested as a key issue to the success of online business (Flavián, Gurrea, & Orús, 2008). Furthermore, websites converged on a consistent layout of footer and header area, navigation area and a content area (Lynch & Horton, 2008). Lee and Koubeck (2010) showed that content organization, visual organization and navigation had a greater impact on user preference of different websites than color and typography. Users have even formed expectations of where they expect advertisements to be located and consciously or unconsciously ignore information that is displayed there. This phenomena was called banner blindness (Benway, 1999). Pagendarm and Schaumburg (2006) argued that this effect was also due to the users either aimlessly browsing on a website and therefore paying attention to all displayed information or searching goal-oriented for information and hereby ignoring irrelevant information. Several authors were able to replicate these findings in different settings (Calisir & Karaali, 2008; Heinz, Hug, Nugaeva, & Opwis, 2013; Heinz & Mekler, 2012; Resnick & Albert, 2014).

Guidelines on where to place certain information on a website however often originate from and represent the designer's viewpoint. Research has tried to assess whether these conventions could also be reflected in users' mental representations of websites. Different approaches were used to assess users' mental representations. Bernard (2001a, 2001b) asked students to place interface elements independently of each other on a grid and showed that users have expectations about the location of interface elements on e-commerce websites. Authors have applied different approaches to gathering data and illustrating users' mental representations of websites (Albert, Mast, & Burmester, 2009; Baharum & Jaafar, 2013; Bernard, 2003; Bernard & Sheshadri, 2004; Cassidy & Hamilton, 2014; Dinet & Kitajima, 2011; Niklas, 2014; Roth et al., 2010). Allowing users to sketch their prototypical website with the possibility of adapting the size of interface elements was the approach used by Roth et al. (2010). Previous studies compared users' mental representations between different user groups and have shown differences between experts or laypeople, with experts having a more complete and elaborated mental model (Roth et al., 2010; Thatcher & Greyling, 1998; Volkamer & Renaud, 2013). In their study Roth et al. (2010) were able to show that users

have formed distinct, website-specific mental representations, such as for online shops, news websites and company sites. Over the years, however, technological advances have influenced the design of websites. But do users' mental representations adapt to the changes in web design and if so, to what extent?

Because mental models are built when users interact with their environment, they seem to evolve dynamically (Gentner & Stevens, 1983). Looking at the representations of websites as cognitive networks, it is also likely that the network they represent degenerates from lack of use – connections break and elements can be lost when they are not frequently used (Norman, 1983) – whereas frequent use can refresh and strengthen the connections (Qian et al., 2011). Additionylly, experience with one system can be transferred to another or newer system and therefore generate certain expectations about the functionality of systems (Slone, 2002).

Some studies have re-assessed these mental representations using different approaches and have compared their findings to previous studies (Cassidy & Hamilton, 2014; Roth et al., 2010; Shaikh & Lenz, 2006). For certain interface elements, studies have shown that users nowadays seem to expect them on certain websites. Huang and Benyoucef (2013) mention that in e-commerce more and more social elements are included: however, no study has systematically looked at the temporal differences over time and assessed the robustness or the dynamics of users' mental representations.

To sum up, no study has systematically compared results to previous studies such as Bernard (2001b) or Roth et al. (2010) to re-examine users' mental representations of websites and show differences over time, and to show the influence of technological developments. We therefore conducted our first studies in this thesis.

Summary of Manuscript 1a: Mental models for Web Objects in Different Cultural Settings (work-in-progress paper)

Aim of the study and contribution. In this work-in-progress, we describe a research project to collect and compare users' mental representations of four different website types in different cultural backgrounds. This project aims at extending the results of a study of Roth et al. (2010) to show the temporal developments of mental representations of websites and beyond the sample of German-speaking countries and the US. Studies re-examining the location of interface elements were able to show some differences over a time period of five years (Shaikh & Lenz, 2006). Most of the studies investigating users' mental representations of websites analyzed data from samples either from Western countries or from Asian countries only. With the growing importance of HCI research expanding into non-WEIRD (Western, educated, industrialized, rich and democratic) countries (Henrich, Heine, & Norenzayan, 2010; Sturm et al., 2015). Studies such as work by Bernard and Shreshadri (2004) have investigated the differences between countries and our aim is to extend their findings further and highlight similarities and differences between five cultural backgrounds.

Method and results. In order to assess the mental representations of websites of a wide range of Internet users, we developed an online sketching application where participants were able to compose their websites using given interface elements. We selected the German-speaking countries and the US to highlight temporal changes and Egypt, India and Vietnam to explore the cultural differences and similarities. During preliminary work, the top 100 websites of Alexa.com (2013) were screened for each of the selected countries. Each website

was categorized and the categorizations discussed until consensus between the coders was reached. Preliminary results displayed in Table 1 reveal that the proportion of website types varies between the countries. The category of web portals seems to be important to the Asian countries. We therefore include 'web portals' into the main study for Asian countries, in addition to the company pages, news websites and online shops included by Roth et al. (2010).

Table 1

The four categories identified during the preliminary categorization of the top 100 websites of each country

Types of websites	DE	AT	CH	EG	IN	US	VN	Mean	Total
Company page	19	15	19	17	18	24	9	17.2	121
Online newspaper	17	15	12	20	7	14	22	15.2	107
Web portal	2	6	3	9	13	8	25	9.4	66
Online shop	10	10	11	1	9	5	8	7.7	54

Discussion and further work. It is the aim of this research project to collect users' current mental representations of websites. We want to compare these findings to the results of Roth et al. (2010) to highlight temporal differences and by including users with different cultural backgrounds we will be able to show the influence of culture, or international working experience. By comparing the expected appearance of each interface element between participants of different cultural backgrounds and by aggregating the results in blueprint models we can highlight differences and similarities.

In the concluding section we discuss potential problems that are anticipated to occur during data collection and analysis. These are problems such as management of the complex parallel recruitment process and potentially missing common understanding of the website types or descriptions of interface elements. The results of the research project will highlight similarities and differences of mental representations over time and between different countries. The implications will provide further insights into how to successfully design websites and to support the internationalization of websites.

Summary of Manuscript 1b: Is it still there where I expect it? – User's Current Expectations of Interface Elements on the most Frequent Types of Websites (full paper)

Aim of the study and contribution. The Internet is constantly evolving and the design of websites change continuously. Studies have shown that websites consistent with users' expectations are successful in different ways. Users were able to find information faster (Baharum & Jaafar, 2014; McCarthy, Sasse, & Riegelsberger, 2004; Roth et al., 2013), had less trouble orienting themselves (Oulasvirta, 2004) and prototypical websites were even judged it to be more visually appealing when looking at them for a very short presentation time (Tuch et al., 2012). Previous research aggregated users' expectations of different websites including the location of certain interface elements (Cassidy & Hamilton, 2014; Roth et al., 2010; Shaikh & Lenz, 2006). To the authors' knowledge however, no study has systematically explored the influence of technological innovations and developments in website design on these mental representations by systematically comparing the assessed mental representations to previous results.

Method. We developed an online application (mentioned in manuscript 1a) and asked 841 participants from German-speaking countries (Germany, Austria and Switzerland, further abbreviated as DACH) and the US to sketch their prototypical version of an online shop, a company website and an online news website. The online portals were not analyzed in this study, as they are not very common in the target areas. Participants were able to use given interface elements identified in a preliminary study and adapt their size according to their expectations. Figure 2 illustrates the main screen of the sketching application.
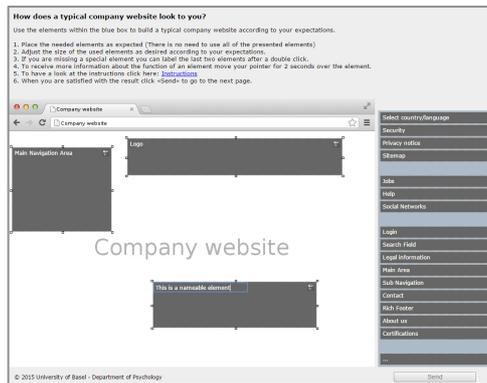

Figure 2: Screenshot of the sketching application used in our study

We collapsed data from US and DACH to compare our data to the data obtained from Roth et al. (2010). These data were originally collected in 2007, investigating a similar sample, and enable us to show to what extent the expected location for the different interface elements has changed. Data were plotted as contour maps for each interface element, split by website type (see examples in Figure 3). These contour maps reflect the density distribution of the centroids of each participant for the selected interface element.

Result. Our results indicate robustness of the expected location for the most frequently placed interface elements, such as *main area, navigation, search* and *logo.* They are expected to be on all three website types and their expected location did not change compared to 2007.

Elements such as *FAQ, RSS feed,* or *link to the top* are no longer expected on neither of the website types: however, participants expected new interface elements on the website. Several elements (such as *contact information, legal information* or *about us*) are now usually often found within the rich footer area of a website and were accordingly placed at the bottom of the site by our participants. Figure 3 illustrates the shift to a more consistent position at the bottom of the page for *legal information.*
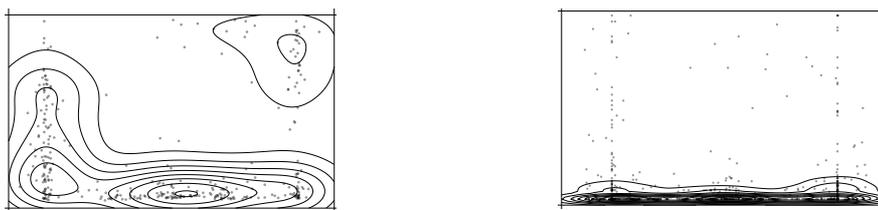

Figure 3. Expected location for legal information in the online shop 2007 (left) and 2014 (right)

Elements indicating social interaction or participation such as *links to social networks,* or elements typical for current website designs such as the *mobile version* are now expected to be found on a typical website. These elements were not yet consistently placed in one location but show a tendency to be placed in the top right area or the bottom area of the websites.

From our results, we aggregated three blueprint models for each of the website types where we indicate where users' expected location for the interface elements. These new blueprints and their respective blueprints in 2007 are displayed in Figures 4-6.
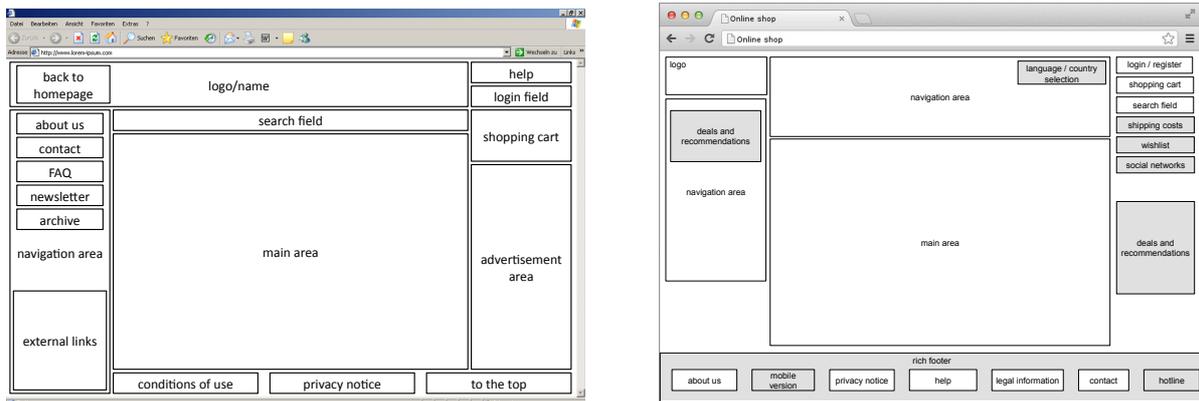

*Figure 4*. Blueprint model for an online shop in 2007 (left) and 2014 (right)
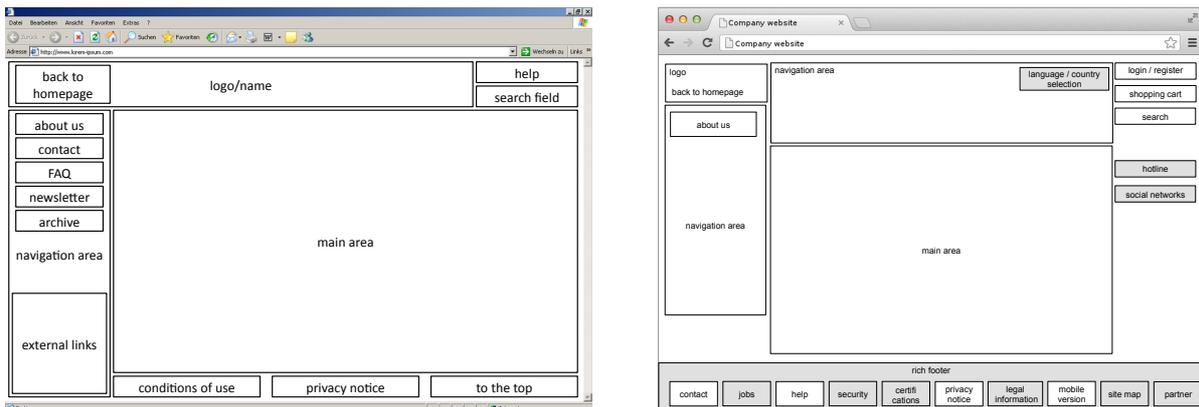
Figure 5. Blueprint model for a company website in 2007 (left) and 2014 (right)
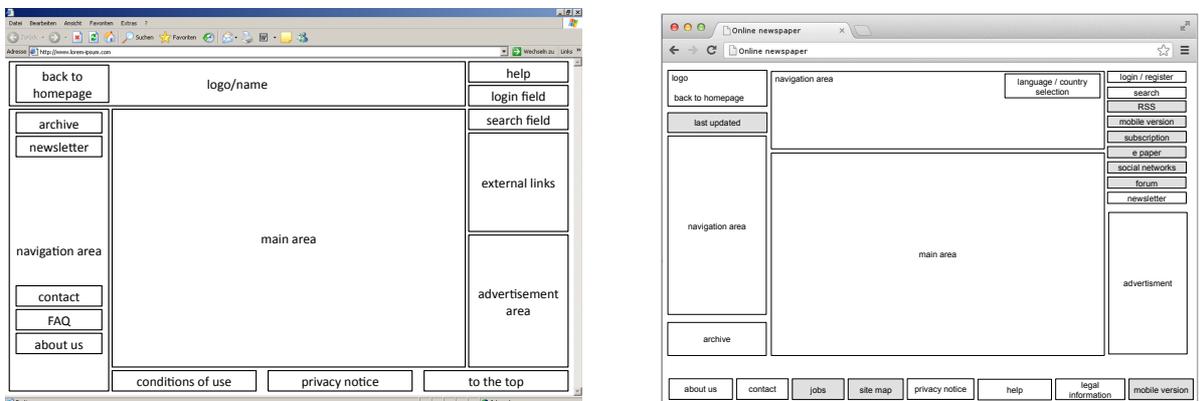

Figure 6. Blueprint model for an online newspaper in 2007 (left) and 2014 (right)

Discussion and conclusion. We were able to find three types of developments for the interface elements included in users' mental representations. The first group of interface elements are still expected to be on the website as the core interface elements (e.g. *navigation, main area)*. Other elements, mostly representing interaction possibilities no longer used in websites, are no longer expected to be on the sites. The third group represents new interface elements included in users' mental representation of a website, mostly elements connected to *social media* and elements indicating collaboration such as *login* areas. Furthermore, elements indicating a *mobile* use of websites were represented in the mental representations of all website types.

Regarding the expected location within the interface, we showed a shift for some but not all website elements, similar to trends observed in previous studies (Baharum & Jaafar, 2013; Shaikh & Lenz, 2006). However, the expected location for main interface elements – such as the *navigation*, the *logo* or the *main area* – was unchanged. Other elements such as *legal information, about us, contact and help* are interface elements that were more consistently placed and all within the bottom of the page, where the *rich footer* is expected to be located. Figure 3 illustrates this shift for one interface element.

Comparing our results to previous results, we showed that the mental representations for all three types of websites have changed to a certain extent. These results imply that the technological advances have an impact on users' expectations. Furthermore our results emphasize the importance of periodically re-evaluating users' expectations and adapting the design recommendations accordingly. Further research should also assess users' mental representations of mobile versions of websites or native apps. And by collecting qualitative data, we would be able to further investigate users' explanations about why they placed interface elements or not. Additionally it would be interesting to see whether users have more specific expectations for social media websites providing content predominantly with single page layouts.

Website Characteristics leading to Trust and Distrust

When users visit a website to complete transactions such as filling in data or even transferring money, it is important that they feel trustful about the website (Wang & Emurian, 2005). In this second section of my thesis, I will provide the theoretical background to our study investigating characteristics of websites that enhance trust and cause distrust.

Trust is important for many aspects in our daily life. However there exist different definitions in literature, and as trust is an abstract concept, the definition and operationalization are difficult (Wang & Emurian, 2005). Two characteristics are shared by most definitions, the existence of two parties and vulnerability due to high perceived risk. The two parties involved are the trustor (trusting part) and the trustee (the party to be trusted). In the Internet the user is typically the trustor and the website or the company providing the website is the trustee (Wang & Emurian, 2005).

As mentioned, trust is especially important in contexts where a trustor is exposed to high perceived risk and therefore shows certain vulnerability (Wang & Emurian, 2005). The Internet is one of these contexts. Online shopping sites are perceived to involve more risk than traditional shopping (Lee & Turban, 2001) and for online banking, the effect of perceived risk on the intention to use a service has been shown (Martins, Oliveira, & Popovič, 2014).

Studies have even showed a moderating effect of perceived risk on the influence of website usability on users' satisfaction (Belanche, Casaló, & Guinalíu, 2012). They conducted an online survey with a Spanish online retailer selling bus tickets and showed that when users perceived great risk, good usability had a higher impact on users' satisfaction and intention to use (Belanche et al., 2012).

Flavián, Guinalíu and Gurrea (2006) showed users' trust being dependent, to a certain extent, on users' satisfaction with the website: however, other studies were also able to show a negative impact of trust on users' satisfaction (Dabrowski, Basinska, & Sikorski, 2014). The long-term relationship between customers and companies relies on users' trust and if users do not have trust in websites, they will not engage with the website or the company (Bart, Shankar, Sultan, & Urban, 2005; Ou & Sia, 2010).

To know the relevant underlying aspects to build trust, it is important operationalize and measure trust. Three facets are often considered to measure the multidimensional construct of trust on websites: benevolence, honesty and competence (Casaló, Flavián, & Guinalíu, 2007). Benevolence represents the belief that the other party will share the same goal, honesty reflects the extent to which the other party is expected to keep their word and competence describes the perceived ability or skill (Casaló, Flavián, & Guinalíu, 2011). Each of these facets includes questions with reference to the users' needs and their expectations (Casaló et al., 2007).

To design websites that users experience as trustful, it is important to know which of the website characteristics impact users' perception of trust or distrust: however, it is not yet clear which interface elements contribute to trustful experiences (Xu, Le, Deitermann, & Montague, 2014). As Cyr (2008) mentions, different authors have considered design elements of websites to be important antecedents of trust and also consumer satisfaction. In a study comparing the influence of trust and satisfaction on customer loyalty between different countries (Germany, Canada and China), aspects of website design were divided into information design (attributed to usability), visual design (summarizing balance, emotional appeal, aesthetics and uniformity of website design) and navigation design (Cyr, 2008). Corritore, Kracher and Wiedenbeck (2003) summarize that ease of navigation, good use of visual design elements, professionalism of product pictures as well as freedom from grammatical and typographical errors, and an overall professional look of the website and the ease of searching are cues about the trustworthiness of a website.

Another set of characteristics compiled in a framework by Wang and Emurian (2005) differentiates between four dimensions: (1) structure design, (2) graphic design, (3) content design and (4) social-cue design. Structure design includes how simple and easy it is for users to get to the information displayed on a website. Good structure design is characterized by help, guides and good instructions, whereas broken links provoke a bad structure design. Fogg et al. (2001) conducted a large study and evaluated the credibility evaluations of 51 different website characteristics. Results indicated that ease of use and search were important characteristics for users' trust. Graphic design, the second dimension, summarizes the visual elements of a website that also contribute to the first impression of a website. Elements such as the used color schemes used or the font size and typography and the overall layout of the website are included in this dimension (Wang & Emurian, 2005). Visual design has been demonstrated to be positively related to trust in correlative studies (e.g. Lindgaard et al., 2011). Analyzing comments of Internet users about the perceived trustworthiness of websites,

46.1% of participants mentioned visual design of the site, including layout or font size (Fogg, 2003). For the third dimension, content design, elements such as the informational aspects (e.g. pictures or texts) are important. This information can be displayed in interface elements such as the logo, a relevant domain name or links to privacy policies or security information dimension (Wang & Emurian, 2005). Sillence, Briggs, Fishwick and Harris (2004) showed that poor layout, adverts and pop-ups had a negative impact on participants' trust ratings and explained that the poor design might provoke a negative first impression. Furthermore the name of the website seems to be important for users to judge whether they can trust the website and the intentions of the appended company. For Wang and Emurian's last dimension (2005), the social-cue design, interface elements such as information and photographs of company members or customer service agents, and chat or call-back possibilities are relevant. The use of photographs was researched, as was customer service. This dimension is important for trust as several studies have shown (Wang & Emurian, 2005). Pictures seem to be one possibility to provide social cues. In a qualitative interview study, Riegelsberger and Sasse (2002) analyzed n=15 participants performing a shopping exercise and showed that including photographs of employees on the website can also be risky and lead to negative reactions and lower trust.

This overview of website characteristics highlights that different cues seem to be responsible for enhancing trust or causing distrust when interacting with a website. However, not enough knowledge has yet been accumulated to define which elements or website characteristics are important for users to judge whether a website is trustful or distrustful.

Another research question concerns the relationship between trust and distrust itself. Distrust has not been researched as extensively as trust (Andrade et al., 2012). Traditionally, trust and distrust have been viewed as two ends of a continuum that cannot co-exist (Schoorman, Mayer, & Davis, 2007). A recent publication suggests that trust and distrust are two distinct constructs that differ from each other qualitatively (Ou & Sia, 2010). For an overview of the existing literature, see Chang and Fang (2013).

To sum up, we still do not yet know which characteristics of a website can be attributed to perceptions of trust or distrust and therefore, in the second manuscript, in an explorative study we will look at users' reports of either a trustful or distrustful experience on a website and discuss which website characteristics these experiences could be attributed to.

Summary of Manuscript 2: Trust and Distrust on the Web: User Experiences and Website Characteristics (full paper)

Aim of the study and contribution. Research has focused on the topic of trust in the online environment but has largely neglected the topic of distrust. Ou and Sia (2010) mentioned in their study that trust and distrust can be evaluated as two distinct constructs. In our study, we analyzed personal user stories of trustful and distrustful experiences with websites to find out how these are related to different website characteristics. The results of the study shed light on which qualities and characteristics of websites are antecedents of users' trust or distrustful feedings. We additionally aim to investigate how users' experiences differentiate on the scales of benevolence, honesty and competence (Casaló et al., 2007).

Method. In this exploratory study we applied Flanagan's (1954) critical incident technique. We assigned half of the participants (n=103) to give us the details of an experience of an encounter with a website where they felt especially trustful and the other half of

participants were asked for details of an incident where they felt especially distrustful (n=118). After describing the incident, participants were asked to fill in questionnaires about their experiences on the scales benevolence, honesty and competence. For the analysis we supplemented a bottom-up with a top-down approach. We extracted the central theme of each of the stories and the most important contributing factor to the experience in an affinity-diagramming workshop. These categories were afterward assigned to the dimensions of Wang and Emurian (2005).

Results. Our participants reported incidents on six different website types. The most frequent website types were e-commerce sites (44% for trust, 47% for distrust), information sites (13% for trust, 20% for distrust), social media (16% for trust, 19% for distrust). Further incidents were encountered on entertainment sites, finance or banking sites, and a small group of other websites. Most of the stories in the distrust conditions happened during the first visit to the site, whereas the critical incidents in the trust conditions were equally spread from the first up to the hundredth visit.

All experiences could be assigned to one of 18 website characteristics. The number of stories ranged from 31 for the *visual design* to 2 for the *real-world link.* These characteristics were then assigned to Wang and Emurian's (2005) dimensions of websites, separated for trust and distrust. The frequencies are displayed in Table 1. Some characteristics could not be assigned to an existing dimension; therefore we created a new category of personal and social proof. For this dimension, only 1% of the distrustful experiences was accounted for whereas 27% of the trustful experiences were based on elements of this dimension.

Table 2

Number and Percentage of Website Characteristics and their Corresponding Dimension

Dimensions/Website Characteristics	Distrust N (%)	Trust N (%)
Graphic design	24 (20.3)	7 (6.8)
Structure design	28 (23.7)	10 (9.7)
Content design	61 (51.7)	48 (46.6)
Social-cue design	4 (3.4)	11 (10.7)
Personal and social proof	1 (0.8)	27 (26.2)

The subjective ratings show that trustful and distrustful experiences were characterized with different pattern of the three scales. For the distrust experiences, competence ratings are significantly higher than the ratings for benevolence and honesty (both $p < .001$). On the other hand, for trustful experiences scores for benevolence are significantly lower than those for competence and honesty ($p = .021$ resp. $p = .011$).

We then analyzed the ratings for the most frequently mentioned characteristics for each condition separately. Trustful experiences show high values on all three constructs, whereas the most frequently identified website characteristics for distrustful experience are accompanied by low values for benevolence, honesty and competence.

Discussion and conclusion. The findings of this study indicate that trustful and distrustful experiences are delineated with different website characteristics and therefore seem to have different antecedents. This supports the view of Ou and Sia (2010) and Andrade et al. (2012) that trust and distrust are two different co-existing constructs.

For distrustful experiences we showed that visual design, structure design (including pop-ups) and content design aspects (for instance, fear of privacy issues such as the collection or the secondary use of data) were the most frequently reported issues. For trustful experiences, the stories reported most frequently report characteristics associated with content design such as security signs and/or personal or social proof. With this study, more detailed insights could be gained into which website characteristics are involved but further studies are needed to evaluate the distinction of the two constructs trust and distrust.

In this study, we were able to show, that those interface elements users expected to be on websites in the first study of this thesis also seem to be important antecedents for trustful experiences. The new interface elements that are part of users' mental representations of websites (such as the *privacy* indications, the *contact* or other proofs of a real-world link) are essential to the building of trust. Additional the interface elements that indicate social proof of others, for example links to social networks or ratings and reviews, contribute to a trustful experience on a website.

The Influence of Web Form Usability on Perceived Efficiency, Effectiveness and Satisfaction

When users interact with a website, not only distrust or missing trust, but also bad usability or the lack of ease of use prevents successful task performance. In the previously summarized study, usability issues were shown to be important to users' increased distrust.

Lee and Koubek (2010) showed that different degrees of usability had an effect on users' preference when participants had to execute tasks on websites. In their study, participants tended to select the online store where they experienced the least problems. Website usability also has an influence on users' intention to return to the website (Belanche et al., 2012). They collected data from 214 customers of website using online questionnaire and analyzed data with a structural equation model. In a field-study where the relationship between usability evaluations and ratings of overall user experience was investigated, results suggested that especially situations that were judged by participants to be ambivalent, usability issues had a negative effect on the overall experience (Raita & Oulasvirta, 2014).

When users interact with websites, web forms are the core interaction elements between users and the website (Seckler et al., 2012). Forms are omnipresent to make an input, to subscribe or register for a service, to give feedback, or when buying something. Wroblewksi (2008) subdivides three types of web forms (1) registration forms to social communities, (2) forms for the checkout process between customers and companies and (3) forms for data input used to search information or share information. The degree of how usable web forms are perceived to be can vary considerably. In their role as gatekeepers, web forms have an influence on drop out rates (Seckler et al., 2012), the loss of data and also users' satisfaction. Poor usability of forms has a negative influence on the task performance time (Bargas-Avila et al., 2010). To improve the usability of form design, guidelines have been periodically complied (Nielsen, 1995). Work by Nielsen (2001), Jarrett and Gaffney (2009) and Wroblewksi (2008) provide an overview of recommendations and guidelines. Most of these guidelines are gained either from experiences using web forms or best practices described by usability experts.

In their study on the placement, timing and grouping of error messages in web forms, Bargas-Avila, Oberholzer, Schmutz, de Vito and Opwis (2007) suggest a modal theory of form completion. They differentiate between a completion mode where users fill in a form and a revision mode after submission and receiving feedback; users do not like to switch between these modes. These two modes are appropriate for categorizing some of the most frequently mentioned web form design recommendations.

First, users have to expect and locate the form within the website. In a next step they have to get an overview of the content the form covers, the data they need to fill in and maybe organize additional data such as credit card details (Bargas-Avila et al., 2010). When scanning for the required information, correct label alignment is essential for users to quickly know what information they need to provide (Das, McEwan, & Douglas, 2008). Research has shown that the indication of required and mandatory form fields using color, additional to asterisks, leads to fewer consecutive errors when submitting a form (Pauwels, Hübscher, Leuthold, Bargas-Avila, & Opwis, 2009). Field format restrictions allow users to prevent unnecessary input and can improve performance time (Bargas-Avila, Orsini, Piosczyk, Urwyler, & Opwis, 2011). Furthermore, clear specifications of the date format input could help within the process (Bargas-Avila, Brenzikofer, Tuch, Roth, & Opwis, 2011a) and the use of multiple option selection showed increased task completion times for list boxes compared to checkboxes (Bargas-Avila, Brenzikofer, Tuch, Roth, & Opwis, 2011b).

Even though users carefully filled in a form completely, errors might occur. As form data need to be consistent and quality of data needs to be ensured, some validation is required. Different possibilities exist to validate data and inform users about errors. It is important to help users to recover as quickly as possible (Bargas-Avila et al., 2010). Usually users are presented with error messages. The manner of these validations can influence the ease of use and the usability of web forms. The placement of error messages is important because the users' attention is often focused on the submit button. Studies have shown that the right side of the form field is the most satisfying location and with the error message displayed in close distance to the input fields, participants were able to solve the tasks more efficiently and more effectively (Seckler et al., 2012). Again, having experience from other websites, users formed some expectations about where they expect error messages to appear. The right side of a form field therefore seems to be the expected location. Additionally, the timing of error message presentation showed to be essential (Bargas-Avila et al., 2007). Error message presentation at the end, after submitting the form, either embedded in the form or summarized, was more effective and efficient and showed higher satisfaction scores. To sum up, guidelines provide valuable recommendations about how to improve the form-filling process, as well as the revision mode, and influence how users rate a form's effectiveness, efficiency and satisfaction.

Bargas-Avila and colleagues (2010) summarized several of these empirically tested findings and made further recommendations in a set of 20 guidelines. They include references about how to improve form content, the layout of forms and when to select which input type such as radio buttons or dropdowns. They further provide information on error handling and the final form submission. This includes displaying a confirmation site and sending an email (Bargas-Avila et al., 2010). To our knowledge no empirical study has applied all these guidelines on a website and holistically evaluated their effect on efficiency, effectiveness and

user satisfaction. To do this and show the combined impact of these guidelines, the study summarized in manuscripts 3a and 3b was conducted.

Summary of Manuscript 3a and 3b: Empirical Evaluation of 20 Web Form Optimization Guidelines (work-in-progress paper); Designing Usable Web Forms – Empirical Evaluation of Web Form Improvement Guidelines (full paper)

Aim of the study and contribution. Web forms represent one the most important interaction possibilities on a website such as an online shop or a news website: however, there are differences in the quality of these web forms and often forms of poor quality present a core barrier to the interaction with websites (Seckler et al., 2012). This raised the need to research the usability of web forms to support improvements. Several publications have explored aspects of form usability (Jarrett & Gaffney, 2009; Wroblewski, 2008) and different sets of guidelines on how to improve the user experience of web forms have been compiled.

In this study, we analyze the influence of a set of 20 guidelines of web form design by Bargas-Avila et al. (2010) and measure the objective performance and subjective evaluations. We directly compare user behavior and performance between the existing and the improved forms in a study where we use a multi-method approach and can therefore highlight and explain the impact of the guideline set.

Method. As preliminary work, we screened different newsletter subscription or registration forms of German-speaking news websites. Based on expert evaluations we selected three web forms of rather good, medium and rather poor quality. Each registration form was recreated with its at that time functionalities and, for each of these forms an improved version was developed based on the guidelines. The original and the improved version of Spiegel.de are displayed in Figure 7.

Figure 7. The original (left) and improved web forms (middle) with improvement examples (right)

In a between-subject laboratory experiment, 65 participants were instructed to fill in either the original or the improved version of each of the three forms. They were presented with the forms in randomized order and while they completed these tasks we collected eye-tracking data. Quantitative objective data such as task completion time and number of correcting trials were analyzed for each form. After each form, users were asked to give feedback on different scales such as a form usability scale (Aeberhard, 2011) and a scale for

cognitive load. After each form participants answered a few qualitative interview questions and after having filled in all three forms they answered a concluding evaluation interview.

Results. Results of the subjective data and the objective data were analyzed separately. Objective users' performance was better for the improved versions of the web forms. We analyzed the number of form submissions, the initial errors and the task completion time. Users needed fewer trials to successfully submit the forms ($p < .001$ to $p = .035$) for all improved versions and for two of the forms, it took them significantly less time to complete the task (both $p < .001$, Cohen's d = 1.00 resp. d = .93). These time savings corresponded in proportion to the predicted times of a Keystroke-Level Model (KLM) form analyzer tool, but the participants needed overall more time than theoretically predicted. Eye-tracking data additionally revealed that for the improved forms, participants needed fewer fixations ($p < .005$, r = .322 resp. $p < .001$, r = .525). These results indicate a more cognitive efficient processing of the improved form.

Analyzing the subjective data, results showed that the improved versions were rated to be more usable ($p < .001$ to $p = .032$) and participants were more satisfied using them ($p = .024$). The cognitive load that participants experienced while completing the task showed users being less frustrated (r = .23, resp. r = .37) and feeling more successful (r = .34, resp. r = .36) for two of the websites.

Interview data showed that participants significantly more often reported having missed format restrictions or the indication of required fields in the original forms, whereas for the improved forms there were more comments on the sequence of the fields being more logical. Eye-tracking data support this data because for the improved form more efficient gaze paths were observed, resulting in fewer fixations for the improved forms. As can be derived from Figure 8, forms presented in one column were able to speed up the eye's path and were more efficient.
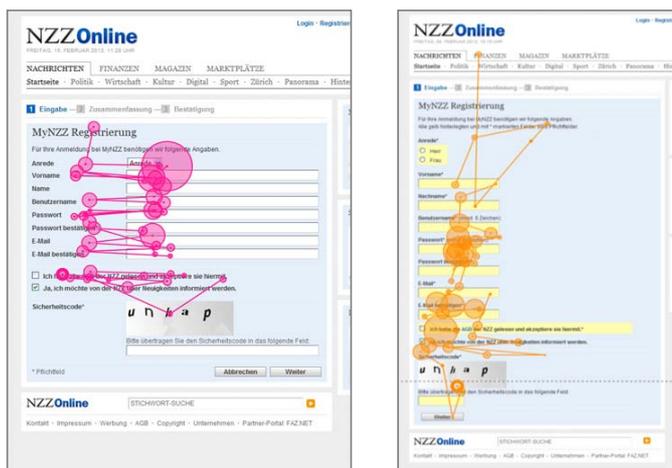

Figure 8. Sample extract of a scan path in the original and improved version of the NZZ[TM] form

Discussion and conclusion. The combined results of the objective and subjective data acknowledge the fact that implementing these 20 guidelines has had a substantial benefit for the overall evaluation of these three web forms, thus the effort to improve web forms is rewarded by benefits for the user on the subjective and the objective level. Results also indicate that the experts' evaluations how important different aspects of the form guidelines are do not necessarily comply with the users' subjective impressions after filling in a form. Analyzing the concluding user comments, we were able to show that to users, guidelines 13 and 4, focusing on the format specifications and identifying required fields, are the most important.

Adapting a multi-method approach enabled us to get an impression about which guideline had an influence, in contrast to other studies conducted to show the influence of either one guideline only or choosing only one approach. Overall, our findings provide support for designers to consider these 20 simple web form guidelines help when aiming at improving the usability and user experience of websites.

Over the last five years, technological developments seem to have influenced web design and users' mental representations of websites. These technological innovations have also changed the appearance and the functionality of web forms. Therefore we see the importance of periodically proving the validity of the guidelines for new technological input types such as the HTML 5 (W3C, 2014) and the increased use on mobile devices. If necessary, the guidelines should be adapted to these new developments by including results from further empirical studies.

Conclusion

The aim of this thesis framework composed of the summarized studies was to gain insights into users' expectations and their interactions on websites. I presented different empirical studies providing insights on three different research topics relevant to users' overall experience on websites. We collected data about users' expectations of a website to find out which interface elements they expect on three different types of websites and where they expect these elements to be located. Furthermore we were able to show that different characteristics enhance trust and cause distrust. And finally, we were able to demonstrate the impact of applying usability guidelines when users' interacted with web forms on websites. Summarizing, each of the studies within this thesis framework examined an important aspect contributing to the overall user experience of websites. I conclude this thesis by discussing implications for practitioners on how to improve the user experience of websites and by outlining topics for future research.

Do Mental Representations of Websites Exist and if so, how Stable are These?

Based on previous research and our results, we can derive that users have formed mental representations of specific types of websites. Comparing our results to previous studies we were able to show that these mental representations are stable to a certain extent. These findings are in line with Shaikh and Lenz (2006). However, we were also able to show some dynamic in these mental representations. Interface elements related to social media or facilitating collaboration are now integrated in users' mental representations. These mental blueprints of websites seem to have adapted to the design of current websites and reflect technological developments, innovation and recent evolution of website design. These

findings imply that recommendations regarding the expected location for core interface elements are still valid for the design of websites, but it is also important to respect the expected locations for new interface elements in order to design good websites.

Can Website Characteristics Enhance Trust or Cause Distrust?

It seems that trust in websites can be related to different characteristics of a website. The results of our exploratory study indicate that some characteristics are important to enhance trust, whereas others relate more strongly to distrust. The different ratings of benevolence, honesty and competence for trustful and distrustful experiences strongly indicate that trust and distrust are independent of each other and can co-exist at the same time, supporting the view of Chang and Fang (2013). By eliminating the causes of distrust (such as eliminating usability issues) and including sources of trust (such as displaying third-party security signs), web design can affect users' perceptions of a website.

How valid are Usability Guidelines?

In our third study we holistically evaluated the impact of a set of usability guidelines. Although these guidelines were applied to a specific context of web forms, it can be assumed that for different aspects of usability, the overall impact of empirically validated guidelines would be similar. Previous research validated single guidelines in a lab setting and without relation to each other: however, we implemented a complete set of guidelines to existing real-world forms and were able to show the ecological validity of these usability guidelines. For practitioners this implies that considering simple usability guidelines increases efficiency, and efficacy of web forms and the users' satisfaction with the interaction and has an impact on and can affect the overall user experience.

Future Research

Within this thesis we answered our research questions: however, new questions were raised and still remain open for future research as innovation continues to drive new web technologies and thereby the evolution of website design. Knowing users' expectations is essential to improving the overall user experience and the interrelation of the three research topics analyzed within this thesis would be interesting to analyze.

We demonstrated that users have mental representations of websites that are impacted by technological advancements, innovation and design evolution and that users expect interface elements associated with security on a website: however, the impact of websites that match users' expectations could be further assessed. Websites including expected interface elements should presumably have a beneficial effect on users' impression of trust. If these interface elements are arranged in a prototypical way, it could further increase the trustful impression of websites. It should also be borne in mind, that it is still unclear whether the removal of website characteristics that cause distrust automatically enhance trust and vice versa.

Users might also have formed expectations about the functionalities and quality of web forms. We were able to show that the application of simple usability guidelines for web forms impacted the users' efficiency (time), their effectiveness (lower number of consecutive errors) and increased their satisfaction. However regarding the overall impression of websites,

it would be interesting to highlight the influence of improved web forms on users' trust and whether forms violating these guidelines impact users' feelings of distrust.

In this thesis, I have shown that users expectations about different website types change and illustrate the trends and developments in website design to a certain extent. Easy-to-navigate websites seem to boost users' feelings of trust, whereas usability issues such as bad web forms have an impact on feelings of distrust. Further efforts to integrate users' expectations into web design and empirically validate these designs could add to the existing research on how to improve the overall user experience and affect long-term outcomes such as e-loyalty of customers.

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References

Aeberhard, A. (2011). FUS-Form Usability Scale. Development of a Usability Measuring Tool for Online Forms. *Unpublished Master's Thesis. University of Basel, Switzerland*.

Albert, D., Mast, M., & Burmester, M. (2009). Nutzererwartungen zur Position von Interface-Elementen auf Webseiten im internationalen Vergleich. In *Berichtband des siebten Workshops des German Chapters der Usability Professionals Association eV* (pp. 92–95). Stuttgart: Fraunhofer.

Alexa. (2013, January 3). Alexa - The Web Information Company. Top sites by countries: Retrieved from http://www.alexa.com/topsites/countries

Al-Qeisi, K., Dennis, C., Alamanos, E., & Jayawardhena, C. (2014). Website design quality and usage behavior: Unified Theory of Acceptance and Use of Technology. *Journal of Business Research*, *67*(11), 2282–2290. http://doi.org/10.1016/j.jbusres.2014.06.016

Andrade, A. A., Lopes, V. V., & Novais, A. Q. (2012). Quantifying the impact on distrust of e-commerce trust factors: A non-parametric study. In *Internet Technology And Secured Transactions, 2012 International Conference for* (pp. 356–361).

Baharum, A., & Jaafar, A. (2013). Users' Expectation of Web Objects Location: Case Study of ASEAN Countries. In H. B. Zaman, P. Robinson, P. Olivier, T. K. Shih, & S. Velastin (Eds.), *Advances in Visual Informatics* (pp. 383–395). Springer International Publishing.

Baharum, A., & Jaafar, A. (2014). Evaluation of ASEAN mental models pattern of web user-centered interface design using eye-tracking technology. *Journal of Computer Science*, *10*(12), 2494–2506.

Bargas-Avila, J. A., Brenzikofer, O., Roth, S. P., Tuch, A. N., Orsini, S., & Opwis, K. (2010). Simple but Crucial User Interfaces in the World Wide Web: Introducing 20 Guidelines for Usable Web Form Design. In R. Matrai (Ed.), *User Interfaces*. InTech.

Bargas-Avila, J. A., Brenzikofer, O., Tuch, A. N., Roth, S. P., & Opwis, K. (2011a). Working Towards Usable Forms on the World Wide Web: Optimizing Date Entry Input Fields. *Adv. in Hum.-Comp. Int.*, *2011*, 9:1–9:8. http://doi.org/10.1155/2011/202701

Bargas-Avila, J. A., Brenzikofer, O., Tuch, A. N., Roth, S. P., & Opwis, K. (2011b). Working Towards Usable Forms on the Worldwide Web: Optimizing Multiple Selection Interface Elements. *Adv. in Hum.-Comp. Int.*, *2011*, 4:1–4:6. http://doi.org/10.1155/2011/347171

Bargas-Avila, J. A., & Hornbæk, K. (2011). Old Wine in New Bottles or Novel Challenges: A Critical Analysis of Empirical Studies of User Experience. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 2689–2698). New York, NY, USA: ACM. http://doi.org/10.1145/1978942.1979336

Bargas-Avila, J. A., Oberholzer, G., Schmutz, P., de Vito, M., & Opwis, K. (2007). Usable error message presentation in the World Wide Web: Do not show errors right away. *Interacting with Computers*, *19*(3), 330–341.

Bargas-Avila, J. A., Orsini, S., Piosczyk, H., Urwyler, D., & Opwis, K. (2011). Enhancing online forms: Use format specifications for fields with format restrictions to help respondents. *Interacting with Computers*, *23*(1), 33–39. http://doi.org/10.1016/j.intcom.2010.08.001

Bart, Y., Shankar, V., Sultan, F., & Urban, G. L. (2005). Are the Drivers and Role of Online Trust the Same for All Web Sites and Consumers? A Large-Scale Exploratory Empirical Study. *Journal of Marketing*, *69*(4), 133–152. http://doi.org/10.1509/jmkg.2005.69.4.133

Belanche, D., Casaló, L. V., & Guinalíu, M. (2012). Website usability, consumer satisfaction and the intention to use a website: The moderating effect of perceived risk. *Journal of Retailing and Consumer Services*, *19*(1), 124–132. http://doi.org/10.1016/j.jretconser.2011.11.001

Benway, J. P. (1999). *Banner blindness: What searching users notice and do not notice on the World Wide Web*. Rice University. Retrieved from http://scholarship.rice.edu/handle/1911/19353

Bernard, M. L. (2001a). Developing Schemas for the Location of Common Web Objects. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *45*(15), 1161–1165. http://doi.org/10.1177/154193120104501502

Bernard, M. L. (2001b). User expectations for the location of web objects (p. 171). ACM Press. http://doi.org/10.1145/634067.634171

Bernard, M. L. (2003). Examining User Expectations for the Location of Common E-Commerce Web Objects. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *47*(11), 1356–1360. http://doi.org/10.1177/154193120304701108

Bernard, M. L., & Sheshadri, A. (2004). Preliminary examination of global expectations of users' mental models for e-commerce web layouts. *Usability News*, *6*(2). Retrieved from http://psychology.wichita.edu/surl/usabilitynews/62/web_object_international.asp

Bhattacherjee, A. (2001). Understanding Information Systems Continuance: An Expectation-Confirmation Model. *MIS Quarterly*, *25*(3), 351–370. http://doi.org/10.2307/3250921

Calisir, F., & Karaali, D. (2008). The impacts of banner location, banner content and navigation style on banner recognition. *Computers in Human Behavior*, *24*(2), 535–543. http://doi.org/10.1016/j.chb.2007.02.019

Casaló, L. V., Flavián, C., & Guinalíu, M. (2007). The role of security, privacy, usability and reputation in the development of online banking. *Online Information Review*, *31*(5), 583–603. http://doi.org/10.1108/14684520710832315

Casaló, L. V., Flavián, C., & Guinalíu, M. (2011). Understanding the intention to follow the advice obtained in an online travel community. *Computers in Human Behavior*, *27*(2), 622–633. http://doi.org/10.1016/j.chb.2010.04.013

Cassidy, L., & Hamilton, J. (2014). Location of Service Industry Web Objects: developing a standard. ACIS. Retrieved from http://aut.researchgateway.ac.nz/handle/10292/8015

Chang, Y.-S., & Fang, S.-R. (2013). Antecedents and Distinctions between Online Trust and Distrust: Predicting High- and Low-Risk Internet Behaviors. *Journal of Electronic Commerce Research, 14*(2), 149–166.

Corritore, C. L., Kracher, B., & Wiedenbeck, S. (2003). On-line trust: concepts, evolving themes, a model. *International Journal of Human-Computer Studies*, *58*(6), 737–758. http://doi.org/10.1016/S1071-5819(03)00041-7

Craik, K. (1943). T*he Nature of Explanation*. Cambridge: Cambridge University Press.

Cyr, D. (2008). Modeling Web Site Design Across Cultures: Relationships to Trust, Satisfaction, and E-Loyalty. *Journal of Management Information Systems*, *24*(4), 47–72. http://doi.org/10.2753/MIS0742-1222240402

Cyr, D. (2013). Website design, trust and culture: An eight country investigation. *Electronic Commerce Research and Applications*, *12*(6), 373–385. http://doi.org/10.1016/j.elerap.2013.03.007

Dabrowski, D., Basinska, B. A., & Sikorski, M. (2014). Impact of Usability Website Attributes on Users' Trust, Satisfaction and Loyalty. *Social Sciences*, *85*(3). http://doi.org/10.5755/j01.ss.85.3.8409

Das, S., McEwan, T., & Douglas, D. (2008). Using Eye-tracking to Evaluate Label Alignment in Online Forms. In *Proceedings of the 5th Nordic Conference on Human-computer Interaction: Building Bridges* (pp. 451–454). New York, NY, USA: ACM. http://doi.org/10.1145/1463160.1463217

Davidson, M. J., Dove, L., & Weltz, J. (1999). *Mental models and usability*. Technical report, Depaul University, Cognitive Psychology, Chicago. Retrieved from http://www.lauradove.info/reports/mental%20models.htm.

Dinet, J., & Kitajima, M. (2011). "Draw Me the Web": Impact of Mental Model of the Web on Information Search Performance of Young Users. In *23rd French Speaking Conference on Human-Computer Interaction* (pp. 3:1–3:7). New York, NY, USA: ACM. http://doi.org/10.1145/2044354.2044358

Di Nocera, F., Capponi, C., & Ferlazzo, F. (2004). Finding Geometrical Associations Between Meaningful Objects in the Web: A Geostatistical Approach. *PsychNology Journal*, *2*(1), 84–98.

Dörr, G., Seel, N. M., & Strittmatter, P. (1986). Mentale Modelle: Alter Wein in neuen Schläuchen. *Unterrichtswissenschaft*, *2*, 168–189.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin*, *51*(4), 327–358.

Flavián, C., Guinalíu, M., & Gurrea, R. (2006). The role played by perceived usability, satisfaction and consumer trust on website loyalty. *Information & Management*, *43*(1), 1–14. http://doi.org/10.1016/j.im.2005.01.002

Flavián, C., Gurrea, R., & Orús, C. (2008). Analysing the Key Factors of Web Design: A Heuristic Evaluation. In *Proceedings of the 9th International Conference on E-Commerce and Web Technologies* (pp. 31–40). Berlin, Heidelberg: Springer-Verlag. http://doi.org/10.1007/978-3-540-85717-4_4

Fogg, B. J. (2003). Prominence-interpretation Theory: Explaining How People Assess Credibility Online. In *CHI '03 Extended Abstracts on Human Factors in Computing Systems* (pp. 722–723). New York, NY, USA: ACM. http://doi.org/10.1145/765891.765951

Fogg, B. J., Marshall, J., Laraki, O., Osipovich, A., Varma, C., Fang, N., … & Treinen, M. (2001). What Makes Web Sites Credible?: A Report on a Large Quantitative Study. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 61–68). New York, NY, USA: ACM. http://doi.org/10.1145/365024.365037

Gentner, D., & Stevens, A. (1983). *Mental models*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Hanke, U. (2006). *Externale Modellbildung als Hilfe bei der Informationsverarbeitung und beim Lernen*. Universitätsbibliothek Freiburg. Retrieved from http://www.freidok.uni-freiburg.de/volltexte/2006/2495/

Hassenzahl, M. (2003). The Thing and I: Understanding the Relationship Between User and Product. In M. A. Blythe, K. Overbeeke, A. F. Monk, & P. C. Wright (Eds.), *Funology* (pp. 31–42). Springer Netherlands. Retrieved from http://link.springer.com/chapter/10.1007/1-4020-2967-5_4

Hassenzahl, M., & Tractinsky, N. (2006). User experience - a research agenda. *Behaviour & Information Technology*, *25*(2), 91–97. http://doi.org/10.1080/01449290500330331

Heinz, S., Hug, M., Nugaeva, C., & Opwis, K. (2013). Online Ad Banners: The Effects of Goal Orientation and Content Congruence on Memory. In *CHI '13 Extended Abstracts on Human Factors in Computing Systems* (pp. 1875–1880). New York, NY, USA: ACM. http://doi.org/10.1145/2468356.2468692

Heinz, S., & Mekler, E. D. (2012). The Influence of Banner Placement and Navigation Style on the Recognition of Advertisement Banners. In *Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design* (pp. 803–804). New York, NY, USA: ACM. http://doi.org/10.1145/2399016.2399156

Henrich, J., Heine, S. J., & Norenzayan, A. (2010). Most people are not WEIRD. *Nature*, *466*(7302), 29–29. http://doi.org/10.1038/466029a

Huang, Z., & Benyoucef, M. (2013). From e-commerce to social commerce: A close look at design features. *Electronic Commerce Research and Applications*, *12*(4), 246–259. http://doi.org/10.1016/j.elerap.2012.12.003

International Organization for Standardization. (1998). *ISO 9241-11 Ergonomics of human-system interaction - Part 11: Usability: Definitions and concepts.* International Standardization Organization (ISO), Geneva, Switzerland.

International Organization for Standardization. (2006). *ISO 9241-110:2006 Ergonomics of human-system interaction - Part 110: Dialogue principles.* International Standardization Organization (ISO), Geneva, Switzerland.

International Organization for Standardization. (2010). *ISO 9241-210:2010 -Ergonomics of human-system interaction - Part 210: Human-centred design for interactive systems.* International Standardization Organization (ISO), Geneva, Switzerland.

Jarrett, C., & Gaffney, G. (2009). *Forms that work: Designing Web forms for usability.* Morgan Kaufmann.

Johnson-Laird, P. N. (1983). Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness. Cambridge, MA, USA: Harvard University Press.

Jonassen, D. H., & Henning, P. (1996). Mental Models: Knowledge in the Head and Knowledge in the World. In *Proceedings of the 1996 International Conference on Learning Sciences* (pp. 433–438). Evanston, Illinois: International Society of the Learning Sciences. Retrieved from http://dl.acm.org/citation.cfm?id=1161135.1161198

Lee, M. K. O., & Turban, E. (2001). A Trust Model for Consumer Internet Shopping. *International Journal of Electronic Commerce*, *6*(1), 75.

Lee, S., & Koubek, R. J. (2010). The effects of usability and web design attributes on user preference for e-commerce web sites. *Computers in Industry*, *61*(4), 329–341. http://doi.org/10.1016/j.compind.2009.12.004

Lindgaard, G., Dudek, C., Sen, D., Sumegi, L., & Noonan, P. (2011). An Exploration of Relations Between Visual Appeal, Trustworthiness and Perceived Usability of Homepages. *ACM Trans. Comput.-Hum. Interact.*, *18*(1), 1:1–1:30. http://doi.org/10.1145/1959022.1959023

Lindgaard, G., Fernandes, G., Dudek, C., & Brown, J. (2006). Attention web designers: You have 50 milliseconds to make a good first impression! *Behaviour & Information Technology*, *25*(2), 115–126. http://doi.org/10.1080/01449290500330448

Lynch, P. J., & Horton, S. (2008). Web style guide: Basic design principles for creating Web sites. Yale University Press.

Martins, C., Oliveira, T., & Popovič, A. (2014). Understanding the Internet banking adoption: A unified theory of acceptance and use of technology and perceived risk application. *International Journal of Information Management*, *34*(1), 1–13. http://doi.org/10.1016/j.ijinfomgt.2013.06.002

McCarthy, J. D., Sasse, M. A., & Riegelsberger, J. (2004). Could I have the Menu Please? An Eye Tracking Study of Design Conventions. In E. O. B. MSc, P. Palanque, & P. J. BSc (Eds.), *People and Computers XVII — Designing for Society* (pp. 401–414). Springer London. Retrieved from http://link.springer.com/chapter/10.1007/978-1-4471-3754-2_25

Nielsen, J. (1995, January 1). 10 Usability Heuristics for User Interface Design. Retrieved from http://www.nngroup.com/articles/ten-usability-heuristics/

Nielsen, J. (1999). *Designing Web Usability: The Practice of Simplicity*. Thousand Oaks, CA, USA: New Riders Publishing.

Nielsen, J. (2001, June 24). Error Message Guidelines. [Web log post]. Retrieved from http://www.nngroup.com/articles/error-message-guidelines/

Nielsen, J. (2010, October 18). Mental Models. [Web log post]. Retrieved from http://www.nngroup.com/articles/mental-models/

Niklas, S. (2014). Mental Maps von Onlineshops-Kulturelle Unterschiede in der Informationsarchitektur. *UP14-Vorträge*. Retrieved from http://dl.mensch-und-computer.de:8080/handle/123456789/3929

Norman, D. A. (1983). Some observations on mental models. In *Mental models* (Vol. 1, pp. 7–14). Hillsdale, NJ, USA: L. Erlbaum Associates Inc.

Norman, D. A., Miller, J., & Henderson, A. (1995). What You See, Some of What's in the Future, and How We Go About Doing It: HI at Apple Computer. In *Conference Companion on Human Factors in Computing Systems* (p. 155). New York, NY, USA: ACM. http://doi.org/10.1145/223355.223477

Ou, C. X., & Sia, C. L. (2010). Consumer trust and distrust: An issue of website design. *International Journal of Human-Computer Studies*, *68*(12), 913–934. http://doi.org/10.1016/j.ijhcs.2010.08.003

Oulasvirta, A. (2004). Task demands and memory in web interaction: a levels of processing approach. *Interacting with Computers*, *16*(2), 217–241. http://doi.org/10.1016/j.intcom.2003.12.004

Oulasvirta, A., Kärkkäinen, L., & Laarni, J. (2005). Expectations and memory in link search. *Computers in Human Behavior*, *21*(5), 773–789.

Owens, J. W. (2013). Getting the gist of websites: Exploring the effects of display duration, size, and resolution. Retrieved from http://soar.wichita.edu/dspace/handle/10057/6728

Pagendarm, M., & Schaumburg, H. (2006). Why Are Users Banner-Blind? The Impact of Navigation Style on the Perception of Web Banners. *Journal of Digital Information*, *2*(1). Retrieved from https://journals.tdl.org/jodi/index.php/jodi/article/view/36

Palmer, J. (2002). Designing for Web site usability. *Computer*, *35*(7), 102–103. http://doi.org/10.1109/MC.2002.1016906

Pauwels, S. L., Hübscher, C., Leuthold, S., Bargas-Avila, J. A., & Opwis, K. (2009). Error prevention in online forms: Use color instead of asterisks to mark required-fields. *Interacting with Computers*, *21*(4), 257–262. http://doi.org/10.1016/j.intcom.2009.05.007

Raita, E., & Oulasvirta, A. (2011). Too good to be bad: Favorable product expectations boost subjective usability ratings. *Interacting with Computers*, *23*(4), 363–371. http://doi.org/10.1016/j.intcom.2011.04.002

Raita, E., & Oulasvirta, A. (2014). Mixed Feelings?: The Relationship Between Perceived Usability and User Experience in the Wild. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational* (pp. 1–10). New York, NY, USA: ACM. http://doi.org/10.1145/2639189.2639207

Rapp, D. N. (2005). Mental models: Theoretical issues for visualizations in science education. In *Visualization in science education* (pp. 43–60). Springer. Retrieved from http://link.springer.com/chapter/10.1007/1-4020-3613-2_4

Resnick, M., & Albert, W. (2014). The Impact of Advertising Location and User Task on the Emergence of Banner Ad Blindness: An Eye-Tracking Study. *International Journal of Human-Computer Interaction*, *30*(3), 206–219. http://doi.org/10.1080/10447318.2013.847762

Riegelsberger, J., & Sasse, M. A. (2002). Face It - Photos Don'T Make a Web Site Trustworthy. In *CHI '02 Extended Abstracts on Human Factors in Computing Systems* (pp. 742–743). New York, NY, USA: ACM. http://doi.org/10.1145/506443.506575

Roth, S. P., Schmutz, P., Pauwels, S. L., Bargas-Avila, J. A., & Opwis, K. (2010). Mental Models for Web Objects: Where Do Users Expect to Find the Most Frequent Objects in Online Shops, News Portals, and Company Web Pages? *Interact. Comput.*, *22*(2), 140–152. http://doi.org/10.1016/j.intcom.2009.10.004

Roth, S. P., Tuch, A. N., Mekler, E. D., Bargas-Avila, J. A., & Opwis, K. (2013). Location Matters, Especially for Non-salient features-An Eye-tracking Study on the Effects of Web Object Placement on Different Types of Websites. *Int. J. Hum.-Comput. Stud.*, *71*(3), 228–235. http://doi.org/10.1016/j.ijhcs.2012.09.001

Schoorman, F. D., Mayer, R. C., & Davis, J. H. (2007). An Integrative Model of Organizational Trust: Past, Present, and Future. *Academy of Management Review*, *32*(2), 344–354. http://doi.org/10.5465/AMR.2007.24348410

Seckler, M., Tuch, A. N., Opwis, K., & Bargas-Avila, J. A. (2012). User-friendly locations of error messages in web forms: Put them on the right side of the erroneous input field. *Interacting with Computers*, *24*(3), 107–118. http://doi.org/10.1016/j.intcom.2012.03.002

Seel, N. M., & Hanke, U. (2015). Allgemeine Pädagogik: Grundlagen der Erziehungswissenschaft. In *Erziehungswissenschaft* (pp. 1–155). Springer. Retrieved from http://link.springer.com/chapter/10.1007/978-3-642-55206-9_1

Shaikh, A. D., & Lenz, K. (2006). Where's the search? Re-examining user expectations of web objects. *Usability News*, *8*(1). Retrieved from http://psychology.wichita.edu/surl/usabilitynews/81/pdf/Usability%20News%2081%20-%20Shaikh2.pdf

Sillence, E., Briggs, P., Fishwick, L., & Harris, P. (2004). Trust and Mistrust of Online Health Sites. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems* (pp. 663–670). New York, NY, USA: ACM. http://doi.org/10.1145/985692.985776

Slone, D. J. (2002). The influence of mental models and goals on search patterns during web interaction. *Journal of the American Society for Information Science and Technology*, *53*(13), 1152–1169.

Sturm, C., Oh, A., Linxen, S., Abdelnour Nocera, J., Dray, S., & Reinecke, K. (2015). How WEIRD is HCI?: Extending HCI Principles to Other Countries and Cultures. In *Proceedings of the 33rd Annual ACM Conference Extended Abstracts on Human Factors in Computing Systems* (pp. 2425–2428). New York, NY, USA: ACM. http://doi.org/10.1145/2702613.2702656

Thatcher, A., & Greyling, M. (1998). Mental models of the Internet. *International Journal of Industrial Ergonomics*, *22*(4), 299–305.

Tuch, A. N., Presslaber, E. E., Stöcklin, M., Opwis, K., & Bargas-Avila, J. A. (2012). The role of visual complexity and prototypicality regarding first impression of websites: Working towards understanding aesthetic judgments. *International Journal of Human-Computer Studies*, *70*(11), 794–811. http://doi.org/10.1016/j.ijhcs.2012.06.003

Volkamer, M., & Renaud, K. (2013). Mental Models − General Introduction and Review of Their Application to Human-Centred Security. In M. Fischlin & S. Katzenbeisser (Eds.), *Number Theory and Cryptography* (pp. 255–280). Springer Berlin Heidelberg. Retrieved from http://link.springer.com/chapter/10.1007/978-3-642-42001-6_18

W3C. (2014). HTML5 A vocabulary and associated APIs for HTML and XHTML. Retrieved from http://www.w3.org/TR/html5/

Wang, Y. D., & Emurian, H. H. (2005). An overview of online trust: Concepts, elements, and implications. *Computers in Human Behavior*, *21*(1), 105–125. http://doi.org/10.1016/j.chb.2003.11.008

Wroblewski, L. (2008). *Web form design: filling in the blanks*. Brookliny, NY: Rosenfeld Media.

Xu, J., Le, K., Deitermann, A., & Montague, E. (2014). How different types of users develop trust in technology: A qualitative analysis of the antecedents of active and passive user trust in a shared technology. *Applied Ergonomics*, *45*(6), 1495–1503. http://doi.org/10.1016/j.apergo.2014.04.012

Appendix

I.   Linxen, S., Heinz, S., Müller, L. J., Tuch, A. N., & Opwis, K. (2014, April). Mental models for web objects in different cultural settings. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems* (pp. 2557-2562). ACM. doi: 10.1145/2559206.2581209

II.   Heinz, S., Linxen, S., Fraßeck, L., Tuch, A. N., & Opwis, K. (submitted). Is it still there where I expect it? – Users' current expectations of interface elements on the most frequent types of websites. [accepted for publication in *Interacting with Computers*]

III.   Seckler, M., Heinz, S., Forde, S., Tuch, A. N., & Opwis, K. (2015). Trust and distrust on the web: User experiences and website characteristics. *Computers in Human Behavior*, 45, 39-50. doi: 10.1016/j.chb.2014.11.064

IV.   Seckler, M., Heinz, S., Bargas-Avila, J. A., Opwis, K., & Tuch, A. N. (2013, April). Empirical evaluation of 20 web form optimization guidelines. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems* (pp. 1893-1898). ACM. doi: 10.1145/2468356.2468695

V.   Seckler, M., Heinz, S., Bargas-Avila, J. A., Opwis, K., & Tuch, A. N. (2014, April). Designing usable web forms: empirical evaluation of web form improvement guidelines. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems* (pp. 1275-1284). ACM. doi: 10.1145/2556288.2557265

Mental Models for Web Objects in Different Cultural Settings

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Abstract

"Know your users!" A short request but a challenging one. Studies have shown that the positioning of web objects according to the users' mental models can prevent errors and increase the efficiency of interaction. Therefore an important aspect of the design of websites is to take the expectations of the users into account. However the results of these studies are based on research with limited target groups and neglected to consider cultural aspects. To approach this issue the currently being conducted study aims primarily to (1) identify and visualize mental models for different websites types for different countries, (2) highlight differences and similarities in the mental models of the subjects based on their nationality and (3) show the influence of experience with international websites on the mental models of the user. The results gained will be helpful during the design and localization process for international target groups.

Author Keywords

Cultural Web Page Design; Culture; Web Page Design; Expectations; Screen Design; Mental Models; Location of Web Objects

ACM Classification Keywords

H.5.2 [Information Interfaces and Presentation (e.g., HCI)]: User Interfaces

Introduction

During the design process of a website broad knowledge about the target group is a crucial factor for successful design. One way to meet the users' expectations is to consider their mental models, which are an important aspect of Human Computer Interaction [10]. A mental model is a person's cognitive representation of a real or imaginary situation or an object. It allows a person, among other things, to make inferences and predictions [5]. Studies have shown that if websites are designed according to the user's expectations or according to their mental models, finding one's way around a website as well as the memorability of the location of web objects (e.g., shopping cart, login field, navigation area) can be improved [8, 9, 12], while the time taken to find certain objects decreases [14]. In a user study, Roth et al. [13] identified distinct mental models for different types of web pages. Aspects such as the age, gender or web expertise of the participants showed no relevant effect on the mental models. However mental models in general are neither accurate nor robust [7]. In addition, the results rely on findings based on work and research with limited target groups. Cultural aspects such as the nationality of the subjects or the national origin of analyzed websites have not yet been taken into account. Most findings are based on WEIRD (western, educated, industrialized, rich, and democratic) test subjects. As Henrich [3] point out "it is about the Western, and more specifically American, undergraduates who form the bulk of the database in the experimental branches of psychology, cognitive science, and economics, as well as allied fields".

The aim of this research project is to approach this issue by identifying and visualizing:

- mental models for different websites types for different countries
- differences in the mental models of the subjects based on their country of origin
- similarities in the mental models across countries
- differences in the use of web objects and the mental models of the users compared to those reported in the study of Roth et al. [13].

For this purpose we developed an online application to collect and visualize mental models for web objects similar to the application used by Roth et al. [13]. To take cultural aspects into account, the subject population will also consist of members of different cultures (nations) which can be identified as non-Weird populations.

Assessing mental models

Development of the online application

For this study an online application (see figure 1) was developed which allows participants to easily sketch their expectations of a prototypical website. According to several authors, drawings and outlines can be used as a way to extract and present the mental models of users [2, 6, 15]. The web objects presented as building elements during the work with the online application will be identified and selected in a preliminary study which is explained in the next chapter. These objects can be placed on a simulated browser area and are easily adaptable regarding size and position via drag and drop. The participants will be requested to build prototypical websites of the several website types in a random order.

(such as power distance and uncertainty avoidance) [4] but also in aspects such as the reading direction and type of characters used (writing). To identify the most common website types and the web objects used, the 100 web sites most often visited in the target countries were identified from Alexa.com [1]. These were classified into categories (e.g., online shops) and sub categories (e.g., auction, direct buy) and analyzed according to the frequency of occurrence. To improve reliability, inductive principles of qualitative data analysis [11] were adopted and two researchers categorized the data independently. The results were then discussed and interpreted until consensus regarding the category was reached.

700 websites from the seven target countries have now been categorized. All sites were categorized according to their main goal and additionally into a subcategory where necessary.

To be able to compare our finding to the results of Roth et al.'s study [13], the authors will include the same categories (online shops, news portals and company web pages) into the main study. Furthermore, web portals will also be added, due to their frequent occurrence in the Asian areas of India and Vietnam. It is suggested that these website types imply relatively large importance in these cultural areas. Table 1 shows the frequency of occurrence of the selected categories for each country. During the categorization of the websites the following categories of websites were also extracted: multimedia sharing, social networking sites, search engines, service portals and miscellaneous websites. These categories were excluded for the main study due to infrequent appearance, unclear classification or a high number of sub categories, all of which prevents meaningful comparison and analysis.

Figure 1: Current state of development of the online application. The user can arrange the web objects presented on the right to generate their own prototypical website of a special website type (in this case for a company website).

However before the online application can be used to collect data countries need to be defined where the study will take place. Furthermore the website types participants are asked to sketch need to be chosen. In addition the web objects, which participants have to place on the simulated browser area need to be determined. Therefore a preliminary study will be conducted.

Preliminary study

To ensure comparability with the results of Roth et al. [13], the study will use the same countries - Germany, Austria, Switzerland, and the United States as representatives of western countries - for the identification of website types and web objects. To compare these countries with different cultural regions, the following set of countries will also be included: Egypt, India and Vietnam. These three countries differ from each other and the western countries listed above not only in several of Hofstede's cultural dimensions

Types of websites	DE	AT	CH	EG	IN	US	VN	Mean	Total
company page	19	15	19	17	18	24	9	17.2	121
online newspaper and news portal	17	15	12	20	7	14	22	15.2	107
web portal	2	6	3	9	13	8	25	9.4	66
online shop	10	10	11	1	9	5	8	7.7	54

Table 1: The results of the preliminary categorization show the frequency of the selected website types within the top 100 websites per country (traffic based, Alexa.com)

After the indexing of the top 100 websites of the target countries, researchers and coders from these countries will start to analyze and list the web objects used on the web sites. During a preliminary study, these objects will be presented in an online survey to members of the respective country with the objective of identifying those web objects which are expected by users on the different website types. For the main study it is planned to use web objects which are selected by at least 40% of the participants. For the preliminary study, at least 40 persons per country are required to take part in the survey.

Design of the main study

Participants of the main study

The aim is to have a total of at least 400 participants per country for the main study. The subjects will be recruited via university websites, bulletin boards, global job marketplaces, as well as the recruitment databases of psychology departments. As a reward, all subjects will take part in a prize draw and have the opportunity to win one of several gift cards worth $25.

Procedure of the main study

Figure 2 shows an overview of the complete procedure of the study.

After a short introduction to the study and general information, the participants will begin the first part of the online survey. First, they will fill out a short demographic questionnaire and will then take part in an exercise to get used to the handling of the main application. Second, information regarding the main task will be presented and the users will be asked to build their prototypical websites for online shops, news portals, company web and portals, according to their expectations. A random generator will define the sequence of the types of websites to minimize sequence effects. In the third and last stage, participants will be asked to state their experience regarding international websites as well as their computer and internet skills. At the end of the survey users can state whether they wish to receive information about the results.

Figure 2: Procedure of the study

Figure 3: Example of the overview of the placement and the frequency of the placement of a web object. The level of grey indicates the frequency of placement by the users.

Identifying and comparing mental models

The placement, or non-placement of web objects as well as the position and size of a placed web object will be examined. In addition, the time required for the completion of the sketch of each website type will be measured. The main focus of the analysis will be placed upon the following points:

1. International experience and both computer and internet knowledge, broken down by country of origin

2. Overview of number, positioning and size of used web objects for all used website types in a heat map (see figure 3 for an example) and in a tabular form including the mean size of the objects.

3. Blueprint models for the examined website types based on the positioned / placed objects

4. Identification of the influence of international web-experience on the expectation of web objects

5. The identification and highlighting of similarities and differences between the study of Roth et al. and the current results of the German-speaking countries as a longitudinal comparison

Outlook and future work

During the next stages of the development and implementation process of our studies, several challenges will be met. First, the recruitment process of international participants is expected to be difficult due to the time-consuming identification or development of recruitment pools. Another critical point will be the creation of a common understanding of website types and the use of web objects among the participants. The occurrence of a bias which could influence the design of the prototypical website during the work with the online application needs to be avoided. Furthermore the

consolidation of website types across countries will present some challenges during the final analysis due to the different characteristics (e.g., web portals in Vietnam sometimes include more services and characteristics than their equivalents in the United States or Germany).

The results of the study will not only identify the existing differences between examined countries in the distribution and number of web site types but also highlight the placement and location of web objects by externalizing and summarizing the mental models of the participants. The results and the extracted blueprints from the data could be used by designers to develop websites and online products based on the mental models of potential user groups in order to improve efficiency of interaction and prevent errors. Furthermore, the results of the study could indicate the necessity and benefits of considering diverse subject populations by including international participants in scientific studies.

The field for future studies consists of general approaches regarding the evolution of web site types and web objects used over the years, the in-depth examination of special and complex website types such as social networking sites and multimedia sharing sites as well as the influence of the insight gained into practice from an economical as well as a user-centered viewpoint.

References

[1] Alexa - The Web Information Company, January 2013, Top sites by country. http://www.alexa.com/topsites/countries.

[2] Denham, P. Nine-to fourteen-year-old children's conception of computers using drawings. *Behaviour & Information Technology 12*, 6 (1993), 346–358.

[3] Henrich, J., Heine, S. J., and Norenzayan, A. Most people are not WEIRD. *Nature 466*, 7302 (2010), 29–29.

[4] Hofstede, G. *Cultures and organizations: Software of the mind.* New York: McGraw-Hill, (1997).

[5] Johnson-Laird, P. N. *Mental models: Towards a cognitive science of language, inference, and consciousness.* Cambridge: Harvard University Press, (1983).

[6] Kerr, S. Wayfinding in an electronic database: the relative importance of navigational cues vs. mental models. *Information Processing and Management 26*, 4 (1990), 511–523.

[7] Norman, D. Some observations on mental models. In: *Mental Models.* Lawrence Erlbaum Associates, Hillsdale, New Jersey, (1983) 7–14.

[8] Oulasvirta, A. Task demands and memory in web interaction: a levels of processing approach. *Interacting with Computers 16*, 2 (2004), 217–241.

[9] Oulasvirta, A., Kärkkäinen, L. and Laarni, J. Expectations and memory in link search. *Computers in Human Behavior 21*, 5 (2005), 773–789.

[10] Payne, J.S.: Mental models in human-computer interaction. In: Sears, A., Jacko, J. (eds.) *The Human-Computer Interaction Handbook,* Lawrence Erlbaum, New York (2008), 63–76.

[11] Pope, C., Ziebland, S. and Mays, N. Qualitative research in health care: analysing qualitative data. *BMJ: British Medical Journal 320*, 7227 (2000), 114–116.

[12] Santa-Maria, L. and Dyson, M.C. The effect of violating visual conventions of a website on user performance and disorientation. How bad can it be? In *Proc. SIGDOC'08,* ACM Press (2008), 47–54.

[13] Roth, S., Schmutz, P., Pauwels, S., Bargas-Avila, J. and Opwis, K. Mental models for web objects: where do users expect to find the most frequent objects in online shops, news portals, and company web pages? *Interacting with Computers 22*, 2 (2010), 140–152.

[14] Roth, S. P., Tuch, A. N., Mekler, E. D., Bargas-Avila, J. A. and Opwis, K. Location matters, especially for non-salient features - An eye-tracking study on the effects of web object placement on different types of websites. *International Journal of Human-Computer Studies 71*, 3 (2013), 228–235.

[15] Thatcher, A. and Greyling, M. Mental models of the Internet. *International Journal of Industrial Ergonomics 22*, (1998), 299–305.

Is it still where I expect it? – Users' current expectations of interface elements on the most frequent types of websites

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Is it still where I expect it? – Users' current expectations of interface elements on the most frequent types of websites

Abstract

Knowing users' expectations about what they expect on a website and where they expect it is crucial for the success of a website. For the last decade, technological advances have entailed major changes in website design but the impact these changes have had on users' mental representations of websites remains unclear. In an online study (N = 841), we asked users to sketch their prototypical version of an online shop, news website and a company page, thereby indicating which interface elements they expect at which location on the website. We compared our results to those of previous studies to investigate changes in users' mental representations of websites over time. This comparison suggests that interface elements such as the logo, main content and the navigation area are still expected in the same location and others have shifted to the rich footer area at the bottom of the website. In addition, new elements such as links to social networks have been incorporated whereas other interface elements have disappeared from users' mental representations. By providing updated consolidated blueprint models for all three website types, we help designers to create expectation-based websites. Further implications for research and practitioners are discussed.

Research Highlights

Measuring current expectations about the location of interface elements,

Website layout: composition and expected location of interface elements,

Gain insights on developments in users' expectations over time

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1. Introduction

Online shopping, reading the news on the Internet and getting information from news websites as well as looking for information on a company are frequent tasks that are performed on websites and therefore need to be efficient. According to recent statistics, after search engines (74%) and social networking sites (64%), web portals (55%), news websites (42%), shopping and auction sites (35% and 39%, respectively) are among the website types users visit at least once a week (Statista, 2013). Knowing what kind of interface elements (e.g., *main navigation*, *search area*) users' expect on a specific website type and also knowing where they expect them to be located can support developers in designing user-friendly and efficient websites. Users tend to be more satisfied with the site (Shaikh & Lenz, 2006) and find it easier to access information if interface elements are where they expect (Baharum & Jaafar, 2013b). Previous research has shown that users are quicker in finding an element of the interface (McCarthy, Sasse, & Riegelsberger, 2004; Roth, Tuch, Mekler, Bargas-Avila, & Opwis, 2013) and have less trouble orienting themselves on a website when the sites are designed according to their expectations (Santa-Maria & Dyson, 2008).

There are different approaches to examining users' expectations and mental representation of the layout of a website. There are quite a few studies that have assessed and aggregated users' expectations of websites (Baharum & Jaafar, 2013a, 2013b, 2014; Bernard, 2001a, 2001b; Bernard, 2003; Bernard & Sheshadri, 2004; Harinarayana et al., 2011; Linxen, Heinz, Müller, Tuch, & Opwis, 2014; Lynch & Horton, 2008; Roth, Schmutz, Pauwels, Bargas-Avila, & Opwis, 2010; Shaikh, Chaparro, & Joshi, 2006; Shaikh & Lenz, 2006). For instance, Bernard (2001a) asked participants to indicate on a grid where they expect different interface elements to be located and assessed the 'prototypical representations' of e-commerce websites. Roth et al. (2010) assessed users' expectations about the location of different interface elements by using an online sketching tool. Participants could sketch how they imagine typical websites and from the aggregated sketches the authors derived a prototypical mental representation of three different website types such as online shops, news websites and company websites.

Due to the technological advances as well as changes in website design, a typical website nowadays looks different to a website from five years ago (O'Reilly & Battelle, 2009). It remains unclear, however, if users' expectations and mental representation of websites have changed as well. Some studies did to a certain extent compare their results to previous studies (Albert, Mast, & Burmester, 2009; Shaikh & Lenz, 2006), but to the authors'

best knowledge, no systematic longitudinal comparison of users' mental representations of websites has been conducted.

To investigate whether users' mental representations of different website types have changed over time, we used an online sketching application allowing participants to compose their prototypical websites by freely arranging interface elements and compared our results to users' mental representation of websites in previous studies. In doing so, we were able to study how changes in interface design (such as the introduction of the *rich footer*, a link collection to important website content at the bottom of a website) have affected users' mental representation of websites and further illustrate which new elements have become central to users' perception of websites.

We (1) assess which interface elements users expect to be present on three different types of websites; (2) visualize users' mental prototypes of these three website types; and (3) identify and highlight changes in users' prototypical mental representations over time by comparing our results to previous studies, and link these changes to recent developments in website design. With our work we aim to highlight the dynamics and the robustness of users' mental representations over time.

2. Theoretical background and related work

In the following section, we introduce the concept of expectations in general, within the field of HCI, and how to capture users' expectations. To explain the potential changes compared to results of previous studies, we further highlight some recent trends in website design.

2.1. Why it is important to know users' expectations?

2.1.1. Expectations, mental models and mental representations

Expectations are the unconscious predictions of a human being that are constantly made to model the world around us to predict and judge our environment (Jonassen & Henning, 1996; Norman, 1983). Expectations are helpful to anticipate events around us such as crossing the street and estimating the speed of an approaching car. Nowadays, based on their experience, Internet users expect that the reactions and feedback of a website will be unambiguous and the design and interaction will adhere to certain habits, standards and guidelines. Users have internal representations of websites, which are often referred to 'mental models' in the literature (e.g., Bernard & Sheshadri, 2004; Qian, Yang, & Gong, 2011; Roth et al., 2010). Norman (1983) and Nielsen (1999) adopted the term 'mental model'

in early HCI research to describe users' simplified internal representations or working models of how a computer system works (Jonassen & Henning, 1996). In cognitive psychology, 'mental models' are internal knowledge representations of an external reality (Gentner & Stevens, 1983; Johnson-Laird, 1983). Early work of Craik (1943) defines them as internal working models for external events, like a small-scale model of how the world works. They have predictive functions to make sense of our environment works, are subject to change and are often formed on the fly (Davidson, Dove, & Weltz, 1999). *Mental models* are dynamic (Craik, 1943; Johnson-Laird, 1983) and can change over time (Thatcher, 2008). With regard to HCI, research could show adjustments of users' mental models when repeatedly interacting with a system (Zhang, 2013). Additionally, the more often users are confronted with a website of the same type, the stronger their mental models become (Thatcher, 2008).

From a cognitive science perspective the concept of mental models does not seem ideal to characterize a user's mental representation of a website, because mental models are built ad hoc and flexible simulations to understand and predict situations. Instead, the concept *schemata* would be a more appropriate as opposed to mental models. Schemata are more stable cognitive representations that are generated by the generalized abstraction of different mental models (Dörr, Seel, & Strittmatter, 1986; Hanke, 2006; Seel & Hanke, 2015). As we are primarily interested in the practical aspects of users' mental models or/and schemata (i.e., where users expect certain interface elements on websites), we refrain from a discussion about terminology and will henceforth use the term *mental representation* when referring to mental models and the like. A mental representation of a website is understood to be a user's 'mental blueprint' of a website including information such as the general structure of a website and the spatial location of its interface elements (Di Nocera, Capponi, & Ferlazzo, 2004; Owens, 2013; Rapp, 2005).

As early as 1983, Norman argued that designers have to be aware of the user's mental representation of software tools when designing its interface. This is also reflected in one of dialogue principles of the ISO 9241-110 standard (ISO 9241-11(E), 1998), which outlines the importance of an interface that conforms with users' expectations. Accordingly, studies have shown that participants could solve more tasks and reported less perceived mental workload when searching information on websites with prototypical vs. non-prototypical arrangements of interface elements (Owens, Palmer, & Chaparro, 2014), or that users can find certain interface elements faster if a website is built according to their expectations (Auinger, Aistleithner, Kindermann, & Holzinger, 2011; Oulasvirta, Kärkkäinen, & Laarni, 2005; Roth et al., 2013). Santa-Maria and Dyson (2008) further showed that having an interface that is

built according to users' expectations can ease the disorientation that users feel when using a system for the first time. In another study, participants were able to correctly categorize websites even when seeing them only for milliseconds. This suggests that users' mental representations of websites are accessible in a extremely fast manner and help to guide users' perception of websites (Owens, 2013).

Websites that do not meet users' expectations, however, can lead to frustrating experiences (Cassidy & Hamilton, 2014; Nadkarni & Gupta, 2007; Palmer, 2002). As a consequence, users may just leave a website and never come back (Bhattacherjee, 2001; Cyr, 2014; Flavián, Guinalíu, & Gurrea, 2006). This, of course, can have a serious impact on the success of a website provider or, even worse, on the image of the corresponding company (Auinger et al., 2011; Soper & Mitra, 2013).

2.2. How to assess users' mental representations of websites

Cassidy and Hamilton et al. (2014) reported that since the first studies of Bernard in 2001, several studies have analyzed users' expectations of websites using different approaches. In the following section, we look at three different methods of how to assess users' expectations.

2.2.1. Placing elements on a predefined grid

Research has often aggregated and displayed the users' expectations in the form of heat maps within a predefined and superimposed grid on a blank website (e.g., Bernard, 2001a, 2001b; Shaikh & Lenz, 2006). Placing interface elements on paper or indicating their position within a grid seems a straightforward way of collecting information about users' mental representations of websites. For instance, Bernard (2001b) used a 7 x 8 grid representing a browser window where participants could place given interface elements. They placed each interface separately and unrelated to others. Several studies have applied this method with different grid sizes (Baharum & Jaafar, 2013a; Bernard, 2003; Harinarayana & others, 2011; Shaikh & Lenz, 2006; Suresh & Gopalakrishnan, 2012). This grid approach was also used in an online study where participants could indicate their 'prototypical representation' of online shops.

2.2.2. Indicating the location of interface elements on a blank screen

The spatial components of users' mental representations of a website have also been assessed by asking participants to indicate the location of common interface elements (Dinet & Kitajima, 2011; Di Nocera et al., 2004; Soper & Mitra, 2013). The interface elements were

displayed sequentially, one after another and repeated in several trials, and the results were aggregated in heat maps. These visual representation of the relative density of clicks showed a remarkable similarity between participants thus hinting at a shared mental representation of a prototypical website (Soper & Mitra, 2013).

2.2.3. Sketching interface elements on a browser canvas

Roth et al. (2010) used an online application where users could sketch their mental representation of different website types. In contrast to (Bernard, 2001b), they used a holistic approach, where participants were asked to compose an online shop, a news website and a company site using given interface elements as building blocks. All interface elements were presented at the same time, participants could choose which interface elements they wanted to place, and they could adapt the size of each interface element. The results were aggregated in consolidated blueprints for each website type (Roth et al., 2010).

2.3. Mental representations of different types of websites and interface elements

Some studies on mental representations have only included one type of website, such as e-commerce, library, and travel websites (Adkisson, 2002; Kim & Fesenmaier, 2008; Naughton & Agosto, 2012; Purwati, 2011; Vasantha & Harinarayana, 2011) whereas others have included and compared different types of websites (Cassidy & Hamilton, 2014; Roth et al., 2010). To categorize websites into different types and analyze them separately seems a sensible approach because previous studies indicate that users have different expectations regarding which interface elements can be found on different website types (Roth et al., 2010). With regard to the concrete interface elements, Cassidy et al. (2014) summarized that in previous studies on mental representations a total of 22 different elements were investigated. These were elements such as *logo*, *navigation*, *search* but also website-type specific elements such as *shopping cart*.

2.4. Changes in location expectations of interfaces element

Expectations about our world and its internal representations can change (Holman, 2011; Shaikh & Lenz, 2006). Only a few studies have analyzed differences in mental representations over time. For instance, McCarthy et al. (2004) showed that if users were confronted with violations of their expectations they were able to quickly adapt to nonstandard layouts in websites. Therefore interacting with a evolving system such as a website or any interactive system must provoke the user's old model to adapt to the new system (Neisser, 1976; Qian et al., 2011). Other studies about mental representations of

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websites have compared their results to previous studies to get an estimate of how these have changed over time. Shaikh and Lenz (2006) and Baharum et al. (2013b) replicated the studies of Bernard (2001a, 2001b) and compared their results. Overall, they were able to show very few changes for several selected interface elements. These studies comparing results over time, however, used different approaches and different grid sizes than the former studies.

Overall, these comparisons to previous studies indicate a stable expected location for some of the elements such as *logo*, or the *main content* of a website, whereas for other elements such as the *main navigation* and *search* they reported differences. Due to the constantly ongoing advances and changes in Internet technologies, it remains important to re-examine users' expectations about the positioning of interface elements (Baharum & Jaafar, 2013c).

2.5. Change in web design

In the following section, we discuss some technological developments and trends in web design that might have had an impact on which elements users expect on a website and where they expect to find them. These technological changes, as well as the modified visual appearance of websites, may affect users' expectations (Baharum & Jaafar, 2013c).

To improve product selling, different techniques are applied, such as using banner advertisement on websites, using wish lists or other suggestive and persuasive selling strategies, or giving users the possibility to personalize the website (Gerrikagoitia, Castander, Rebón, & Alzua-Sorzabal, 2015). The adaptation of these strategies impacts the visual design of websites, as does the use and integration of social media and social networks. This could be observed for different categories of websites such as library websites (Vasantha & Harinarayana, 2011), education and instructional design (Tess, 2013), travel and tourism (Xiang, Wang, O'Leary, & Fesenmaier, 2014) or even search engines (Mlilo & Thatcher, 2011). Social media also influences how customers interact on e-commerce sites towards social commerce (Huang & Benyoucef, 2013).

Certain of these interface elements have been used by several websites and developed into de facto standards (Adkisson, 2002; Albert et al., 2009). To determine whether these described technological and design changes have been manifested within users' mental representations of websites and to monitor their robustness, it is necessary to measure and capture users' expectations over time using the same or a very similar approach as previous studies (e.g., Roth et al., 2013).

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2.6. Aim of the study

The aim of this study is to capture the current state of users' expectations regarding interface elements and their positioning of three different website types. The study provides insights into (1) which interface elements are currently expected on a website; (2) where users expect these interface elements to be positioned on different website types; and (3) how—by comparing our results to the study of Roth et al. (2010)—users' expectations about different types of websites might have changed over time based on the exposure to new website layouts.

3. Methods

This study, with the overall goal to investigate the temporal aspects of users' mental representations of websites, reports the results of participants from German-speaking countries (Germany, Austria and Switzerland, further abbreviated as DACH) and the United States (US). Roth et al. (2010) investigated a similar sample, which allows us to directly compare their results to ours and thereby illustrate potential changes in users' mental representation over time.

3.1. Design of the study

As in Roth et al. (2010), we assessed users' mental representations by asking them to sketch their prototypical mental image of each of three different website types using a predefined set of interface elements as building blocks.

3.1.1. Stimuli selection procedure

In order to select the most frequent and most representative website types for our study, two independent coders categorized the 100 most frequently visited websites in Germany, Austria, Switzerland and the United States. Website traffic information was retrieved from Alexa.com (Alexa Internet, 2013). In a first step, the two coders categorized the websites independently from each other and in a second step they compared their categorizations and discussed discrepancies until consensus was reached. Across all countries, the following categories occurred most frequently: company websites (19%), news websites (15%), online shops (9%), social networking sites (7%), and search engines (13%). The remaining websites (38%) were categorized into various smaller categories. Table 1 gives an overview of the website types identified in Roth et al. (2010) and in our study. The numbers

of online shops and news websites in the top 100 websites have increased compared to the study of Roth et al. (2010), whereas the number of company websites has decreased.

We excluded social networking sites such as Facebook and Twitter because they grant only limited access to the main page without login and we excluded search engine websites such as Yahoo and Google because they have a very simple layout of the start page. Further, we excluded the remaining websites in the category 'other' because of either their infrequent appearance, the high number of subcategories, or unclear classification not allowing a meaningful comparison and analysis.

Table 1
Categorization of the top 100 websites (traffic based, Alexa.com) into website types. Numbers represent percentage of occurrence

Type of website	2010	2014
Company websites	35	19
News websites	10	15
Online shops	5	9
Search engines	5	13
Social networking sites	30	7
Other	15	38

After categorizing the websites, each interface element on the start pages of the websites of all online shops, news websites and company sites was identified. An overview of the interface elements with their description can be found in Appendix 1. A total of 44 interface elements could be identified (see Table 2 for details). We reduced the number of interface elements to be included in the main study by conducting an online survey on crowdflower.com with participants (47-50, depending on country) from the respective countries. For each website type, the 25 most frequently identified elements were presented in randomized order and participants indicated which of these elements they would expect to find on a typical website. The 18 most frequently selected interface elements that were selected by at least 40% of the participants per country were included as building blocks for the main study.

Table 2
Overview of the different interface elements and their frequency for each website type 2014 in alphabetical order. The 18 interface elements included in the main study are marked bold.

Element	Company site		News website		Shop	
About us	**91%**		**64%**	**	**84%**	
Accessibility	45%	**				
Advertisement	24%		**46%**		30%	
Archive			**80%**	*		
Certifications	**47%**	**				
Contact	**90%**		**76%**		**92%**	
Cookies	30%		33%		36%	**
Create ad			36%		20%	
Deals and recommendation	28%	**			**75%**	
E-Paper			**61%**	*		
FAQ						
Feedback			49%	**		
Forum	26%		**45%**		25%	
Guestbook						
Help	**69%**		**56%**		**81%**	
Home	**84%**	*	83%			
Hotline	**67%**	*			**76%**	*
Jobs	**68%**		**52%**		28%	
Language country selection	**63%**		38%	**	**60%**	
Last updated			**68%**	**		
Legal information	**65%**		**53%**		**72%**	
Login or register	45%		**55%**		**84%**	
Logo	**89%**		**70%**		**83%**	
Main area	**79%**		**74%**		**82%**	
Mobile version	44%		**54%**		**66%**	**
Navigation area main	**78%**		**74%**		**75%**	
Newsletter			**69%**	*		
Partner	44%		29%	*	26%	
Payment						
Press releases	41%	*			14%	
Privacy	**73%**		**60%**		**71%**	
Rich footer	**49%**		**45%**		**46%**	
RSS			51%			
Search	**68%**		**76%**		**80%**	
Security	**55%**	**				
Shipping cost					**90%**	
Shopping cart	49%	*			**89%**	
Sitemap	**63%**		**68%**	**		
Social networks	41%		**55%**		38%	
Subarea						
Sub navigation	**50%**		44%		**51%**	
Subscription			**64%**	*		
Wish list					**61%**	*

*　　　only in DACH
**　　　only in US

3.2. Participants

Participants were recruited online via Crowdflower.com. As compensation participants received 1.70 US$. Additionally, to support recruiting in German-speaking countries the Psychology Departments' participant pool, mailing lists and social networks were used to further promote the survey, with a raffle of three vouchers (30 US$ each).

In total, 649 participants started the DACH version of online study and 485 the US version. A total of 530 participants completed the DACH version and 428 the US version. We excluded participants who either did not complete the survey or did not correctly answer the verification questions at the end of the survey. The verification questions required participants to describe the purpose of the study without being able to go back and check the survey again. Additionally, we excluded participants who spent less than a minimum of 100 seconds for sketching the three website types. In the end, we were able to use the data of 841 participants (459 DACH and 382 US) for further analysis (313 female, 524 male, 4 no answer provided). For detailed information about the demographical data of the participants, see Table 3.

Participants' mean age over all participants (DACH) was 35.0 years (SD=12.0, range = 14 - 69) and for the US 35.3 years (SD = 11.2, range = 18 - 71). The 459 participants for the German-speaking area were from Germany (77.1%), Switzerland (5.9%) and Austria (9.4%); the remaining 7.6% of participants were from other countries. For the US sample, 96.1% named USA as their country of origin, the remaining participants coming from Canada (<1.0%), China (<1.0%), Iraq (<1.0%), Mexico (<1.0%) and Trinidad and Tobago (<1.0%). The average time to complete the survey was approximately 18.1 minutes (SD = 9.7) for participants from DACH and 17.4 minutes (SD = 10.0) for participants from the US. Overall, our sample was well educated and experienced in using the Internet as nearly all participants used the Internet on a daily basis.

Table 3
Demographical data of participants.

	M	SD	%
Age (in years)	35,1	11.6	
Level of education	3.4	1.1	
Normal education or equivalent			5.8
Apprenticeship or equivalent			10.5
Intermediate education or equivalent			11.9
Higher education or equivalent			32.0
University degree or equivalent			38.9
other			1.0
Experience using the computer [a]	5.5	1.3	
Experience using the Internet [a]	5.6	1.3	
Experience in web design [a]	3.1	1.6	
Frequency of Internet use for private reasons [b]	5.8	0.8	
Frequency of Internet use for professional reasons [b]	4.7	1.9	
Frequency of [b]… … doing online shopping	3.2	1.2	
…searching information on company site	3.7	1.4	
… reading an online newspaper	4.2	1.7	
… visiting an web portal	4.3	1.7	

Note:
[a] : 1=very low, 7=very high
[b]: 1=never, 2 = 1-11 times per year, 3= 1-4 days a month, 4 =1-3 days a week, 5=4-6 days a week, 6=every

3.3. Procedure of the study

The procedure of the main study is illustrated in Figure 1 and was identical for all countries. The study was divided into three parts. In the first part, at the beginning of the online questionnaire, participants were presented with a short demographic questionnaire followed by the instructions on how to use the sketching application (text based and within an instructional video). Participants were then forwarded to the training version of the sketching application where they could familiarize themselves with the features of the application by fitting furniture items into a bedroom floor plan. In the main sketching application, a virtual browser canvas window of 800 x 520 pixel was presented at the left side and on the right side the interface elements identified in the preliminary study as bricks to compose the prototypical websites. Figure 2 illustrates an example of a participant composing a company website. The size of the canvas was chosen to represent the most frequently used screen sizes. Participants were asked to sketch each website type according to their expectations by placing the interface elements on the canvas by drag and drop. The instruction "How does a typical online shop / company website / news website look to you? Use the elements within the blue box to build a typical online shop / company website / news website according to your expectations" was repeated at the top of each page. Tooltips revealed additional information for each interface element on mouse-over. All interface elements initially had the same size (24px x 240px) but could be easily resized by drag and drop to match the participants' expectations. Participants could additionally place two empty elements and label them.

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Participants had to place a minimum of four elements before they could proceed to the next page and were randomly redirected to one of the remaining website types (online shop, news website, and company website) to control for sequence effects.

```
┌─────────────────────────────────────────┐
│   Welcome and information about the study │
├─────────────────────────────────────────┤
│   Demographic questionnaire               │
├─────────────────────────────────────────┤
│   Video tutorial and instructions         │
├─────────────────────────────────────────┤
│   Training exercise                       │
├─────────────────────────────────────────┤
│   Online shop                             │  Randomized order
│   News website                            │
│   Company website                         │
├─────────────────────────────────────────┤
│   Questionnaire about                     │
│   computer and Internet expertise         │
├─────────────────────────────────────────┤
│   Verification questions                  │
└─────────────────────────────────────────┘
```
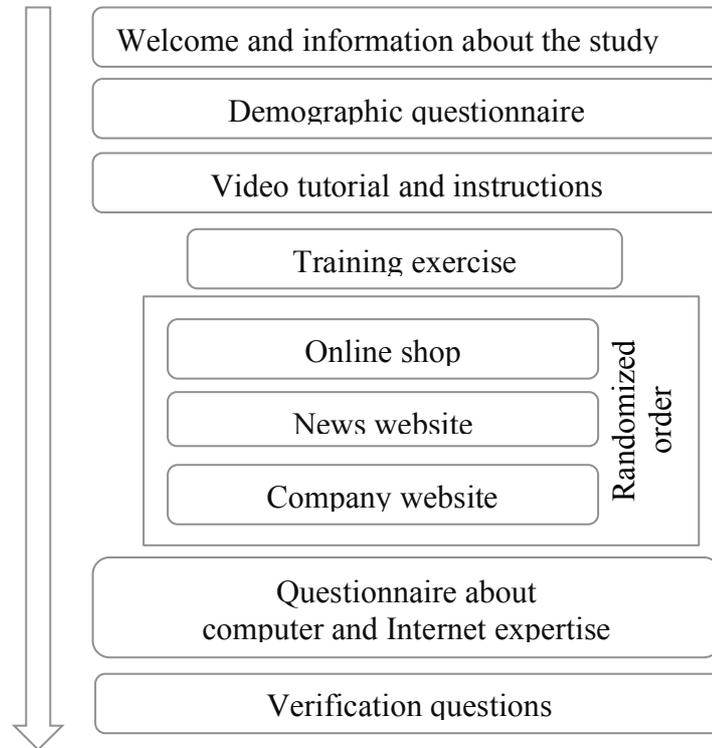
Figure 1: Schematic illustration of the procedure of the study.

In the third part, the online questionnaire, participants were asked to answer questions concerning their computer usage and Internet knowledge and how frequently they used each of the three website types. Finally, participants answered three verification questions where they had to decide if certain questions were part of the survey to ensure the data quality. After answering these verification questions, the study was completed and participants received the confirmation code to get their compensation on crowdflower.com.
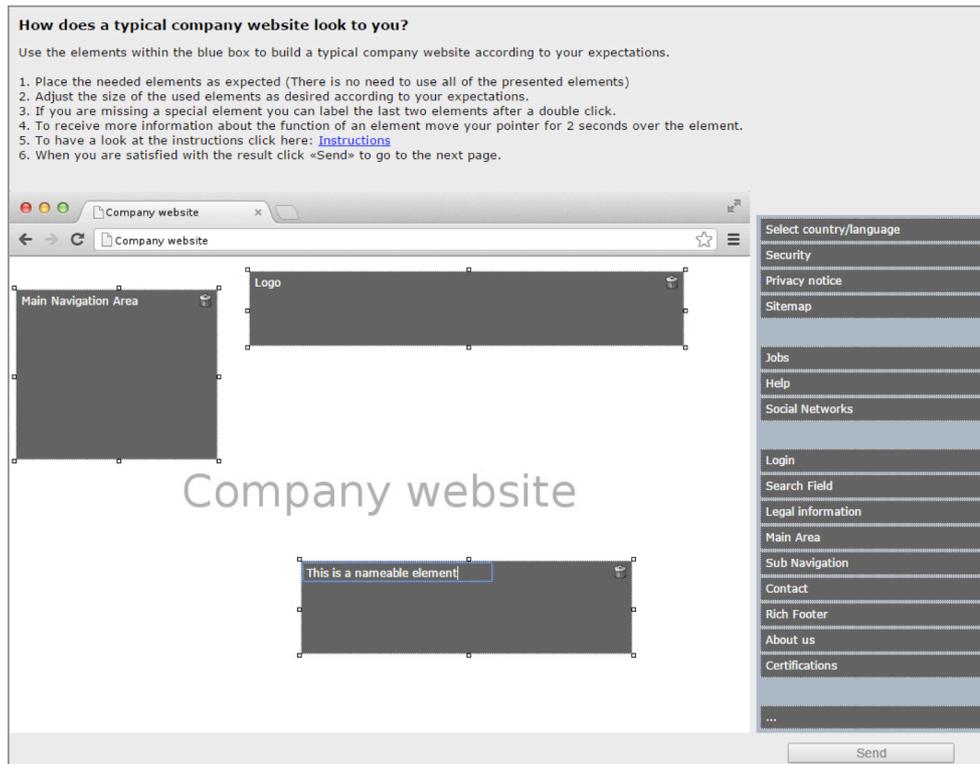
Figure 2: Screenshot of the sketching application.

3.4. Data collection with the online sketching application

To allow the participants to sketch their mental representations of websites, we used a multi-lingual web software that was especially developed for this purpose (Fraßeck, 2014). It runs in a web browser providing an interface for sketching different two-dimensional objects (e.g., websites). It has a drag and drop API (application programming interface) to place objects on a virtual browser canvas. Technically, the application was implemented using a LAPP (Linux, Apache, PostgreSQL, PHP) stack. For functions such as drag and drop, resizing or data aggregation, it makes extensive use of JavaScript, jQuery (The jQuery Foundation, 2014) as well as the Google Closure Library (2014). The software is capable of providing predefined objects in different languages. After submitting a final sketch of a website type, all objects are stored in an online database. Besides producing raw data of user sessions in csv–files, the software can process versatile heat maps of the submitted objects organized by website type, interface object, language and participant. Raw data will be provided in an online appendix (2015).

3.4.1. Data preparation and data reduction to visualize

For each participant and for each website type, the positioning of each interface element was recorded by saving the 'x'- and 'y'- coordinates, as well as its height and width. We pooled the DACH and US data to be able to compare our results with those of Roth et al. (2010), thereby investigating changes over time in users' expectations. Data were analyzed using SPSS 21(IBM Corp., 2012) and R (R Core Team, 2014). To visualize how participants placed the interface elements on the canvas, we generated contour maps based on the centroid of the elements. We did this for each element and each website type separately. The contour lines in the plots represent two-dimensional kernel density estimations that are calculated on the basis of the centroids of the elements and the dots represent the centroids of the elements. We used the kde2d function in MASS package (Venables & Ripley, 2002) to calculate the density estimations and the ggplot2 package (Wickham, 2009) to generate corresponding contour maps. The contour maps illustrate the density distribution of a certain interface element on the website canvas. The raw data of Roth et al. (2010) were analyzed, and visualized using the same methods.

4. Results

In the following section, we analyze (1) which interface elements users expect to be found on websites and (2) where they expect these elements to be located on the site. From the authors of Roth et al. (2010), we obtained the data originally collected in 2007 (personal communication, 2013). We compare the current expectations (i.e., 2014) to the expectations Roth et al. (2010) collected in 2007.

4.1. Interface elements users expect on a website

A complete overview of mean percentages of participants placing an interface element on the canvas split by website type and study is provided in Table 4. This table also highlights that participants did not use all the interface elements presented to them in the study to build their websites. From these placement frequencies we inferred that in the view of users not all elements seem to be as important to be part of a website. Over all website types, the most frequently placed interface elements in 2014 are *about us, contact, help, login/register, logo, main area, main navigation area, privacy* and *search*. This was similar back in 2007.

4.1.1. *Changes over time that affect all website types*

Looking at Table 4, it can be seen that there are interface elements that were no longer placed for either of the website types. These are interface elements such as *link-list with external links, to the top* or *FAQs*.

The next section within Table 4 displays interface elements that were not included in 2010, but are now part of the users' mental representation of a website The interface element *social network* was placed in all three website types. The *rich footer* was expected to be found on online shop and company sites, but not (yet) on news websites. *Legal information*— similar, but not completely identical to the *conditions of use* in former studies—was expected to be found on all websites by more than half of participants. Our data suggest that a switch to the *mobile version* of a website is expected to be found on an online shop and a news website, but not necessarily on a company website. One reason might be that looking up a product or news is frequently done while on the go.

Jobs and a *site map* are only expected to be found on news websites and company websites. As indication of the expected customization of an online shop and a company site, participants placed an interface element to *select the country or language*. For the news website, this element was not placed, presumably because a newspaper is provided in one main language. For all website types, interface elements related to *privacy* of data are now expected to be on the websites.

Table 4
Overview of the interface elements and the **frequency of their placement** for each website type in 2010 and in 2014 (if available).

	Interface element	Online Shop (%)		News website (%)		Company website (%)	
		2010	2014	2010	2014	2010	2014
Elements placed in 2010 and 2014	About us	75	77	71	31	91	84
	Advertisement	65	–	66	32	–	–
	Archive	–	–	82	39	59	–
	Back to homepage	81	–	83	32/44	88	41
	Contact	88	78	82	75	93	82
	Help	80	70	72	64	71	62
	Login or register	94	78	86	72	–	30
	Logo	93	84	93	83	96	84
	Main area	90	83	90	84	91	83
	Main navigation area	74	74	75	73	74	72
	Newsletter	56	–	66	41	70	–
	Privacy	76	66	61	66	64	70
	Search	91	80	92	78	59	68
	Shopping cart	94	80	–	–	–	30
	Legal information (2010: Conditions of use)	83	66	64	56	75	68
2014 only	Certifications	–	–	–	–	–	15
	Deals and recommendation	–	64	–	–	–	–
	E- Paper	–	–	–	29	–	–
	Forum	–	–	–	33	–	–
	Hotline	–	40	–	–	–	41
	Jobs	–	–	–	58	–	69
	Language / country	–	52	–	–	–	59
	Last time updated	–	–	–	21	–	–
	Legal information	–	66	–	56	–	68
	Mobile version	–	21	–	53	–	–
	Partner	–	–	–	–	–	30
	Rich footer	–	40	–	–	–	41
	RSS	–	–	–	53	–	–
	Security	–	–	–	–	–	19
	Shipping cost	–	64	–	–	–	–
	Sitemap	–	–	–	27	–	61
	Social networks	–	25	–	28	–	30
	Sub-navigation	–	52	–	–	–	48
	Subscription	–	–	–	34	–	–
	Wishlist	–	36	–	–	–	–
2010	FAQ	79	–	62	–	74	–
	Link-List (external Links)	47	–	60	–	62	–
	To the top	54	–	57	–	55	–

Note: As we pooled data for DACH and US, there are more than18 elements in the 2014 sample.

4.1.2. *Changes over time that are website-type specific*

As previous studies comment, there are interface elements that are typical for the main purpose of a website (Roth et al., 2010). We now look at each website type in turn. In 2014, users frequently placed the interface elements *deals and recommendations*, and *shipping cost* – an area where information about the shipping costs is displayed or linked – when sketching their prototypical online shop. Additionally, results suggest that other typical online shop elements such as *shopping cart* and *login/register* are still expected to be found on an online shop website. On a typical news website, new elements expected by participants were the possibility of a *subscription,* an indication of when the information was *last updated*, and to

be able to use an *RSS feed* to export information. For users, a company page no longer has to include an *archive*. However, users expect to see a *login/register* area, a *shopping cart*, *jobs*, and links to *social network*. As these elements were selected by more than 30% of users, this might be an indication that users expect company sites to be more service oriented and not only to provide static information about the company.

4.2. Where do users expect the interface elements to be placed?

In the next section, we visualize the users' raw data for each interface element and website type. First, we give an overview of the currently expected location for the most frequently placed interface elements for all website types (see Figure 3, 4 and 5). The dots represent the centroid of an element and the lines of the contour maps indicate the density of the elements. The more scattered the dots and the lower the density of dots is, the wider apart the lines are. This represents a less consistent expected location for these interface elements. On the other hand, a higher density of dots results in finer lines and can be interpreted as a more consistent expected location. Where data were available in the data set of 2007, we visualized the data identically and display the corresponding results next to each other. Two of the authors visually inspected each contour map and discussed its interpretation until agreement was reached.

4.2.1. Interface elements in similar locations for all website types

First, we look interface elements that were consistently placed in a similar location across all or at least two website types. The *logo* was placed in the far left corner or at the center at the top of the website. The *main area*, where a website's content is displayed, is expected to be in the center of the website. To *contact* the owner of the website, users consistently expect to find this interface element at the bottom of the website, where they also expect the *help* to be found. Also, all *legal information* is expected to be found at the bottom of the site, presumably within the *rich footer area*. However, as for the news website, the rich footer was not frequently enough placed and we cannot reach a final conclusion. When users search for something, they expect the *search box* to be located in the top right corner. In this far right corner, they also expect the *login or register* area to be found. When users want to change the *language or country* for the online shop or the company website, they expect to be able to do it in the top right corner.

There were some interface elements that were placed on all website types, but their expected location was not as consistent as for other elements. For the links to *social networks*,

users do not seem to have a specific expected location yet, as for all website types the raw data for this interface element showed wider lines and less consistent positioning; however, there is a tendency to place it in the top right area.

4.2.1. *Changes for interface elements locations for all website types*

Next, we compare the expected location for the interface elements to the data from 2007. Overall, results suggest that the positioning of elements has not fundamentally changed over the years, but still there are some noteworthy differences. The location of interface elements such as the *main content area* as well as the *logo* and the *navigation area* has remained stable since 2007. It seems that the expected locations have become even more pronounced because participants agree more strongly on the locations of these elements than back in 2007. For instance, as can be seen in Figure 3, the *logo* of an online shop is more consistently placed in the top left area. In 2007, *contact* was often placed on the left side of the website, probably revealing that contact information in previous designs used to be frequently integrated in the navigation area; however, in 2014 for all website types *contact* was placed in the bottom area of the website, most likely within the footer area. With regard to the *navigation area*, most users still place it on the left side of the website. However, in 2014 there is also a tendency to expect the *navigation area* at the top towards the center of the website. This was not the case in 2007. The shift towards the center of the website might indicate that navigational interaction patterns using mouse-over animations and mega-fly outs (a big, 2-dimensional drop-down panel) are more widely used and are incorporated in users' mental representation of websites. Web sites designed for mobile devices also position these navigational interface elements centrally on the screen.

4.2.2. *Changes for interface elements on specific website types*

Results indicate that there are no interface elements that have changed their location for specific website types only; however, for each website type there are new interface elements that are incorporated in users' mental representations. For the online shop, *wish list* is a new element and is expected to be located in the top right corner of the website, where the *country selection* is also expected to be found. On a typical news website, the *mobile version* seems to be an important new element, but there is no consensus where on the site it is expected. As visualized in Figure 4, the *e-Paper* (electronic version) of a newspaper and the indication of when the site was *last updated* is accordingly not yet expected to be found in one distinct location. For the company website, users in 2014 expect to find the information about the company in the *about us* element at the bottom of the website. This is different to the

placement in 2007, where the information was expected to be found within the navigation area of a website. As illustrated in Figure 5, if users would like to get in touch with the *hotline* they seem to expect this interface element to be located either next to *contact* in the top right corner or within the footer area.
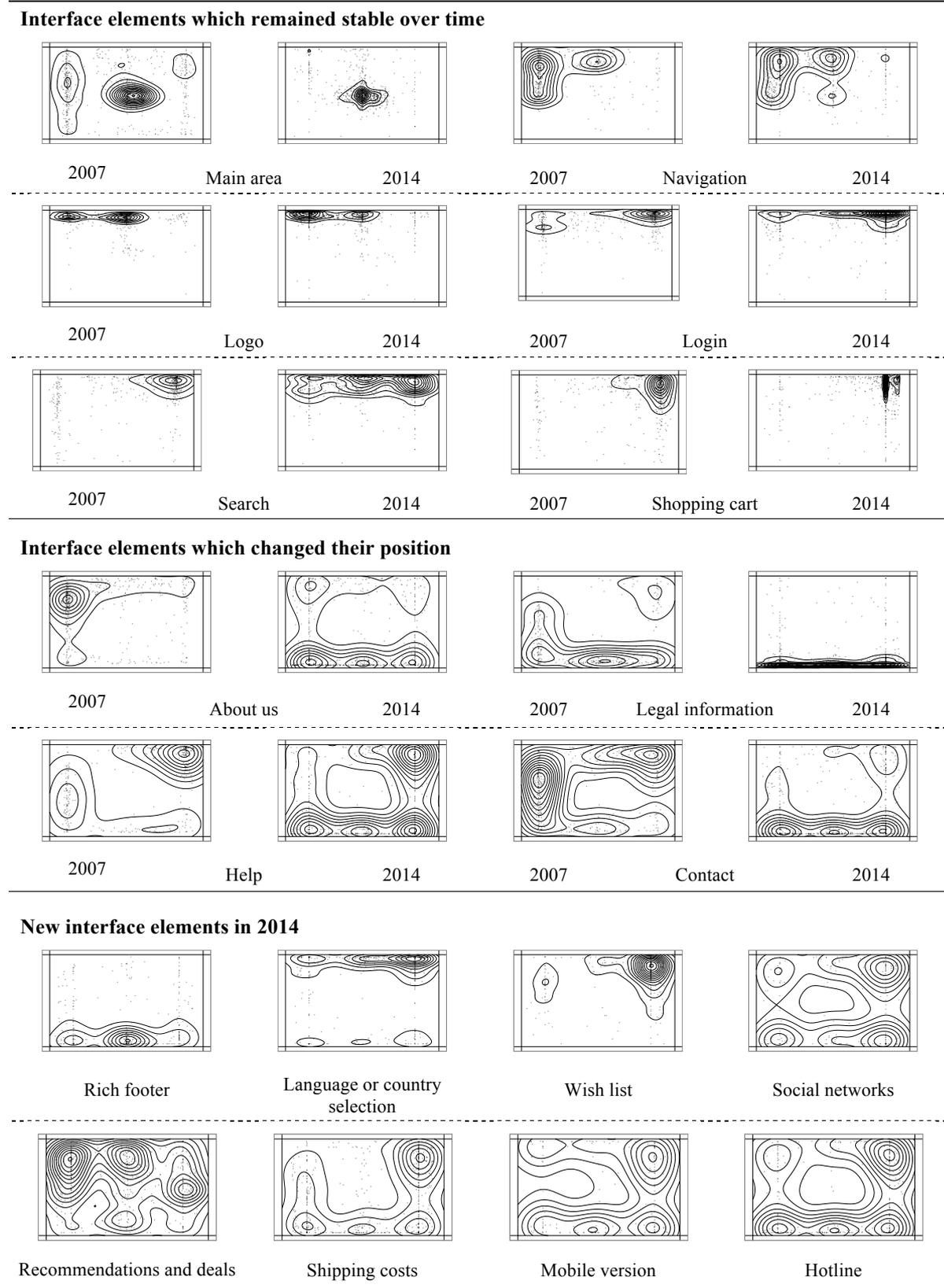
Interface elements which remained stable over time

| 2007 | Main area | 2014 | 2007 | Navigation | 2014 |

| 2007 | Logo | 2014 | 2007 | Login | 2014 |

| 2007 | Search | 2014 | 2007 | Shopping cart | 2014 |

Interface elements which changed their position

| 2007 | About us | 2014 | 2007 | Legal information | 2014 |

| 2007 | Help | 2014 | 2007 | Contact | 2014 |

New interface elements in 2014

| Rich footer | Language or country selection | Wish list | Social networks |

| Recommendations and deals | Shipping costs | Mobile version | Hotline |

Figure 3. Expected locations of the most frequently placed interface elements from 2007 (Roth et al., 2010) (left) and the current study (right) for online shop.

Interface elements which remained stable over time
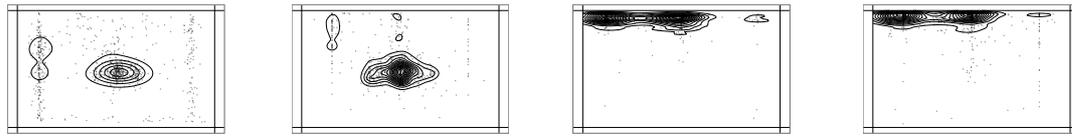
| 2007 | Main area | 2014 | 2007 | Logo | 2014 |

| 2007 | Navigation | 2014 | 2007 | Search | 2014 |

| 2007 | Login / register | 2014 |
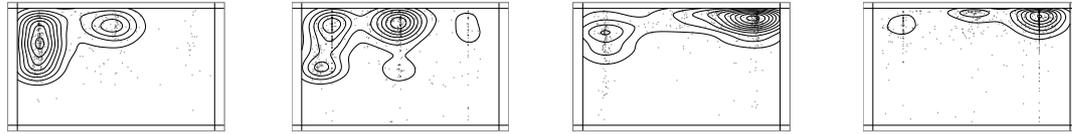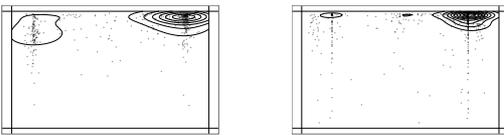
Interface elements which changed their position
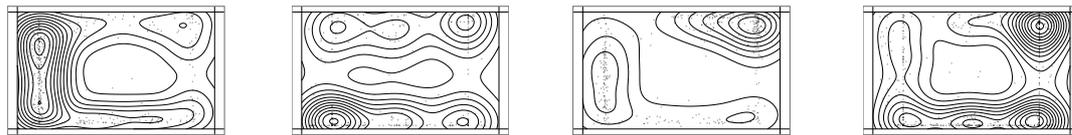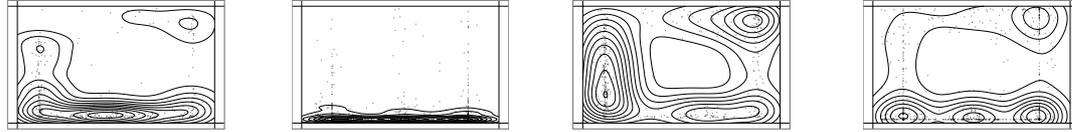
| 2007 | About us | 2014 | 2007 | Help | 2014 |

| 2007 | Legal information | 2014 | 2007 | Contact | 2014 |

New interface elements in 2014
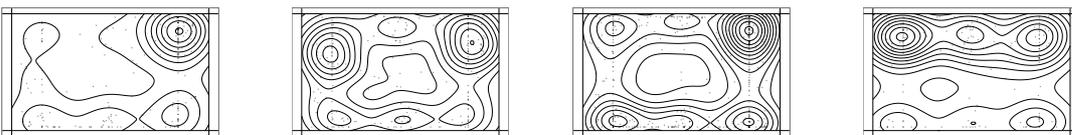
| Social networks | e – Paper | Mobile version | Last updated |

| Subscription | Forum | RSS | Jobs |

| Archive | Site map |
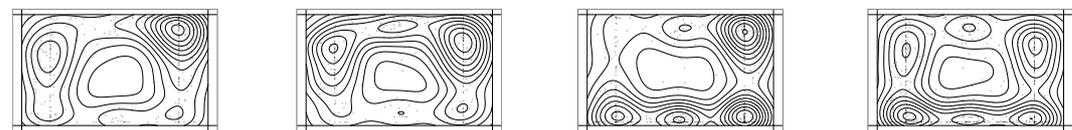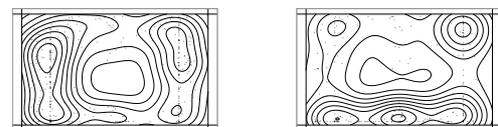
Figure 4. Expected locations of the most frequently placed interface elements from 2007 (Roth et al., 2010) (left) and the current study (right) for online newspaper.

Interface elements which remained stable over time

| 2007 | Main area | 2014 | 2007 | Search | 2014 |

| 2007 | Navigation | 2014 | 2007 | Logo | 2014 |

Interface elements which changed their position

| 2007 | About us | 2014 | 2007 | Help | 2014 |

| 2007 | Contact | 2014 | 2007 | Legal information | 2014 |

New interface elements in 2014

| Social Networks | Rich Footer | Language and country selection | Shopping Cart |

| Mobile Version | Hotline | Partner | Security |

| Certifications | Jobs | Sitemap | Login |
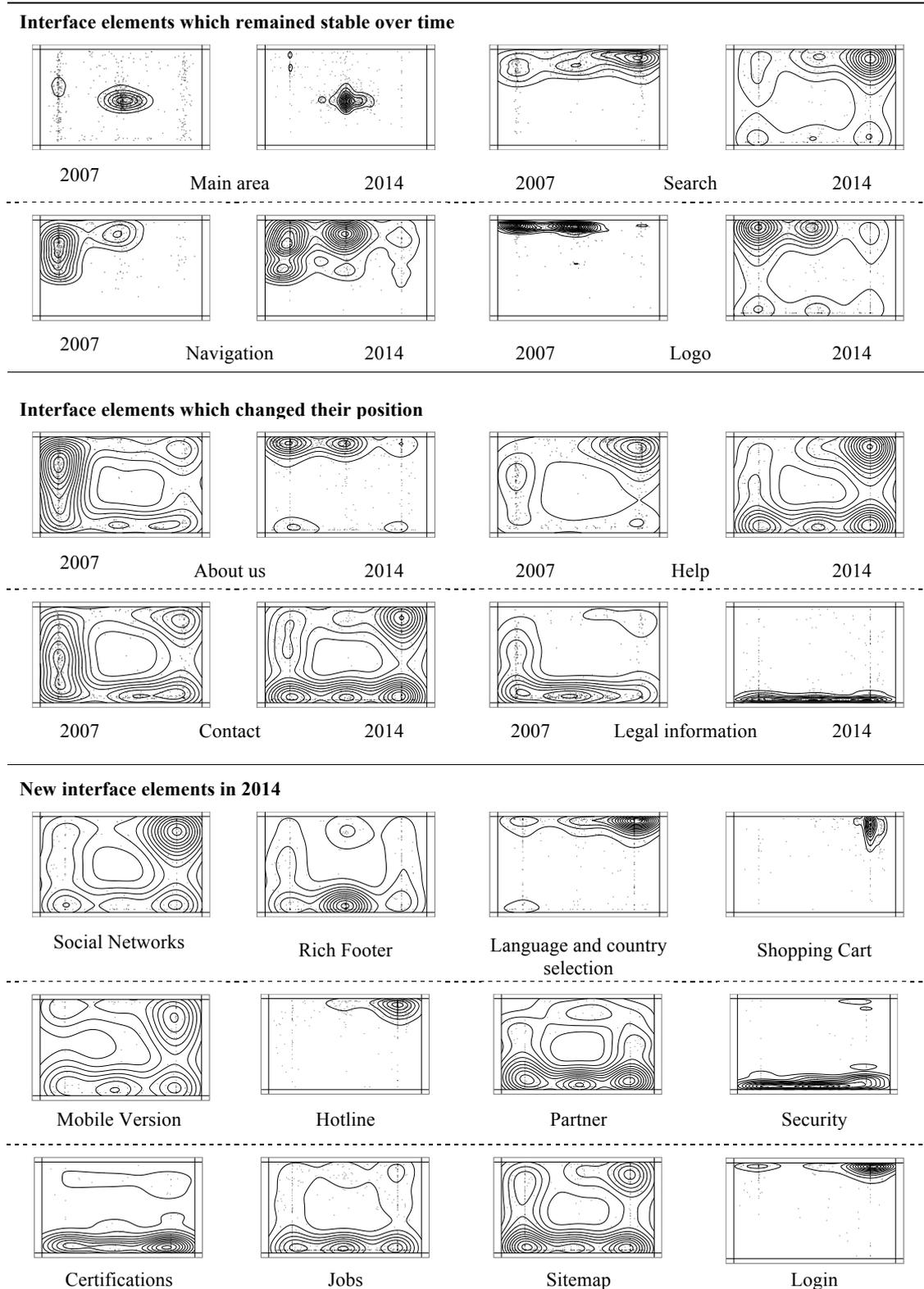
Figure 5. Expected locations of the most frequently placed interface elements from 2007 (Roth et al., 2010) (left) and the current study (right) for company pages.

4.3. What do users expect a prototypical website to look like?

One aim of this study was to provide guidelines for website designers to know where website users expect specific interface elements to be located. We therefore summarize the results of all interface elements for each website type in aggregated blueprints. To do so, two researchers visually compared the contour maps for each interface element and decided on the most typical location for each. If results were ambiguous or indicated several possible locations, the two researchers placed the elements to result in a balanced layout. The most pronounced location for each interface element was integrated in a blueprint, as an approximation of the contour maps. To visually illustrate the overall changes over time, we oppose the blueprint models from 2007 (adopted from Roth et al., (2010) to our blueprints from 2014 (Figure 6, 7, and 8). The new elements in the blueprints for 2014 are highlighted in grey.
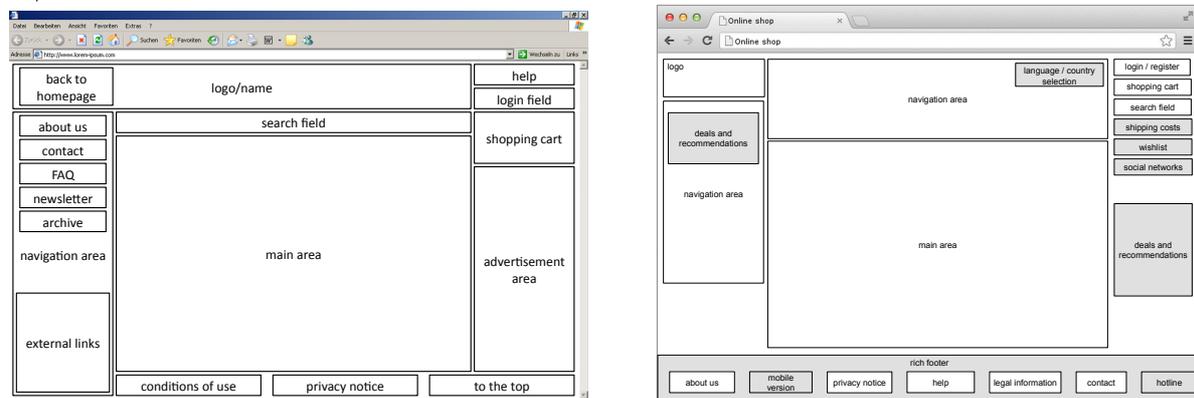
Figure 6. Blueprint model for an online shop in 2007 (left) and 2014 (right)
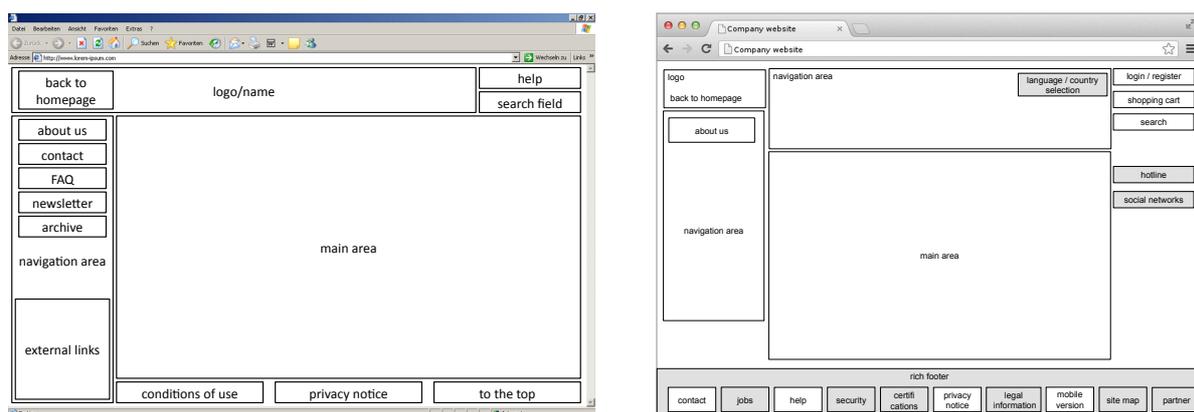
Figure 7. Blueprint model for a company website in 2007 (left) and 2014 (right)
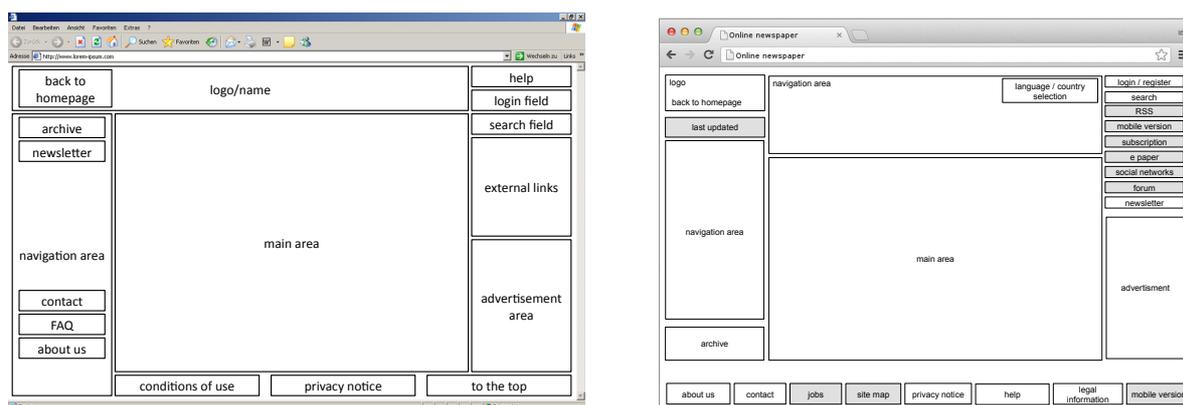
Figure 8. Blueprint model for an online newspaper in 2007 (left) and 2014 (right)

As discussed in the previous sections, compared to 2007, several new interface elements are expected to be found on each website type. For all website types, we included links to *social networks*. The expected location of several interface elements such as *contact, privacy information, legal information,* or *help* seem to have transferred to the bottom of the page, presumably within the *rich footer* area. This *rich footer* was integrated in the blueprint for the online shop and the company page, but not for the news website as users did not select this interface element frequently enough in the preliminary study for it to be included in the main study.

For the online shop displayed in Figure 6, we integrated new interface elements such as the *wish list*, *deals and recommendations*. The *search* was placed in the center of the page in 2007, but could now be placed in the top right corner according to the contour maps. In Figure 7, the new elements for news websites were *mobile version* and *e-version*. These elements were placed on either the right or the left side of the website. The indication of when the website was *last updated* was expected to be on the top of the site. For the company page, the *jobs*, *mobile version* and *hotline* were integrated in the blueprint model in Figure 8.

5. Discussion

In this study we investigated which interface elements are expected to be on different website types, and where users expect them to be located. Moreover, we compared our results to data from 2007 in order to investigate differences in expected interface elements over time. Results suggest that there are interface elements that users expect to find on all the three types of websites we analyzed (i.e., online shopping, company website, news website). These are core interface elements of a website such as the *main area, navigation area,* or the *search box,* but also elements containing information regarding the owner of the website such as the *logo, about us* or *contact*. These results are consistent with previous studies that looked at the

design of websites and the layout of interface elements (Cassidy & Hamilton, 2014). Overall, it seems users' expectations about these interface elements have not changed since 2007. These are relevant interface elements of any website and have been shown in other studies to be the most important for a website (Cassidy & Hamilton, 2014). In regard to other elements, however, users have changed their expectations. Today, users expect social media and personalization elements such as links to *social networks*, *wish lists* or areas to *login or register* to be found on a website. Due to technological advances in the mobile field, interface elements such as a *mobile version* of a website or an *e-version* of an online newspaper are now expected to be on a website.

There are also interface elements that are no longer part of the user's mental representation of a website. Among these are elements that allow the user to navigate within a webpage such as a link leading *to the top*. This might be explained by the use of horizontal scrolling or the willingness of users to scroll on websites and new navigation habits. In 2014, advertisements are no longer expected to be on websites. One explanation might be that ads are undesired and were therefore not selected. Moreover, *FAQs* are not expected to be found on any of the website types. One reason might be that users find other ways such as search engines, social networks or specialized knowledge sites to find answers to their questions.

With regard to users' expectations about the concrete location of elements on websites, we were able to observe some changes between 2007 and 2014, but only for a couple of elements. We infer from this that users' mental representations of websites are relatively stable over time. The location for most core interface elements (such as *main content, logo, and search*) remained unchanged; however, the location for other elements (such as *contact and help*) has changed towards the bottom of the page. In a similar study, Shaikh et al. (2006) compared users' mental representations of websites between 2001 and 2006. They observed changes in location expectation for *internal links* (i.e., navigation), *search* and *ads*. In our study, however, the expected location for the *navigation area* as well as *search* remained unchanged over time. We could see more consistent location expectations for the *legal information*. Albert et al. (2009) were able to show similar trends for more consistent user expectations for *home*, *search* and the *navigation area* compared to previous results

Our preliminary study about which elements users expect and our main study about the expected location of these interface elements suggest that users' mental representations seem to have included new interface elements that are frequently used in website design and often encountered such as mouse-over navigation and the *rich footer*. This is manifested by an

expansion towards the top right for the *navigation area* and several interface elements now expected to be found at the bottom of the website across website types.

Some of the new elements are very website specific such as *shipping costs* but were nonetheless placed by a substantial number of users. One explanation could be that there are some leading websites (like Amazon for online shops) for each website type. These sites are frequently visited by users and if these major websites introduce certain new web design elements, the user's mental representation of this specific website type is affected by elements encountered on this prototypical site.

5.1. Limitations

As with empirical studies, there are certain limitations to our study, which we would like to point out in the following. First, we know that assessing users' expectations is a challenge. One drawback of the online survey used is that one cannot ask participants about why they placed interface elements in a certain location. Furthermore, asking participants to sketch a prototypical website can result in users drawing how they imagine a website or how they would wish an ideal website to be (Volkamer & Renaud, 2013).

Second, the generalizability of our results is to a certain extent limited by the focus on three website types only. As more and more diverse social network sites appear in the top websites, it would be interesting to see whether a representation of a prototypical social network website has formed in the minds of the users.

Third, we recruited the participants of our studies using a crowdsourcing platform. This might have had an effect on the participants' motivation and demographical distribution such as education, and web experience in general compared to other recruiting channels. However, Weinberg, Freese, and McElhattan (2014) compared data of panels and crowdsourcing platforms and were able to show that the data quality is even better when using crowdsourcing. Finally, to compare our results to previous studies (Bernard, 2001a, 2003; Bernard & Sheshadri, 2004; Roth et al., 2010) we only allowed participants to complete the study on a desktop computer or notebook. This means that we excluded mobile devices. This clearly is a limitation as we cannot make statements about users' expectations of the three website types in their mobile version. To the authors' knowledge, no study has been conducted to show the expected location of interface elements on the small screens of mobile phones or tablets using some kind of drawing approach. Study results have shown a positive influence of the agreement with users' mental models about a smartphone on perceived usefulness and ease of use (Jung & Yim, 2015) and it would be interesting to see whether

there are mental models for the layout of interfaces on mobile or tablet screens and how these trends are influenced by the guidelines of the most common operating systems.

5.2. Conclusion and future research

As more and more companies rely on their Internet presence and the success of many e-commerce websites depends on their users being able to get along with their website, it is necessary to understand what users expect from specific types of websites. Consequently, the goal of this paper was to assess interface elements users expect to find on different types of websites (1), where Internet users would expect these interface elements to be placed (2) and to show similarities and differences to previous studies (3).

This paper makes a contribution in terms of highlighting the dynamic and stable elements in the users' current prototypical mental representations over time. We compared our current results to previous results of 2007 and these results suggest that, overall, users' mental representation of a typical online shop, news website and company page has remained stable over time. However, an interplay of trends in website design, technological developments, and the adaptation of users' mental representations of websites has taken place. We were able to show that new elements such as a *rich footer* and *mobile versions* of the website and interface elements such as links to *social networks* or *wish lists* are now part of users' mental representations of a prototypical website.

Our results suggest that website designers creating websites to meet users' expectations should still adhere to design conventions that have been established because Internet users seem to adapt to these conventions. The contour maps, together with the aggregated blueprint model, can support designers during the development process by showing where to place certain new interface elements to meet the users' needs and expectations.

To get a better understanding of the dynamics of mental representations of websites, it would be interesting to investigate which websites influence users most; for instance, whether design changes in a popular website have a stronger impact on users' expectations than changes in less popular ones. And regarding the increasing internationalization of websites, cultural differences should be closely examined. Furthermore, we believe that the influence of interfaces with prototypical or non-prototypical layouts on different long-term behavioral outcomes (such overall customer satisfaction, willingness to buy products, and customer loyalty and therefore its impact a company's success) should be investigated with additional studies.

References

Adkisson, H. P. (2002). Identifying de-facto standards for e-commerce web sites. In *Professional Communication Conference, 2002. IPCC 2002. Proceedings. IEEE International* (pp. 22–45). IEEE.

Albert, D., Mast, M., & Burmester, M. (2009). Nutzererwartungen zur Position von Interface-Elementen auf Webseiten im internationalen Vergleich. In *Berichtband des siebten Workshops des German Chapters der Usability Professionals Association eV* (pp. 92–95). Stuttgart: Fraunhofer.

Alexa. (2013, January 3). Alexa - The Web Information Company. Top sites by countries. Retrieved from http://www.alexa.com/topsites/countries

Auinger, A., Aistleithner, A., Kindermann, H., & Holzinger, A. (2011). Conformity with User Expectations on the Web: Are There Cultural Differences for Design Principles? In A. Marcus (Ed.), *Design, User Experience, and Usability. Theory, Methods, Tools and Practice* (pp. 3–12). Springer Berlin Heidelberg.

Baharum, A., & Jaafar, A. (2013a). Generation Y Expectations for the Location of Web Objects. Retrieved from http://www.aicit.org/JDCTA/ppl/JDCTA3644PPL.pdf

Baharum, A., & Jaafar, A. (2013b). Users' Expectation of Web Objects Location: Case Study of ASEAN Countries. In H. B. Zaman, P. Robinson, P. Olivier, T. K. Shih, & S. Velastin (Eds.), *Advances in Visual Informatics* (pp. 383–395). Springer International Publishing.

Baharum, A., & Jaafar, A. (2014). Generation Y Expectations for the Location of Web Objects. *International Journal of Digital Content Technology and Its Applications*, *8*(2), 81–89.

Bernard, M. L. (2001a). Developing Schemas for the Location of Common Web Objects. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *45*(15), 1161–1165. http://doi.org/10.1177/154193120104501502

Bernard, M. L. (2001b). User expectations for the location of web objects (p. 171). ACM Press. http://doi.org/10.1145/634067.634171

Bernard, M. L. (2003). Examining User Expectations for the Location of Common E-Commerce Web Objects. *Proceedings of the Human Factors and Ergonomics Society Annual Meeting*, *47*(11), 1356–1360. http://doi.org/10.1177/154193120304701108

Bernard, M. L., & Sheshadri, A. (2004). Preliminary examination of global expectations of users' mental models for e-commerce web layouts. *Usability News*, *6*(2). Retrieved from http://psychology.wichita.edu/surl/usabilitynews/62/web_object_international.asp

Bhattacherjee, A. (2001). Understanding Information Systems Continuance: An Expectation-Confirmation Model. *MIS Quarterly*, *25*(3), 351–370. http://doi.org/10.2307/3250921

Cassidy, L., & Hamilton, J. (2014). Location of Service Industry Web Objects: developing a standard. ACIS. Retrieved from http://aut.researchgateway.ac.nz/handle/10292/8015

Craik, K. (1943). *The Nature of Explanation*. *C*ambridge: Cambridge University Press.

Cyr, D. (2014). Return visits: a review of how Web site design can engender visitor loyalty. *Journal of Information Technology*, *29*(1), 1–26. http://doi.org/10.1057/jit.2013.25

Davidson, M. J., Dove, L., & Weltz, J. (1999). *Mental models and usability.* Technical Report, Depaul University, Chicago.
Retrieved from http://www.lauradove.info/reports/mental%20models.htm

Dinet, J., & Kitajima, M. (2011). "Draw Me the Web": Impact of Mental Model of the Web on Information Search Performance of Young Users. In *23rd French Speaking Conference on Human-Computer Interaction* (pp. 3:1–3:7). New York, NY, USA: ACM. http://doi.org/10.1145/2044354.2044358

Di Nocera, F., Capponi, C., & Ferlazzo, F. (2004). Finding Geometrical Associations Between Meaningful Objects in the Web: A Geostatistical Approach. *PsychNology Journal*, *2*(1), 84–98.

Dörr, G., Seel, N. M., & Strittmatter, P. (1986). Mentale Modelle: Alter Wein in neuen Schläuchen. *Unterrichtswissenschaft*, *2*, 168–189.

Flavián, C., Guinalíu, M., & Gurrea, R. (2006). The role played by perceived usability, satisfaction and consumer trust on website loyalty. *Information & Management*, *43*(1), 1–14. http://doi.org/10.1016/j.im.2005.01.002

Fraßeck, L. (2014). Chameleon 0.6: mental modelling software. Retrieved from https://mmi.psycho.unibas.ch/tools/

Gentner, D., & Stevens, A. (1983). *Mental models*. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Gerrikagoitia, J. K., Castander, I., Rebón, F., & Alzua-Sorzabal, A. (2015). New Trends of Intelligent E-marketing Based on Web Mining for E-shops. *Procedia - Social and Behavioral Sciences*, *175*, 75–83. http://doi.org/10.1016/j.sbspro.2015.01.1176

Google Closure Library. (2014). Rect (Closure Library API Documentation - Java Script). Retrieved from http://docs.closure-library.googlecode.com/git/class_goog_math_Rect.html

Hanke, U. (2006). *Externale Modellbildung als Hilfe bei der Informationsverarbeitung und beim Lernen*. Universitätsbibliothek Freiburg.

Harinarayana, N. S., & others. (2011). Identifying the Location of Web Objects: A Study of Library Web Sites. Retrieved from http://ir.inflibnet.ac.in/handle/1944/1597

Holman, L. (2011). Millennial Students' Mental Models of Search: Implications for Academic Librarians and Database Developers. *The Journal of Academic Librarianship*, *37*(1), 19–27. http://doi.org/10.1016/j.acalib.2010.10.003

Huang, Z., & Benyoucef, M. (2013). From e-commerce to social commerce: A close look at design features. *Electronic Commerce Research and Applications*, *12*(4), 246–259. http://doi.org/10.1016/j.elerap.2012.12.003

IBM Corp. (2012). *IBM SPSS Statistics for Mac, Version 21.0* [Mac]. EN, Armonk, NY: IBM Corp.

International Organization for Standardization. (1998). ISO 9241-11 *Ergonomic requirements for office work with visual display terminal (VDT's)–Part 11: Guidance on usability*. International Standardization Organization (ISO), Geneva, Switzerland.

Johnson-Laird, P. N. (1983). *Mental Models: Towards a Cognitive Science of Language, Inference, and Consciousness*. Cambridge, MA, USA: Harvard University Press.

Jonassen, D. H., & Henning, P. (1996). Mental Models: Knowledge in the Head and Knowledge in the World. In *Proceedings of the 1996 International Conference on Learning Sciences* (pp. 433–438). Evanston, Illinois: International Society of the Learning Sciences. Retrieved from http://dl.acm.org/citation.cfm?id=1161135.1161198

Jung, W., & Yim, H. R. (2015). *The Effects of Mental Model on the Variables in the Technology Acceptance Model.*
Retrieved from http://www.sersc.org/journals/IJMUE/vol10_no3_2015/17.pdf

Kim, H., & Fesenmaier, D. R. (2008). Persuasive design of destination web sites: An analysis of first impression. *Journal of Travel Research*, *47*(1), 3–13.

Linxen, S., Heinz, S., Müller, L. J., Tuch, A. N., & Opwis, K. (2014). Mental Models for Web Objects in Different Cultural Settings. In *CHI '14 Extended Abstracts on Human Factors in Computing Systems* (pp. 2557–2562). New York, NY, USA: ACM. http://doi.org/10.1145/2559206.2581209

Lynch, P. J., & Horton, S. (2008). Web style guide: Basic design principles for creating Web sites. Yale University Press.

McCarthy, J. D., Sasse, M. A., & Riegelsberger, J. (2004). Could I have the Menu Please? An Eye Tracking Study of Design Conventions. In E. O. B. MSc, P. Palanque, & P. J. BSc (Eds.), *People and Computers XVII — Designing for Society* (pp. 401–414). Springer London.

Mlilo, S., & Thatcher, A. (2011). Mental Models: Have Users' Mental Models of Web Search Engines Improved in the Last Ten Years? In D. Harris (Ed.), *Engineering Psychology and Cognitive Ergonomics* (pp. 243–253). Springer Berlin Heidelberg.

Nadkarni, S., & Gupta, R. (2007). A Task-based Model of Perceived Website Complexity. *MIS Q.*, *31*(3), 501–524.

Naughton, R., & Agosto, D. E. (2012). Favorite websites: Understanding prior knowledge of teens' mental models of public library websites for teens. *Proceedings of the American Society for Information Science and Technology*, *49*(1), 1–11. http://doi.org/10.1002/meet.14504901109

Neisser, U. (1976). *Cognition and reality: Principles and implications of cognitive psychology* (Vol. xiii). New York, NY, US: W H Freeman/Times Books/ Henry Holt & Co.

Nielsen, J. (1999). *Designing Web Usability: The Practice of Simplicity*. Thousand Oaks, CA, USA: New Riders Publishing.

Norman, D. A. (1983). Some observations on mental models. In *Mental models* (Vol. 1, pp. 7–14). Hillsdale, NJ, USA: L. Erlbaum Associates Inc.

O'Reilly, T., & Battelle, J. (2009). *Web Squared: Web 2.0 Five Years On*. O'Reilly Media, Inc.

Oulasvirta, A., Kärkkäinen, L., & Laarni, J. (2005). Expectations and memory in link search. *Computers in Human Behavior*, *21*(5), 773–789.

Owens, J. W. (2013). Getting the gist of websites: Exploring the effects of display duration, size, and resolution. Retrieved from http://soar.wichita.edu/dspace/handle/10057/6728

Owens, J. W., Palmer, E. M., & Chaparro, B. S. (2014). The pervasiveness of text advertising blindness. *Journal of Usability Studies*, *9*(2), 51–69.

Palmer, J. (2002). Designing for Web site usability. *Computer*, *35*(7), 102–103. http://doi.org/10.1109/MC.2002.1016906

Purwati, Y. (2011). Standard Features of E-commerce User Interface for the Web. *Journal of Arts, Science & Commerce*, *2*(3), 77–87.

Qian, X., Yang, Y., & Gong, Y. (2011). The Art of Metaphor: A Method for Interface Design Based on Mental Models. In *Proceedings of the 10th International Conference on Virtual Reality Continuum and Its Applications in Industry* (pp. 171–178). New York, NY, USA: ACM. http://doi.org/10.1145/2087756.2087780

Rapp, D. N. (2005). Mental models: Theoretical issues for visualizations in science education. In *Visualization in science education* (pp. 43–60). Springer. Retrieved from http://link.springer.com/chapter/10.1007/1-4020-3613-2_4

R Core Team. (2014). R: A language and environment for statistical computing. R Foundation for Statistical Computing. Vienna, Austria. Retrieved from http://www.R-project.org/

Roth, S. P., Schmutz, P., Pauwels, S. L., Bargas-Avila, J. A., & Opwis, K. (2010). Mental Models for Web Objects: Where Do Users Expect to Find the Most Frequent Objects in Online Shops, News Portals, and Company Web Pages? *Interact. Comput.*, *22*(2), 140–152. http://doi.org/10.1016/j.intcom.2009.10.004

Roth, S. P., Tuch, A. N., Mekler, E. D., Bargas-Avila, J. A., & Opwis, K. (2013). Location Matters, Especially for Non-salient features-An Eye-tracking Study on the Effects of Web Object Placement on Different Types of Websites. *International Journal of Human-Computer Studies*, *71*(3), 228–235. http://doi.org/10.1016/j.ijhcs.2012.09.001

Santa-Maria, L., & Dyson, M. C. (2008). The Effect of Violating Visual Conventions of a Website on User Performance and Disorientation: How Bad Can It Be? In *Proceedings of the 26th Annual ACM International Conference on Design of Communication* (pp. 47–54). New York, NY, USA: ACM. http://doi.org/10.1145/1456536.1456547

Seel, N. M., & Hanke, U. (2015). Allgemeine Pädagogik: Grundlagen der Erziehungswissenschaft. In *Erziehungswissenschaft* (pp. 1–155).

Shaikh, A. D., Chaparro, B. S., & Joshi, A. (2006). Indian Users' Expectations for the Location of Web Objects on Informational Websites. In *Proceedings of the Human Factors and Ergonomics Society Annual Meeting* (Vol. 50, pp. 1922–1926). SAGE Publications. Retrieved from http://pro.sagepub.com/content/50/17/1922.short

Shaikh, A. D., & Lenz, K. (2006). Where's the search? Re-examining user expectations of web objects. *Usability News*, *8*(1). Retrieved from http://psychology.wichita.edu/surl/usabilitynews/81/pdf/Usability%20News%2081%20-%20Shaikh2.pdf

Soper, D. S., & Mitra, S. (2013). An Inquiry into Mental Models of Web Interface Design. Retrieved from http://aisel.aisnet.org/amcis2013/HumanComputerInteraction/GeneralPresentations/1/

Statista, T. chart illustrates that the majority of people across all world regions thinks that affordable internet access should be a basic human. (2013, November 12). Online Demographics & Use - Statistics and market Data. Retrieved March 21, 2015, from http://www.statista.com/chart/1709/most-used-website-categories/

Suresh, K., & Gopalakrishnan, S. (2012). Content Organization in Websites of Agricultural Universities in India: A Web Analytic Study. Retrieved from http://digitalcommons.unl.edu/libphilprac/817/

Tess, P. A. (2013). The role of social media in higher education classes (real and virtual) – A literature review. *Computers in Human Behavior*, *29*(5), A60–A68. http://doi.org/10.1016/j.chb.2012.12.032

Thatcher, A. (2008). Web search strategies: The influence of Web experience and task type. *Information Processing & Management*, *44*(3), 1308–1329. http://doi.org/10.1016/j.ipm.2007.09.004

The jQuery Foundation. (2014). jQuery. Retrieved from http://jquery.com/

Vasantha, R. N., & Harinarayana, N. S. (2011). Identifying the Location of Web Objects: A Study of Library Websites. *8th International Caliber*, 28–39.

Venables, W. N., & Ripley, B. D. (2002). *Modern applied statistics with S*. Springer Science & Business Media.

Volkamer, M., & Renaud, K. (2013). Mental Models – General Introduction and Review of Their Application to Human-Centred Security. In M. Fischlin & S. Katzenbeisser (Eds.), *Number Theory and Cryptography* (pp. 255–280). Springer Berlin Heidelberg.

Weinberg, J. D., Freese, J., & McElhattan, D. (2014). Comparing data characteristics and results of an online factorial survey between a population-based and a crowdsource-recruited sample. *Sociological Science*, *1*, 292–310.

Wickham, H. (2009). *ggplot2*. New York, NY: Springer New York. Retrieved from http://link.springer.com/10.1007/978-0-387-98141-3

Xiang, Z., Wang, D., O'Leary, J. T., & Fesenmaier, D. R. (2014). Adapting to the Internet: Trends in Travelers' Use of the Web for Trip Planning. *Journal of Travel Research*. http://doi.org/10.1177/0047287514522883

Zhang, Y. (2013). The development of users' mental models of MedlinePlus in information searching. *Library & Information Science Research*, *35*(2), 159–170. http://doi.org/10.1016/j.lisr.2012.11.004

Trust and distrust on the web: User experiences and website characteristics

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ABSTRACT

The aim of this research is to study the content of trustful and distrustful user experiences on the web to identify website characteristics that enhance trust or cause distrust. We collected users' reports about critical incidents and quantitative questionnaire data by means of an online survey. Results from $N = 221$ participants suggest that distrust is mostly an effect of graphical (e.g., complex layout) and structural (e.g., pop-ups) design issues of a website, whereas trust is based on social factors such as reviews or recommendations by friends. The content of a website affects both trust and distrust: privacy issues had an effect on distrust and security signs enhanced trust. Furthermore, we show how trustful and distrustful user experiences differ in terms of perceived honesty, competence, and benevolence. High honesty and competence characterize a trustful experience, whereas a distrustful experience is associated with missing honesty and missing benevolence. We discuss how different website characteristics help to enhance trust or to prevent distrust and how this impacts the allocation of design resources.

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1. Introduction

Designing for trust in technology-mediated interaction is an increasing concern in human–computer interaction (Riegelsberger, Sasse, & McCarthy, 2005). As the online environment features many possibilities for fraud such as identity theft, credit-card fraud and unfulfilled product promises, users are eager to find out whether a particular website is trustworthy or not. In e-commerce, trust was found to be one of the main factors for customers buying a product or in the event of distrust, aborting the shopping process (Jarvenpaa, Tractinsky, & Saarinen, 1999; Schlosser, White, & Lloyd, 2006). For information websites, judgments about their quality are based on trust in the website (Wathen & Burkell, 2002). Moreover, users' trust is a predictor for the usage of social network sites (Sledgianowski & Kulviwat, 2009) and leads to a higher intention to send and receive information in virtual communities (Ridings, Gefen, & Arinze, 2002).

In the last 15 years, a considerable amount of research has investigated how to increase trust in the online context (see Beldad, De Jong, & Steehouder, 2010). However, comparatively little research has investigated how to prevent distrust. Recent studies suggest that trust and distrust are two distinct constructs and differ qualitatively from each other (e.g., Ou & Sia, 2010). Nonetheless, only a few studies about website characteristics have integrated both trust and distrust in the same empirical research (Andrade, Lopes, & Novais, 2012; Chang & Fang, 2013; Cho, 2006; McKnight & Choudhury, 2006; Ou & Sia, 2010). As Chang and Fang (2013) noted, there is a need for studies that examine whether trust and distrust have different antecedents. It is not clear what web users watch out for when they decide whether a website is trustful or distrustful. Moreover, determining whether trust and distrust are distinct constructs has significant implications for website design and management because different website characteristics may need to be managed in order to enhance trust and to reduce distrust (Ou & Sia, 2010).

To address this gap, the present study aims to simultaneously investigate web trust and distrust by means of the critical incidents technique (Flanagan, 1954) and subjective questionnaire data. We analyze the content of 221 incident reports on trust and distrust obtained from an online study about users' past web experiences. This method enabled us to gain insight into how and why people trust or distrust a website and to gather information about specific website characteristics related to trust and/or distrust. The present research aims to provide new perspectives explaining how the formation of web trust and distrust is significant. We show that web trust and distrust are affected by different antecedents and that trustful and distrustful user experiences differ in terms of

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perceived honesty, competence, and benevolence. Furthermore, we highlight important implications for web designers and managers on how to enhance users' trust or to prevent distrust by optimizing specific website characteristics.

2. Related work

2.1. Trust in an online context

Trust is an essential factor in many kinds of human interactions, allowing people to act under uncertainty and with the risk of negative consequences (Flavián, Guinalíu, & Gurrea, 2006). It also plays a crucial role in human–computer interaction due to the high complexity and anonymity associated with e-commerce, e-banking or information search (Wang & Emurian, 2005). Presently, however, researchers have difficulty in operationalizing what exactly trust is and there exist multiple definitions in the literature. This is likely because trust is an abstract concept and is often used interchangeably with related concepts such as credibility, reliability, or confidence. Thus, to define the term and to delineate the distinction between trust and its related concepts have proven challenging for researchers (e.g., Wang & Emurian, 2005). Moreover, although trust has been widely studied in many disciplines, but each discipline has its own understanding of the concept and different ways to operationalize it. In their review about trust in the context of the online environment, Wang and Emurian (2005) highlighted two characteristics that most definitions have in common. First, there must exist two specific parties in any trusting relationship: a trusting party (trustor) and a party to be trusted (trustee). In online trust, the trustor is typically a user who is browsing a website, and the trustee is the website, or more specifically, the merchant that the website represents. Second, trust involves vulnerability. Trust is only needed, and actually flourishes, in an environment that is uncertain and risky. Users are often uncertain about the current risks and their full consequences when transacting or visiting online websites.

As suggested in the literature, trust is a multidimensional construct (Chen & Dhillon, 2003), consisting of three different facets: benevolence, honesty, and competence (e.g., Casaló & Cisneros, 2008; Casaló, Flavián, & Guinalíu, 2007; Chen & Dhillon, 2003; Flavián et al., 2006). *Benevolence* is related to the user's belief that the other party is interested in his welfare, motivated by a search for a mutually beneficial relationship and without intention of opportunistic behavior (Flavián et al., 2006); namely, that a website is concerned with the present and future interests, desires and needs of its users and gives useful advice and recommendations. *Honesty* is the belief that the other party will keep his or her word, fulfill promises, and be sincere (Doney & Cannon, 1997). For websites, this means that there are no false statements and the information on the site is sincere and honest. In turn, *competence* means that the website has the resources (whether technical, financial, or human) and capabilities needed for the successful completion of the transaction and the continuance of the relationship (Casaló & Cisneros, 2008).

In recent years, a lot of research has been conducted into the importance of trust in an online context. In e-commerce, trust has been shown to have an important positive influence on the intention to buy a product (Bart, Shankar, Sultan, & Urban, 2005; Jarvenpaa et al., 1999; McKnight, Choudhury, & Kacmar, 2002; Schlosser et al., 2006). On social networks, users are more likely to contact friends and to connect with other users if they trust the website (Almadhoun, Dominic, & Woon, 2011). Additionally, people's intentions to share more of their personal information increases if they trust a website (Bart et al., 2005; McKnight et al., 2002).

2.2. Trust and distrust as distinct constructs

Although the extant research on trust has revealed how trust can be built and maintained, the topic of distrust has been relatively neglected. For a long time, researchers viewed trust and distrust as extreme values along the same dimension (Schoorman, Mayer, & Davis, 2007). However, in more recent research it is argued that trust and distrust are not opposite ends on the same conceptual spectrum but actually two distinct constructs that coexist (for an overview see Chang & Fang, 2013). Distrust is defined as unwillingness to become vulnerable to the trustee based on the belief that the trustee will behave in a harmful, neglectful, or incompetent manner (e.g., Benamati, Serva, & Fuller, 2010). As antecedent of this unwillingness, users' generally have negative expectations regarding a website's conduct, characterized as suspicion, wariness and fear of transactions (e.g., Lewicki, McAllister, & Bies, 1998).

The deliberation of trust and distrust can be traced back to ambivalence theories on examining positive-valent and negative-valent attitudinal reactions (Ou & Sia, 2010). Two main arguments have been used to defend this approach (Andrade et al., 2012): (a) distrust may co-exist with high trust at the same time (e.g., McKnight & Choudhury, 2006) and (b) high trust does not necessarily mean low distrust, and the absence of trust is not enough to necessarily create distrust (Lewicki et al., 1998). Furthermore, evidence from neuroscience theories and functional brain-imaging studies have shown that trust and distrust are connected to different cortical regions. Whereas distrust is associated with the amygdala and the right insular cortex, trust is linked to the caudate nucleus and the medial prefrontal cortex (Dimoka, Pavlou, & Davis, 2007).

However, Schoorman et al. (2007) raised concerns about the deliberation of trust and distrust as distinct constructs, arguing that most studies do not account for different attribution factors. The authors concluded that it is possible to experience distrust and high trust at the same time due to attribution factors such as trusting a colleague to do a good job collaborating on a research project but not trusting him/her to do a good job teaching your class in your absence.

To sum up, little is known as to how trust is formed differently in contrast to distrust and to what extent distrust affects behavioral outcomes differently compared with lack of trust (Cho, 2006; Ou & Sia, 2010). However, determining whether trust and distrust are actually two distinct constructs has significant implications for website design and management (Ou & Sia, 2010).

2.3. Facets of trust and distrust

Several authors found that trust and distrust are built up of the same three facets, which are – as discussed above – benevolence, honesty and competence (e.g., Casaló et al., 2007; Cho, 2006). There is little research, however, that has investigated potential differences between the three facets for distrust and trust experiences in the web design context. Cho (2006) conducted a study about business-to-consumer Internet exchange relationships. She identified the benevolence and competence of e-vendors as the two key antecedents of trust and distrust. The results of Cho's study (2006) showed that trust is primarily driven by benevolence whereas distrust is based on a lack of competence.

2.4. Website characteristics

The characteristics of a website are important determinants for web trust (Shankar, Urban, & Sultan, 2002). McKnight et al. (2002) suggest that as a first step, users explore a website before being ready to do transactions. At this initial stage, website

characteristics such as reviews or content quality play a crucial role. But it is still unclear which further website characteristics are relevant for the formation of trust or distrust. Without attempting to identify these characteristics, it is difficult to derive effective and reliable design principles or implications for enhancing users' trust or lowering users' distrust in websites (Wang & Emurian, 2005). A fair amount of research has therefore been carried out on the influence that website characteristics have on trust (e.g., Bart et al., 2005; Ou & Sia, 2010; Wang & Emurian, 2005). For example, brand strength, third-party statements and user friendliness were found to affect web trust (Shankar et al., 2002). But effects on distrust have long been overlooked.

The few studies about the effect of website characteristics on trust and distrust provide a more differentiated view. Regarding trust, Chang and Fang (2013) and Andrade et al. (2012) showed that correct and helpful website information as well as informative customer service (e.g., the possibility to contact a vendor via e-mail) lead to higher trust but have no effect on distrust. This is in line with Ou and Sia (2010), who confirm that customer service leads to higher trust but does not influence distrust. Regarding distrust, Ou and Sia (2010) discovered that the quality of the content, the technical functionality, and similarity to other websites help to eliminate users' distrust. Other characteristics were found to influence trust and distrust, or neither of them. Andrade et al. (2012) found an effect of unpleasant design on trust and on distrust. Elements of social proof such as ratings (e.g., ratings on travel websites) influenced neither trust nor distrust (Ou & Sia, 2010).

For other website characteristics, there exist several discrepancies between different studies. According to Chang and Fang (2013), distrust is lowered if the website is linked to a positive image/brand, although there is no effect on trust. Andrade et al. (2012), however, found the opposite effect (i.e., the brand and the logo of a bank lead to higher trust but have no effect on distrust). Similar discrepancy is found for the easiness to browse the website and privacy policy and security indications (e.g., security symbols by third parties). According to Chang and Fang (2013), these characteristics have no effect on trust or distrust. Ou and Sia (2010), in contrast, found that these three factors contributed to both trust and distrust. And finally, Andrade et al. (2012) concluded that only privacy statements and security signs (such as lock symbols) influence both trust and distrust, but ease of browsing the site only has an effect on trust (but not on distrust).

The above-described studies have two main shortcomings. First, they focused only on website characteristics that were defined in advance and inquired by means of predefined scales. This may lead to a limited conceptualization of trust and distrust as it is not clear whether users care for the predefined characteristics and whether content validity is given for trust as well as for distrust. Second, previous studies only evaluated website characteristics on a limited number of different websites (mostly one or two; e.g., Ou & Sia, 2010) and website types (mostly online shops or online banking sites; Andrade et al., 2012; Benamati, Serva, & Fuller, 2006, 2010; Chang & Fang, 2013; Cho, 2006; McKnight & Choudhury, 2006). In our study, we apply a more holistic approach in the sense that we allow participants to describe personal experiences that led to trust or distrust without restricting them to predefined evaluation criteria or to a specific type of website. By doing so, we expect to get a more detailed and comprehensive description of which website characteristics are important for users and have an influence on trust or distrust.

2.5. Dimensions for website characteristics

Based on a literature review, Wang and Emurian (2005) found four dimensions which incorporated the existing website characteristics that induce trust: (1) The *graphic design* refers to the websites' graphical elements that trigger the users' first impressions. This comprises the overall visual design of a site, including layout, typography, font size, and color schemes used on the page as well as photo quality. (2) The *structure design* refers to accessibility by users to the information displayed on the website and how the website is generally organized. Usability in general and help such as prompts, guides, tutorials, and instructions in particular contribute to a good structure design, whereas broken links, ads and inconsistencies lead to a bad structure design. (3) The *content design* includes informational elements that are placed on the website, either textual or graphical (e.g., correct information or company logo). Furthermore, the use of seals of approval or third-party certificates, a relevant domain name, links to security and privacy policies as well as the use of comprehensive and correct information belong to this dimension. Finally, (4) *social-cue design* refers to social cues that are integrated into the website such as photographs and names of customer service agents, chat and call-back opportunities, and photographs of the company.

2.6. Trust research applying critical incidents technique

A technique becoming increasingly important for trust research is the critical incidents technique (CIT) (Münscher & Kühlmann, 2012). The CIT is a method of gathering facts (incidents) from users of an existing system to gain knowledge of how to improve or maintain the performance. According to Flanagan (1954, p. 338) "an incident is critical if it makes a 'significant' contribution, either positively or negatively to the general aim of the activity." Typically, critical incidents can be gathered by asking respondents to tell a story about an experience they have had. Detailed analysis of critical incidents enables researchers to identify similarities, differences and patterns, and to seek insight into how and why people engage in the activity. Since its introduction by Flanagan (1954), CIT has proven valuable in a number of research disciplines such as education, service marketing and management (for an overview see Münscher & Kühlmann, 2012). Uppvall (2009) showed through the use of the CIT that maintaining trust is a key factor if two parties work together in product development. Moreover, Scarbrough, Swan, Amaeshi, and Briggs (2013) used CIT to explore the role of trust in the deal-making process for early-stage technology ventures and showed that the form of trust changes during the process. To the authors' knowledge, there are no studies on trust or distrust research applying the CIT in HCI. However, as Münscher and Kühlmann (2012) have already noted, a joint look at critical incidents enhancing trust and critical incidents causing distrust can help to give a better understanding of the nature of trust and distrust development.

2.7. Aim of the study and study rationale

The purpose of our study is to gain qualitative data on trustful and distrustful experiences on different types of websites. Moreover, we also aim to supplement these experiences through quantitative data on the facets honesty, benevolence, and competence for all experiences. The rationale behind this approach is to gain insight into how and why people trust or distrust a website and to gather information about specific website characteristics related to trust and/or distrust. Our goal is to investigate whether certain characteristics mainly evoke trust or distrust, or whether there are characteristics that are relevant for trust and distrust or for none of those. We want to outline important implications for web designers and managers on how to enhance users' trust or to prevent distrust by optimizing specific website characteristics.

3. Method

We collected data using a web-based survey containing 27 questions (and further 41 questions for another research project about privacy and security).

3.1. Design

A between-subject design was used for this study. The independent variable was the quality of the reported experience (trustful vs. distrustful). Approximately half of the participants ($n = 103$) were asked to describe an incident where they had felt exceptionally trustful about using a website, the other half ($n = 118$) were asked to report on an incident where they had felt exceptionally distrustful about using a website.

3.2. Questions

The questionnaire applied the critical incidents technique (Flanagan, 1954) by beginning with the key item, which was an open-ended question. The aim of the question was to receive descriptions of trustful and distrustful web experiences:

"Please think of an occasion where you felt exceptionally distrustful using a website, for example with an information site, a social network or an online shop. Think of distrustful in whatever way makes sense to you. Please try to describe your experience as accurately and detailed as you remember it."

For the group that had to describe a trustful user experience, the description was changed slightly by changing the word "distrustful" to "trustful". Questions about online user trust/distrust were the same as used by Casaló et al. (2007) and Flavián et al. (2006). Questions about the disposition to trust were taken from McKnight et al. (2002). When answering these questions, participants were reminded to think of the critical incident. See Table 1 for detailed information about the questions.

3.3. Participants

All participants were recruited via Amazon Mechanical Turk. In total, 367 participants started the study and 254 completed it. Out of these 254, we did not accept the answers of 11 participants because they described a distrustful incident instead of a trustful incident; another 10 participants were excluded because they did not refer to a specific incident. A further 12 participants had to be excluded because they described the experiences too vaguely, reducing the acceptable answers to 221 (49% female, 51% male). All participants were from the U.S.A. The mean age was 29.4 years ($SD = 9.1$; range: 18–62). All participants use the Internet daily and in average for 13.6 years ($SD = 3.9$; range: 2–21).

3.4. Procedure

Participants were directed from Amazon Mechanical Turk to an external questionnaire. All questions, except one on the participants' age, were mandatory. For ratings of honesty, benevolence, and competence, participants had the possibility of answering "I don't know". The order of the questions is shown in Table 1. On average, completing the questionnaire took 18.5 min (for the full questionnaire).

3.5. Data preparation, content and context analysis

The primary goal of the data preparation was to extract the key website characteristic from the critical incidents that led to a trustful or a distrustful experience. To categorize the critical incidents' website characteristics, an affinity-diagramming workshop was organized (also known as KJ method, see Scupin, 1997). An affinity diagram is an organizing tool used to locate similar facts, arguments, or other information together. The rationale behind this technique is to reduce problems of variety and complexity by categorizing information according to higher-level abstract concepts (Beyer & Holtzblatt, 1999). This technique enabled us to focus on the website characteristics mentioned in each incident.

The process during the workshop consisted of the following six steps: First (1), each story was printed on a notecard and four researchers individually grouped the incidents based on the similarity in regard to the mentioned website characteristics. Researchers were told to focus on the website characteristic that was most crucial for causing trust (or distrust). The grouping was done separately for trustful and distrustful experiences, as previous studies have shown that trust and distrust could have different antecedents. To avoid overlooking these characteristics, we did not merge trust and distrust reports in this first step. Then (2), we combined the individual groupings of all researchers, again separately for trust and distrust. If not all researchers agreed on the allocation of an incident to a group, we put this incident aside and discussed it at a later step. In total, 17.4% of all trust incidents and 17.8% of all distrust incidents were sorted out for later discussion.

Most incidents described concrete website characteristics that either awoke the users' distrust or caused trust. However, there were some incidents on trustful experiences that mentioned prior experiences with this site as the only reason. Other incidents described how recommendations from friends influenced their trust in a website; however, this happened mostly not on the actual website but on a social media network. These incidents stand out from the other incidents, but we could not find any reference to another website characteristic. Therefore, we defined one separate group for prior experiences. Incidents concerning recommendation from friends were merged with incidents of recommendations from other users (website characteristics such as user ratings and reviews). Then (3) all incidents where the researchers had not agreed on a grouping were discussed until consensus was reached and the incident could be assigned to one of the existing groups. At the end of this step, 13 different groups of distrust and 11 different groups of trust incidents emerged.

Next (4), the 24 different distrust and trust groups were compared. Researchers looked at the different distrust groups and wrote down keywords that characterize each group (see definitions in Table 2). Then, the same was done for the trust groups. Based on the similarity of the keywords, the researchers merged groups from the distrust and the trust condition (e.g., group with incidents about a good usability and a group with bad usability incidents). With this procedure, we managed to merge five trust groups with five distrust groups, representing the following website characteristics: *visual design*, *usability*, *security signs*, *privacy* and *social proof*.

Then (5) we looked at the remaining 14 groups (eight for distrust, six for trust). Three distrust and three trust groups did not have as strong a connection as the groups defined in step 4 but were described with related keywords. These groups were merged and got rather broad titles: *image/brand*, *expertise*, *customer service*. Five groups of distrust incidents were not mixable with any trust groups. For these distrust groups, the following titles were defined: *pop-ups/ads*, *demands*, *web address*, *content*, *implausible promises*. Finally, three trust groups were not mixable with any distrust group: *policy*, *real-world link*, *prior experience*.

We chose this bottom-up approach described so far because there is little research on distrust characteristics. By applying this approach, we wanted to ensure that we considered the characteristics that are important for the users; we did not want to just

Table 1
Questions used in the survey.

Order of Questions

Critical Incident (Trustful or Distrustful Web Experiences)
 Open-ended (text field) critical incident question: "Please think of an occasion where you felt exceptionally trustful (distrustful) using a website"

Context of the Critical Incident
 3 questions about the context of the experience
  (1) How long ago did the event take place?
  (2) Into what category does the website of your event fall?
  (3) How often did you visit the website before the event occurred?

Honesty (Casaló et al., 2007)
 5 questions answered as "strongly disagree"(1) to "strongly agree" (7);
  (1) I think that this website usually fulfills the commitments it assumes
  (2) I think that the information offered by this site is sincere and honest
  (3) I think I can have confidence in the promises that this website makes
  (4) This website does not make false statements
  (5) This website is characterized by the frankness and clarity of the services that it offers to the consumer

Benevolence (Casaló et al., 2007)
 6 questions answered as "strongly disagree"(1) to "strongly agree" (7);
  (1) I think that the advice and recommendations given on this website are made in search of mutual benefit
  (2) I think that this website is concerned with the present and future interests of its users
  (3) I think that this website takes into account the repercussions that their actions could have on the consumer
  (4) I think that this website would not do anything intentional that would prejudice the user
  (5) I think that the design and commercial offer of this website take into account the desires and needs of its users
  (6) I think that this website is receptive to the needs of its users

Competence (Casaló et al., 2007)
 4 questions answered as "strongly disagree"(1) to "strongly agree" (7);
  (1) I think that this website has the necessary abilities to carry out its work
  (2) I think that this website has sufficient experience in the marketing of the products and services that it offers
  (3) I think that this website has the necessary resources to successfully carry out its activities
  (4) I think that this website knows its users well enough to offer them products and services adapted to their needs

Disposition Trusting Stance (McKnight et al., 2002)
 Three questions answered as "strongly disagree" (1) to "strongly agree" (7);
  (1) I usually trust people until they give me a reason not to trust them
  (2) I generally give people the benefit of the doubt when I first meet them
  (3) My typical approach is to trust new acquaintances until they prove I should not trust them

Online Experience and Personal Background
 Two questions about web usage and 3 demographic questions;
  (1) How long have you been using the Internet?
  (2) How many hours a week do you spend online (work and leisure time)?
  (3) How old are you?
  (4) Please indicate you gender
  (5) What country do you live in?

adopt a predefined list of website characteristics from prior research. This approach allowed us to identify 16 website characteristics. However, there were two groups – *privacy* and *social proof* – that all researchers judged as too heterogeneous. Therefore, in a next step (6), we decided to include a top-down step and evaluated whether previous research could provide a more detailed subdivision of these two groups. Culnan and Armstrong (1999) present a useful privacy classification; they differentiate between *privacy secondary use* and *privacy collection* (see Table 2 for a precise definition). We applied this differentiation for our *privacy* group. Fuller, Serva, and Benamati (2007) provided a framework about social proof characteristics that differentiate between *friends' social proof* and *users' social proof* (see Table 2), which we used to refine our *social proof* group. For our remaining groups, there was no indication from literature to split them further. The whole process from step one to step six resulted in 18 different website characteristics (see Table 2 for an overview).

3.5.1. Classification of website characteristics to superior trust and distrust dimensions

As the final step, the 18 website characteristics were grouped by the classification from Wang and Emurian (2005). They argue that website characteristics for trust can be described with four dimensions: *graphic design*, s*tructure design, content design* and *social-cue*

design. Three researchers independently assigned each of the 18 website characteristics to one dimensions in the framework from Wang and Emurian (2005). An interrater agreement of $\kappa_{\text{Fleiss}} = 0.588$ $(z = 7.85, \ p < .01)$ was achieved, indicating an intermediate to good agreement between all three researchers. The grouping worked well for all but three of the 18 characteristics. These three characteristics did not target the design of the website but (1) prior experience with a website, (2) social proof from other users, and (3) social proof from friends. Therefore a new dimension was defined, which was called "personal and social proof". The five final dimensions and the corresponding characteristics are presented in the results section.

3.5.2. Content of the experiences

Most descriptions of the participants' web experiences not only contained evaluative statements about the site but also included narrative elements such as information about the context, the users' motivation to use the website, and their main action. In general, the structure of the incidents was similar to previous research on self-reported user experiences (Tuch, Trusell, & Hornbæk, 2013). This is an example for a distrustful experience:

"I had to ride in an ambulance to a hospital. They sent me a bill and gave me a website where I could pay online if I wanted to. The website looked weird because it was a .info and I had never been to a

Table 2
Final 18 website characteristics mentioned in trust and/or distrust experiences with anonymized examples.

Website characteristics	Definition	Example of an experience	N
Visual design	Use of colors, site layout, layout complexity, photographs	"When I visited their site it looked very cheaply put together and the overall appearance of the site and products made me not feel safe shopping there."	31
Security signs	Security aspects such as passwords, authentication questions or the version of communication protocol	"When I log in to my bank account, and it uses a secure connection as well as requires me to have a personalized key, so I feel secure."	26
Privacy: secondary use	Users' fears that their information might be used for another reason than what it was collected for	"When I learned that the social media website sells information to people."	18
Usability	Effectiveness and efficacy with the task flow, site navigation, links	"None of the coupon codes were working and a lot of items were out of stock or mismatched. The links were broken and the images were not showing up."	17
Pop-ups/ads	Pop-ups and visual or audio ads	"As soon as I get to the site, I get pop ups, sounds and other annoying sensory garbage that distract me. I felt as if the site wanted to manipulate me."	15
Privacy: collection	Users' concern that data could be collected by the website operator	"Although the sight is probably legitimate, it asked for me to enter information such as my XY sign on and password which I would not like to share with any company."	15
Implausible promises	Promises the participants felt could not be kept by website operators	"I started looking and comparing their computers to name brand computers and just couldn't believe how good the deals were. but in the end I didn't buy from them because I just couldn't trust a site with deals like that."	15
Users' social proof	User ratings and reviews	"The many good reviews with almost no bad reviews made me feel very trustful of the website."	13
Customer service	Availability of customer service agents, provision of service to customers after a purchase	"Whenever I buy from XY, I know I can trust them because their customer service is forgiving and very well put together. If a package is broken, they'll take my word for it and send a new one."	13
Image/Brand	Image or brand of the website operator	"Of course, XY has a massive reputation. If they weren't as well known, I would probably have been more hesitant to give out the information they needed."	12
Expertise	Competence and professional knowledge	"The seller was very thorough in their explanation of the product and how it works, as well as why it is more reasonable to purchase this way, as opposed to paying for the same amount of less medication."	8
Prior experience	Previous experience of the user on the same site	"I feel company XY is a completely trustful website, I have never had any issues with it."	8
Content	Credibility of information, correct and up-to-date information	"The news I got from XY about Z turned out to be based on false speculations."	7
Friends' social proof	Recommendations given by colleagues, friends and family members	"My friends and family did not report an unpleasant experience with company XY, so I began to trust the site with my personal information."	7
Demands	Demands to share a link, download a piece of software or create an account to get access to a website or a service	"Then the site seemed suspicious, as I had to answer multiple questions before I could reach any kind of main page for the website."	6
Web address	Domain name or website name	"The website looked weird because it was a .info and I had never been to a website with that extension before."	4
Policy	Policy, general terms and conditions	"They have a protection policy that convinced me."	4
Real-world link	A link to the life of the website owner or a link to the real world such as a shop	"So when I went to their website and found similar information set up in the same basic format as the magazine I knew it was a legitimate site and trusted it implicitly."	2

website with that extension before. I decided to proceed anyway but I was very wary. After double checking it was supposed to be the right website. It had three links and that was to pay a bill or ask a question or submit information I think. I decided to take the risk and submitted an online payment and my insurance information. The website ended up being legit but the whole thing was very strange to me."

And this is an example for a trustful experience:

"XY.com is a web host that has gotten a lot of good reviews from the tech community. I searched for reviews in forums, which I find to be much more reliable than other channels. The many good reviews with almost no bad reviews made me feel very trustful of the website. Especially because I assume the people on forums have no incentive to oversell the site, and generally the tech community is very savvy when it comes to judging the quality of a web service."

On average participants used 85 words to describe their experience. For the trustful web experiences, fewer words (77 words) were used than for the description of the distrustful experiences (92 words).

3.5.3. Context of the experiences

Twenty percent of all incidental experiences had happened within the previous week, 16% between one week and one month, 14% between one and three months, 28% between three months and one year, 21% happened between one and five years, and 3% happened more than five years ago.

We also looked at the different website types (information site, e-commerce, entertainment, finance/e-banking, social media, others) that were described in the experiences. We could not find any significant difference between the different website types, ($\chi^2 = 7.57$, $p = .181$). See Table 3 for descriptive data.

4. Results

We begin this section by (1) presenting a short overview of the frequencies of experiences in each dimension separately for trust and distrust. In the second part of this section (2), we describe each of the five dimensions and their corresponding website characteristics that emerged from our affinity diagramming. Doing so, we provide concrete starting points for how to enhance trust and prevent distrust. Further (3), we analyze how often participants visited the website before the critical incident occurred. In the last part (4), we compare the questionnaire ratings for trust and distrust facets to further investigate the differences between trust and distrust.

4.1. Dimensions of website characteristics

The 18 website characteristics could be subordinated into the four design dimensions described by Wang and Emurian (2005) and into the additional dimension "personal and social proof"

Table 3
Number and percentage of distrust and trust experiences for different website types.

Website type	Examples	Distrust N (%)	Trust N (%)
Information site	Sport, travel, health, news	20 (16.9)	13 (12.6)
E-Commerce	Clothing, electronics, jewelry	44 (37.3)	49 (47.6)
Entertainment	Movie/video sites, online gaming, music streaming	14 (11.9)	5 (4.9)
Finance/e-banking	Banking websites, online money transfer services	11 (9.3)	15 (14.6)
Social media	Facebook, Twitter	19 (16.1)	16 (15.5)
Others	Surveys, work tasks	10 (8.5)	5 (4.9)
Total		118 (100)	103 (100)

(see Table 4). The most frequent descriptions of distrustful experiences focused on content design (51.7%) followed by structure design (23.7%), and graphic design (20.3%). The more frequently a dimension is mentioned, the more frequently these distrust incidents happen on the web.

In contrast, the most frequent trustful web experiences were about content design (46.6%), personal and social proof (26.2%), social-cue design (10.7%), and structure design (9.7%). To further analyze whether there was a significant difference in the frequencies of experiences, we conducted a chi-square test. Results showed that distrustful and trustful experiences significantly differ in regard to the five dimensions of website characteristics, ($\chi^2 = 46.00$; $p < .001$), indicating that different characteristics are important for trust and for distrust.

4.1.1. Graphic design

The dimension graphic design consists of a single website characteristic that we called visual design. Experiences concerning this characteristic described the use of colors, the layout of the site such as the complexity or the balance, and the use of photographs and pictures. A typical incident of a distrustful experience is "*The whole site was poorly designed, with a static background and clashing colors.*" An example for a trustful experience is the following: "*I felt comfortable because of how professional, clean and well-designed the manufacturer's site was. The pictures were crisp and clear.*"

Descriptive data show that this dimension is frequently mentioned in distrust experiences, but not in trust experiences. To analyze whether this dimension is significantly more important for

Table 4
Number and percentage of website characteristics and their corresponding dimension mentioned in distrust and trust experiences.

Dimensions/website characteristics	Distrust N (%)	Trust N (%)
Graphic design	*24 (20.3)*	*7 (6.8)*
Visual design	24 (20.3)	7 (6.8)
Structure design	*28 (23.7)*	*10 (9.7)*
Usability	7 (5.9)	10 (9.7)
Pop-ups/ads	15 (12.7)	
Demands	6 (5.1)	
Content design	*61 (51.7)*	*48 (46.6)*
Security signs	4 (3.4)	22 (21.4)
Image/brand	1 (0.8)	11 (10.7)
Expertise	2 (1.7)	6 (5.8)
Privacy: collection	13 (11.0)	2 (1.9)
Privacy: secondary Use	15 (12.7)	3 (2.9)
Content	7 (5.9)	
Web address	4 (3.4)	
Implausible promises	15 (12.7)	
Policy		4 (3.9)
Social-cue design	*4 (3.4)*	*11 (10.7)*
Customer service	4 (3.4)	9 (8.7)
Real-world link		2 (1.9)
Personal and social proof	*1 (0.8)*	*27 (26.2)*
Users' social proof	1 (0.8)	12 (11.7)
Friends' social proof		7 (6.8)
Prior experience		8 (7.8)

causing distrust than for enhancing trust, we conducted a configural frequency analysis with Eye (Grüner, 2008). This test is able to detect patterns in the data that occur significantly more or less often than expected by chance. Results showed that there is a significant difference between expected and effective frequency for "graphic design" for distrust ($z = 1.90$, $p = .028$) as well as trust ($z = 2.03$, $p = .021$), indicating that graphic design is especially relevant for distrust but less relevant for trust. This means that users often do not explicitly appreciate when a website has a clear design; however, as soon as there are some deficits (e.g., grammar issues, pixelated photographs, high visual complexity), users will focus on those deficits and experience a website as distrustful.

4.1.2. Structure design

This dimension appeared in 19% of all experiences, making it the second most frequent dimension. It consists of four website characteristics: usability, pop-ups and ads, and demands. Whereas pop-ups and ads are most frequently mentioned in distrust experiences, a good usability is often reported in trust experiences. Two typical incidents of this dimension are the following. "*I was very impressed with how user-friendly the site's interface was and I felt secure*" (trustful experience) and "*As soon as I get to the site, I get pop ups, sounds and other annoying sensory garbage that distract me*" (distrustful experience).

Descriptive data show that in total, there are more distrust experiences that could be assigned to this dimension. Configural frequency analyses with Eye (Grüner, 2008) again showed that trust and distrust differ significantly (distrust: $z = 1.80$, $p = .036$; trust: $z = 1.91$, $p = .028$). A good structure design therefore is able to lower distrust but not to enhance trust in a website.

4.1.3. Content design

Appearing in almost half of all experiences, content design was the most prominent dimension. We found eight website characteristics that are part of this dimension, making this dimension more heterogeneous than the other dimensions. Incidents mentioning security signs of the website were the most frequent in trust experiences (e.g., "*I felt more secure because it requires 2 passwords, and a secret word in a certain order in order to gain access to the account.*"). Furthermore, incidents focusing on the website operators' image or brand were also more frequently mentioned in trust experiences (e.g., "*I felt like it was secure because it is a well known, big company.*").

The most mentioned website characteristic in distrustful experiences was privacy. The experiences focusing on these issues could be further divided into incidents that focused on users' concerns that their data could be collected by the website operator (privacy: collection) such as "*I recently felt very distrustful of one of these sites that retains all your personal info like name, address, phone, E-mail, social networks...*" and users' fears that their information was being used for another reason than what it was collected for (privacy: secondary use) for instance "*I felt like they just wanted to verify my information to steal my identity*". In total, 13% of the distrust but none of the trust experiences concerned promises on the

website that the participants felt could not be kept by operators (implausible promises). The website characteristics content, policy, expertise and web address were mentioned in less than 5% of all experiences.

No significant difference was found for this dimension between expected and effective frequency for trust and distrust. As this dimension is rather heterogeneous, this result is not surprising. Within the dimension, however, different website characteristics were mentioned in trustful and distrustful incidents.

4.1.4. Social-cue design

Social-cue design is the least mentioned dimension; its website characteristics were found in only 7% of all experiences. It consists of customer service (e.g., "*they [customer service agents] informed me that they would be returning my money*") and real-world links (e.g., "*I discovered that the people who worked on* X *and who ran the website, had their own profiles*"). No significant difference was found for this dimension between expected and effective frequency for trust and distrust. This dimension therefore is not as important as the other dimensions for enhancing trust or causing distrust.

4.1.5. Personal and social proof

Personal and social proof mainly appeared in trust experiences. Out of a total of 28 experiences concerning personal and social proof, just one was an incident causing distrust. Personal and social proof is made up of (1) users' social proof and (2) friends' social proof, and (3) the participants' prior experience with the reported website. The difference between users' and friends' social proof is that users' social proof focuses on user rating and reviews (e.g., "*I looked at the star ratings of the seller and also looked at past comments from previous buyers to assess whether or not this person was trustworthy*") and friends' social proof on information given by colleagues, friends, and family members (e.g., "*Many friends were active on the site*"). Configural frequency analyses with Eye (Grüner, 2008) showed significant differences between expected and effective frequency for personal and social proof for distrust ($z = 3.74$, $p < .001$) as well as trust ($z = 3.98$, $p < .001$), indicating that this dimension is especially important in enhancing users' trust (but not their distrust) in a website.

4.2. Site visits before the critical incident occurred

We further analyzed how often the participants visited the website before the critical incident occurred (see Table 5). There was a significant difference between the distrustful and trustful experiences and their visits, ($\chi^2 = 13.34$, $p = .004$). Descriptive data show that in almost half of all cases for distrustful experiences, the critical incident happened at the participants' first visit to a site. In these cases, once visitors to a website distrusted the site, they would likely not use that site again. Nonetheless, distrustful experiences could also happen when a site had been visited more than 100 times previously. This was especially the case for incidents happening on social networks (e.g., chance of privacy policy). Trustful experiences, on the contrary, occurred more often after

several previous visits. Particularly for the category of e-commerce sites, most of the trustful experiences happened on websites that had been visited (many times) before. For example, one participant reported having had good, but not extraordinary experiences with an online shopping website several times. Then the trustful critical incident was a very positive experience with the customer service of this online store.

4.3. Ratings for trust and distrust experiences

We compare the ratings of honesty, benevolence, and competence to further investigate potential differences between these three facets for distrustful and trustful experiences. Reliability analyses for all subscales show good internal consistency with Cronbach's α between 0.84 and 0.94 (see Table 6). The authors of the scale (Casaló et al., 2007) showed good ratings for the construct validity. They assessed the convergent as well as the divergent validity. Convergent validity analyses showed that the factor loadings of the confirmatory models were all statistically significant on the 0.01 level and loaded substantively on each of the constructs. Analyses of Casaló et al. (2007) regarding the discriminatory validity showed values less than 0.8.

Descriptive data (see Table 6) shows that distrustful incidents can be characterized by low ratings of honesty and benevolence. Perceived competence of a website was not rated as low as one might expect. It seems that competence is not as strongly associated with a distrustful experience as the other facets.

In contrast, trustful experiences show another pattern of the three facets, which is characterized by high honesty and competence ratings. Benevolence, however, is rated slightly lower than the other two facets. A trustful experience is therefore rather associated with perceived honesty and competence of a website. Benevolence seems to be slightly less important than the other two facets.

Statistical analyses support this interpretation. We examined these differences with two within-subject ANOVAs (one for distrust, one for trust). Results showed that there is a significant difference within the facets for distrust ($p < .001$, $N_p^2 = .29$) as well as trust ($p = .005$, $N_p^2 = .07$). Post-hoc tests by pairwise comparison and Bonferroni correction revealed that in the distrust condition, competence significantly differs from the other two facets (both $p < .001$) whereas in the trust condition, benevolence significantly differs from the other two facets ($p = .021$ resp. $p = .011$).

4.4. Ratings for the five different website dimensions

To analyze whether there is a difference in honesty, benevolence, and competence between the different website dimensions within trust and distrust, we conducted for each facet and for trust and distrust a one-way ANOVA for independent samples (the five website dimensions as independent and three facets as dependent variables). However, results showed that there are no significant differences for any of the facets and the five dimensions within distrust as well as within trust. Thus we looked at differences at the level of the website characteristics.

4.5. Ratings for the most mentioned website characteristics

Of the three most frequently mentioned website characteristics in distrust experiences, *privacy secondary use* got the highest and *implausible promises* the lowest ratings on all three facets (see Table 7). We conducted for each facet a one-way ANOVA for independent samples to analyze whether the three website characteristics (independent variable) significantly differ in terms of honesty, benevolence, and competence (dependent variable). The three website characteristics differ significantly in regard to

Table 5
Number and percentage for the number of visits before the critical incident occurred.

Visits before	Distrust N (%)	Trust N (%)
First time visit	54 (45.8)	26 (25.2)
2–9 visits before	33 (28.0)	28 (27.2)
10–99 visits before	17 (14.4)	28 (27.2)
More than 100 visits before	14 (11.9)	21 (20.4)
Total	118 (100)	103 (100)

Table 6
Descriptive statistics for distrust and trust ratings and their three facets.

Facets	Distrust		Trust	
	M (SD) ($N = 76$)	Cronbach's alpha	M (SD) ($N = 78$)	Cronbach's alpha
Honesty	2.5 (1.4)	0.92	6.5 (0.8)	0.89
Benevolence	2.6 (1.5)	0.94	6.3 (0.9)	0.84
Competence	3.6 (1.9)	0.91	6.5 (0.9)	0.84

Table 7
Descriptive statistics for distrust ratings regarding the most frequently mentioned website characteristics.

Facets	Privacy secondary use M (SD) ($N = 22–24$)	Visual design M (SD) ($N = 19–20$)	Implausible promises M (SD) ($N = 11–13$)
Honesty	3.0 (1.2)	2.9 (1.8)	1.6 (0.8)
Benevolence	3.0 (1.5)	2.8 (1.8)	1.5 (1.0)
Competence	4.8 (1.6)	3.5 (1.9)	2.7 (1.8)

Table 8
Descriptive statistics for trust ratings regarding the most frequently mentioned website characteristics.

Facets	Security signs M (SD) ($N = 18–21$)	Users' social proof M (SD) ($N = 17–19$)	Image M (SD) ($N = 9–11$)
Honesty	6.5 (0.9)	6.7 (0.4)	6.6 (0.7)
Benevolence	6.4 (0.8)	6.8 (0.4)	6.0 (1.0)
Competence	6.4 (0.9)	6.8 (0.3)	6.5 (0.8)

honesty ($p = .018$, $N_p^2 = .15$), benevolence ($p = .032$, $N_p^2 = .13$), and competence ($p = .002$, $N_p^2 = .21$), further indicating that *implausible promises* are evaluated as significantly more distrustful than the other two facets. Although *privacy secondary use and visual design* are mentioned more often and therefore are likely more common, if users encounter critical incidents due to *implausible promises* these are rated as more distrustful.

Table 8 shows that trustful experiences mentioning users' social proof were rated highest on all three facets. In contrast to the distrust condition, the three most frequently mentioned characteristics in trustful experiences significantly differ only on benevolence ($p = .047$, $N_p^2 = .14$) but no significant difference was found for the other two facets. These results show that (1) there are smaller differences in the evaluation of the most mentioned website characteristics for trust than for distrust. Furthermore (2), for *image* the facet benevolence is rated the lowest.

5. Discussion

The main goals of this research were (1) to identify website characteristics that influence trust and/or distrust and (2) to show whether and how trustful and distrustful web experiences differ in terms of perceived honesty, competence, and benevolence. In the following (3) we discuss our findings and the implication for trust conceptualization as well as the implications for designing websites.

5.1. Website characteristics and dimensions

First, our findings highlight that web trust and web distrust do not have the same website characteristics as antecedents. Website characteristics associated with graphical design and structure design were significantly more often reported in distrust than trust experiences. On the contrary, personal and social proof was associated with trust rather than distrust incidents. For content design and social-cue design, no significant differences between trust and distrust were found. However, content design is a very heterogeneous dimension; descriptive data show some differences between trust and distrust at the level of its website characteristics.

Security signs and image/brand were often mentioned within trustful experiences, whereas implausible promises and privacy concerns were the most frequent topics of distrustful experiences.

5.1.1. Graphic design dimension
We were able to show that the website characteristic visual design is especially relevant for distrust but of little relevance for trust. Andrade et al. (2012), however, found an effect of unpleasant design both on distrust and on trust. In contrast to our study, these authors used a single-item scale, which asked to rate "unpleasant design" of six preselected websites. As Gliem and Gliem (2003) were able to show, single-item questions are less reliable than multi-item scales and should not be used in drawing conclusions. For our study, we used a qualitative approach without a predefined scale for graphic design.

5.1.2. Structure design dimension
Regarding the ease of browsing the site (or usability in general), the present study is in line with Andrade et al. (2012) who found only an effect on trust (but not on distrust).

5.1.3. Content design dimension
Most previous studies focused on website characteristics within the dimension content design. Contrary to our results, Chang and Fang (2013) investigated privacy policy and security indications and found no effects on trust or distrust. Andrade et al. (2012) concluded that privacy and security signs influence both trust and distrust, whereas our study reveals that privacy concerns are associated with distrust and security indications with trust. A possible explanation for this difference between our results and the results from other authors may be due to the different methodological approaches. By imagining a critical incident, users might remember different aspects than predefined questionnaires could measure. Regarding security, Chang and Fang (2013) only asked for signs or symbols from third-party companies; however, our participants also mentioned additional authentication questions or the version of communication protocol (e.g., https or http). Andrade et al. (2012), moreover, only used a single item for privacy and a single item for security. With our approach, we received

information not only about the characteristic "data collection" and "privacy policy" but also about users' fears that their information might be used for another reason than what it was collected for ("secondary usage").

5.1.4. Social-cue design dimension

In our study, customer service was only mentioned a few times and therefore is not likely an important antecedent for trust or distrust. However, customer service (Ou & Sia, 2010), particularly order fulfillment (Chang & Fang, 2013), had a significant effect on web trust in prior studies. The difference between the present study and prior studies is probably due to the website types that were used. Ou and Sia (2010) as well as Chang and Fang (2013) focused on online shops as study material and customer service might be more important for this specific website type.

5.1.5. Personal and social proof dimension

Finally, Ou and Sia (2010) were not able to find an effect of elements of social proof (such as ratings) on trust or on distrust. Our results, however, suggest that these elements have an important influence on trust. These differences could be based on the fact that Ou and Sia (2010) only used two different websites as stimuli and social proof characteristics might not have been relevant or prominent characteristics on these sites. A contribution of our paper is that by applying the CIT, we were able to find website characteristics in distrustful incidents (demands, implausible promises, users' social proof, friends' social proof, prior experience, real world link, web address, pop-ups/ads and policy) that users actually experienced and that were overlooked by earlier work on website characteristics' effect on distrust (Chang & Fang, 2013; Ou & Sia, 2010).

5.2. Facets web trust and web distrust

Besides the website characteristics, we analyzed differences in the facets of web trust and web distrust. Our results suggest that different facets characterize a trustful and a distrustful experience. Distrustful experiences are based on the lack of honesty and benevolence of a website but to a lesser extent on competence. In contrast, for web trust high competence and high honesty of a website are needed, although significantly less benevolence. This implies that to prevent distrust, resources should be invested to enhance the honesty and benevolence of the website, whereas to enhance trust, one should rather focus on competence and honesty. These results contradict the findings of Cho (2006), who showed that trust is primarily driven by benevolence whereas distrust is based on a lack of competence. In contrary to the present study, Cho (2006) focused on existing online shops and this may explain the different results. Another explanation could be the eight-year difference between our research and Cho's (2006) study. There are many more tools available nowadays that makes it easier for a company to design a website that has a competent appearance. More research is needed to further clarify the facets of trust and distrust.

Depending on the reported website characteristic, the facets of web trust and web distrust receive different ratings. For the three most mentioned website characteristics for web trust experiences (security signs, users' social proof, and image), we found significant differences in benevolence between all three. The highest ratings for all three facets were reached by the website characteristic users' social proof. This implies that to receive high web trust, users' social proof is important. For the three most mentioned characteristics in the distrust condition, implausible promises received low ratings for all facets, which suggests that implausible promises have a large effect on distrust.

5.3. Trust and distrust concepts

Previous literature argues that trust and distrust are two distinct constructs that coexist and that different website characteristics may need to be managed in order to elevate trust and to reduce distrust (Ou & Sia, 2010). Our results support Lewicki et al.'s (1998) statement that it would be misleading to assume that the positive predictors of trust would necessarily be negative predictors of distrust or vice versa. Our research findings provide support that web trust and distrust are affected by different antecedents (Chang & Fang, 2013; Ou & Sia, 2010). Therefore, efforts to build trust may not always eliminate distrust (Chang & Fang, 2013). However, like Schoorman et al. (2007), we still raise concerns about the deliberation of trust and distrust as distinct constructs. It may be possible to experience trust as well as distrust at the same time due to different attribution factors. Users may trust a website because of good reviews and a good brand image, but at the same time experience distrust due to a bad visual design and privacy concerns. We cannot support the statements from Ou and Sia (2010), who argue that if trust and distrust are found to be the same construct, then users would note the same website characteristics in a positive or negative way. It still might be possible that trust and distrust are the same construct but have different antecedents. Our study provides a more detailed insight into different website characteristics; however, more studies are needed to investigate trust and distrust to conclude whether they are the same or two distinct constructs.

5.4. Implications

Our findings imply that to avoid distrust, a website should focus on improving the graphic and structure design, as well as the content design in terms of enhancing privacy and avoiding implausible promises. On the other hand, to achieve more trust a website should provide good usability and use security sign cues such as lock symbols. Furthermore, social-cue design and personal and social proof enhance trust in a website.

It should be noted that distrust can be prevented more easily by website operators because changes in visual design, avoiding secondary use of users' data, and making sincere promises do not involve third parties. All these issues are under a company's own control. However, changing how users perceive a company's image and getting good ratings from users to enhance social proof is more difficult to achieve. Enhancing users' trust is therefore more difficult. In Table 9 we used the most frequently mentioned website characteristics for trust and distrust to provide guidance to enhance trust and avoid distrust. Furthermore, we supplement these characteristics with references from previous studies.

5.5. Limitations and further research

Although there are positive aspects of the CIT, it leads to some limitations in our research. First, participants have to be capable of verbalizing the experienced incident. As the participants have to recall a past event, we have to rely on participants' memory. Experiences that took place far back in the past may not be remembered with the same accuracy as newer incidents. Memory biases may have influenced the participants' answers. Furthermore, it is important to highlight that we focused on incidents that are critical and not everyday experiences.

There are also some limitations concerning the affinity diagram process and the coding procedure. Because this is a group process, it is important that there is a shared understanding of all the characteristics and dimensions. We tried to eliminate any uncertainties during consolidation with all researchers (step two); however, there is no guarantee that there were no differences between the

Table 9
Implications for trust and distrust.

How to enhance trust	How to avoid distrust
– Make your site easily accessible and easy to use (Wang & Emurian, 2005)	– Take care of your visual design (Andrade et al., 2012)
– Provide security sign cues such as https encryption, lock symbols or third-party certificate (Bart et al., 2005)	– Do not abuse user data and state clearly what you are going to do with data provided (Bart et al., 2005)
– Show your brand prominently and care for your image (Bart et al., 2005)	– Do not force your users to do something they do not want to do (Bart et al., 2005)
– Highlight your expertise (Wang & Emurian, 2005)	– Avoid pop-ups and ads (Fogg et al., 2003)
– Provide links to your policy and make it easy to understand (Shneiderman, 2000)	– Use a well-known web address and domain name (Wang & Emurian, 2005)
– Provide a helpful and friendly customer service (Chang & Fang, 2013)	– Provide comprehensive, correct, and up-to-date information (Bart et al., 2005)
– Care for good reviews and ratings (Ou & Sia, 2010)	– Do not make implausible promises (Sher & Lee, 2009)
– Care for your users to enhance the possibility for further visits (prior experience with a site enhances trust) (Fogg et al., 2003)	– Do not ask for unnecessary input and explain what the data are used for (Bart et al., 2005)

four researchers. A further limitation is the possibility that not each researcher had the same influence and that there might have been an individual dominating the group decisions. Finally, in step four and five we reduced our set of data by creating self-written keywords describing the incident groups. The groups with related keywords were then merged. Comparing keywords instead of the incidents themselves and the consequential merging may lose some of the actual meaning; however, at some point in the evaluation process, a reduction of the qualitative data must take place.

The focus of this study, moreover, was on websites in general. Further studies should analyze the different types of websites separately to learn more about the differences between the various website types and to provide more inferences to the practice of specific website types.

To statistically support our findings on website characteristics, in future research larger sample sizes should be applied. Further research is needed to explore whether the findings from this study can be replicated by other studies using other methods or participants from different countries. Additionally, from an economic standpoint it would be interesting to know how our findings may not only influence the trust or distrust of a website but also result in higher conversion rates.

6. Conclusion

This paper contributes to the growing body of literature on web trust in two ways. First, we show that distrust is mostly an effect of graphical (e.g., complex layout) and structural (e.g., pop-ups) design issues of a website, whereas trust is based on social factors such as reviews or recommendations by friends. The content of websites affects both trust and distrust: privacy issues had an effect on distrust and security signs enhanced trust. Second, our results showed that trustful experiences can be characterized by high honesty and competence, whereas a distrustful experience is based on missing honesty and missing benevolence.

References

Almadhoun, N. M., Dominic, P. D. D., & Woon, L. F. (2011). Perceived security, privacy, and trust concerns within Social Networking Sites: The role of information sharing and relationships development in the Malaysian Higher Education Institutions' marketing. In *2011 international conference on control system, computing and engineering* (pp. 426–431). Penang: IEEE.

Andrade, A. A., Lopes, V. V., & Novais, A. Q. (2012). Quantifying the impact on distrust of e-commerce trust factors: A non-parametric study. In *2012 international conference on internet technology and secured transactions* (pp. 356–361). London: IEEE.

Bart, Y., Shankar, V., Sultan, F., & Urban, G. L. (2005). Are the drivers and role of online trust the same for all web sites and consumers? A large-scale exploratory empirical study. *Journal of Marketing, 69*(4), 133–152.

Beldad, A., De Jong, M., & Steehouder, M. (2010). How shall I trust the faceless and the intangible? A literature review on the antecedents of online trust. *Computers in Human Behavior, 26*(5), 857–869.

Benamati, J., Serva, Mark A., & Fuller, Mark A. (2006). Are trust and distrust distinct constructs? An empirical study of the effects of trust and distrust among online banking users. In *Proceedings of the 39th annual Hawaii international conference on system sciences, HICSS'06* (Vol. 6, pp. 121b). IEEE.

Benamati, J. S., Serva, M. A., & Fuller, M. A. (2010). The productive tension of trust and distrust: the coexistence and relative role of trust and distrust in online banking. *Journal of Organizational Computing and Electronic Commerce, 20*(4), 328–346.

Beyer, H., & Holtzblatt, K. (1999). Contextual design. *Interactions, 6*(1), 32–42.

Casaló, L. V., & Cisneros, J. (2008). An empirical test of the multiplicative effect of usability on consumer trust and satisfaction. In *DEXA'08 19th international workshop on database and expert systems application* (pp. 439–443). IEEE: Turin.

Casaló, L. V., Flavián, C., & Guinalíu, M. (2007). The role of security, privacy, usability and reputation in the development of online banking. *Online Information Review, 31*(5), 583–603.

Chang, Y. S., & Fang, S. R. (2013). Antecedents and distinctions between online trust and distrust: Predicting high-and low-risk internet behaviors. *Journal of Electronic Commerce Research, 14*(2), 149–166.

Chen, S. C., & Dhillon, G. S. (2003). Interpreting dimensions of consumer trust in e-commerce. *Information Technology and Management, 4*(2–3), 303–318.

Cho, J. (2006). The mechanism of trust and distrust formation and their relational outcomes. *Journal of Retailing, 82*(1), 25–35.

Culnan, M. J., & Armstrong, P. K. (1999). Information privacy concerns, procedural fairness, and impersonal trust: An empirical investigation. *Organization Science, 10*(1), 104–115.

Dimoka, A., Pavlou, P. A., & Davis, F. D. (2007). NEURO-IS: The potential of cognitive neuroscience for information systems research. *Information Systems Research, 22*(4), 687–702.

Doney, P. M., & Cannon, J. P. (1997). An examination of the nature of trust in buyer-seller relationships. *Journal of Marketing, 61*(2), 35–51.

Flanagan, J. C. (1954). The critical incident technique. *Psychological Bulletin, 51*(4), 327–358.

Flavián, C., Guinalíu, M., & Gurrea, R. (2006). The role played by perceived usability, satisfaction and consumer trust on website loyalty. *Information and Management, 43*(1), 1–14.

Fogg, B. J., Soohoo, C., Danielson, D. R., Marable, L., Stanford, J., & Tauber, E. R. (2003). How do users evaluate the credibility of Web sites?: A study with over 2500 participants. In *Proceedings of the 2003 conference on designing for user experiences* (pp. 1–15). NY: ACM.

Fuller, M. A., Serva, M. A., & Benamati, J. (2007). Seeing is believing: The transitory influence of reputation information on E-commerce trust and decision making. *Decision Sciences, 38*(4), 675–699.

Gliem, J. A., & Gliem, R. R. (2003). Calculating, interpreting, and reporting Cronbach's alpha reliability coefficient for Likert-type scales. In *Midwest research-to-practice conference in adult, continuing, and community education*.

Grüner, H. (2008). Configural frequency analysis, <http://gruener.userpage.fu-berlin.de/spss-dialogs.htm>.

Jarvenpaa, S. L., Tractinsky, N., & Saarinen, L. (1999). Consumer trust in an Internet store: A cross-cultural validation. *Journal of Computer-Mediated Communication, 5*(2), 1–5.

Lewicki, R. J., McAllister, D. J., & Bies, R. J. (1998). Trust and distrust: New relationships and realities. *Academy of Management Review, 23*(3), 438–458.

McKnight, D. H., & Choudhury, V. (2006). Distrust and trust in B2C e-commerce: Do they differ? In *Proceedings of the 8th international conference on electronic commerce: The new e-commerce: innovations for conquering current barriers, obstacles and limitations to conducting successful business on the internet* (pp. 482–491). NY: ACM.

McKnight, D. H., Choudhury, V., & Kacmar, C. (2002). Developing and validating trust measures for e-commerce: An integrative typology. *Information Systems Research, 13*(3), 334–359.

Münscher, R., & Kühlmann, T. M. (2012). Using critical incident technique in trust research. In G. Lyon, G. Möllring, M. Saunders, & J. Hatzakis (Eds.), *Handbook of research methods on trust* (pp. 161–172). Cheltenham, UK: Edward Elgar.

Ou, C. X., & Sia, C. L. (2010). Consumer trust and distrust: An issue of website design. *International Journal of Human-Computer Studies, 68*(12), 913–934.

Ridings, C. M., Gefen, D., & Arinze, B. (2002). Some antecedents and effects of trust in virtual communities. *The Journal of Strategic Information Systems, 11*(3), 271–295.

Riegelsberger, J., Sasse, M. A., & McCarthy, J. D. (2005). The mechanics of trust: A framework for research and design. *International Journal of Human–Computer Studies, 62*(3), 381–422.

Scarbrough, H., Swan, J., Amaeshi, K., & Briggs, T. (2013). Exploring the role of trust in the deal-making process for early-stage technology ventures. *Entrepreneurship Theory and Practice, 37*(5), 1203–1228.

Schlosser, A. E., White, T. B., & Lloyd, S. M. (2006). Converting web site visitors into buyers: how web site investment increases consumer trusting beliefs and online purchase intentions. *Journal of Marketing, 70*(2), 133–148.

Schoorman, F. D., Mayer, R. C., & Davis, J. H. (2007). An integrative model of organizational trust: Past, present, and future. *Academy of Management Review, 32*(2), 344–354.

Scupin, R. (1997). The KJ method: A technique for analyzing data derived from Japanese ethnology. *Human Organization, 56*(2), 233–237.

Shankar, V., Urban, Glen L., & Sultan, F. (2002). Online trust: A stakeholder perspective, concepts, implications, and future directions. *The Journal of Strategic Information Systems, 11*(3), 325–344.

Sher, P. J., & Lee, S. H. (2009). Consumer skepticism and online reviews: An elaboration likelihood model perspective. *Social Behavior and Personality: An International Journal, 37*(1), 137–144.

Shneiderman, B. (2000). Designing trust into online experiences. *Communications of the ACM, 43*(12), 57–59.

Sledgianowski, D., & Kulviwat, S. (2009). Using social network sites: The effects of playfulness, critical mass and trust in a hedonic context. *Journal of Computer Information Systems, 49*(4), 74–83.

Tuch, A. N., Trusell, R., & Hornbæk, K. (2013). Analyzing users' narratives to understand experience with interactive products. In *Proceedings of the SIGCHI conference on human factors in computing systems* (pp. 2079–2088). ACM: NY.

Uppvall, L. (2009). *The collaborative challenge of product development: Exploring sustainable work systems through critical incidents in R&D alliances*. Stockholm, SE: Department of Industrial Economics and Management, Royal Institute of Technology.

Wang, Y. D., & Emurian, H. H. (2005). An overview of online trust: Concepts, elements, and implications. *Computers in Human Behavior, 21*(1), 105–125.

Wathen, C. N., & Burkell, J. (2002). Believe it or not: Factors influencing credibility on the Web. *Journal of the American Society for Information Science, 53*(2), 134–144.

Empirical Evaluation of 20 Web Form Optimization Guidelines

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Abstract

Most websites use interactive online forms as a main contact point to users. Recently, many publications aim at optimizing web forms. In contrast to former research that focused at the evaluation of single guidelines, the present study shows in a controlled lab experiment with n=23 participants the combined effectiveness of 20 guidelines on real company web forms. Results indicate that optimized web forms lead to faster completion times, less form submission trials, fewer eye fixations and higher user satisfaction in comparison to the original forms.

Author Keywords

Web Forms; Form Guidelines; Form Evaluation

ACM Classification Keywords

H.3.4 Systems and Software: Performance evaluation;
H.5.2 User Interfaces: Evaluation/methodology;
H.5.2 User Interfaces: Interaction styles

Introduction

Since its early beginning, the Internets technological development has come a long way. Hypertext, the core component of the World Wide Web that helped breaking the linearity of text, was quickly expanded by many powerful technologies that added high levels of interactivity and different types of media.

Despite this evolution, web forms remain one of the core interaction elements between users and website owners [15]. Web forms are used as registration forms to subscribe to services and communities, checkout forms to initiate transactions between users and companies, or data input forms to search or share information [16]. In this sense, they can be regarded as gatekeepers between website owners and users. As a consequence of this gatekeeper role, any kind of problems and obstacles users may experience while filling in forms, may lead to increased drop-out rates and data loss for the provider of the forms. Therefore website developers must pay special attention to optimize their forms and make them as usable as possible.

In the last years, an increasing number of publications looked at a broad range of aspects surrounding web form interaction, to help developers optimize their forms. These include topics such as error message optimization [15], error prevention [6, 14], optimization of form interaction elements [4, 5, 7, 8], optimization for different devices [11], or accessibility optimization [13].

These studies share light on selected aspects of web form interaction, and in the last years there have been several approaches to gather the various sources of knowledge in this field and compile them as checklists [10] or guidelines [3]. The latter presents 20 rules that aim at optimizing form content, layout, input types, error handling and submission.

Currently there is no empirical study that applies these guidelines in a holistic approach to web forms and shows if there are effects on efficiency, effectiveness and user satisfaction.

It is this gap that we aim to close with our ongoing study. The main research goal is to conduct an empirical experiment to understand if optimizing web forms using current guidelines lead to a significant improvement of total user experience. For this we selected a sample of existing web forms from popular news web sites, and optimized them according to the 20 guidelines presented in [3]. In a controlled lab experiment we let participants use the original and optimized forms, while measuring efficiency, effectiveness and user satisfaction. We expected all optimized forms to perform better than their original counterpart.

Method

Study design

In order to investigate as to how the implementation of the form guidelines of [3] improve user experience, we conducted an eye tracking lab study, where participants had to fill in either the original or an optimized version of an online form (within-subject design). User experience was measured by means of objective data such as task completion time, effectiveness of corrections and number of fixations, but also by subjective ratings on satisfaction, usability and mental load.

Participants

In total 23 participants (12 female) took part in the study. Eleven were assigned to the original form and 12 to the optimized form condition. The mean age of the participants was 30 years ($SD = 12$) and all were experienced Internet users (M = 5.4, SD = 0.85 with 1 = "no experience"; 7 = "expert").

Selection and optimization of web forms

By screening www.ranking.com for high traffic websites we ensured to get realistic and commonly

used web forms. Thereby we focused on the top ranked German-speaking newspapers and magazines, which provide an online registration form (N = 23). Subsequently, we evaluated all forms in regard to the 20 form design guidelines provided by [3]. Two raters independently coded for each form whether a guideline was violated or not (Cohen's
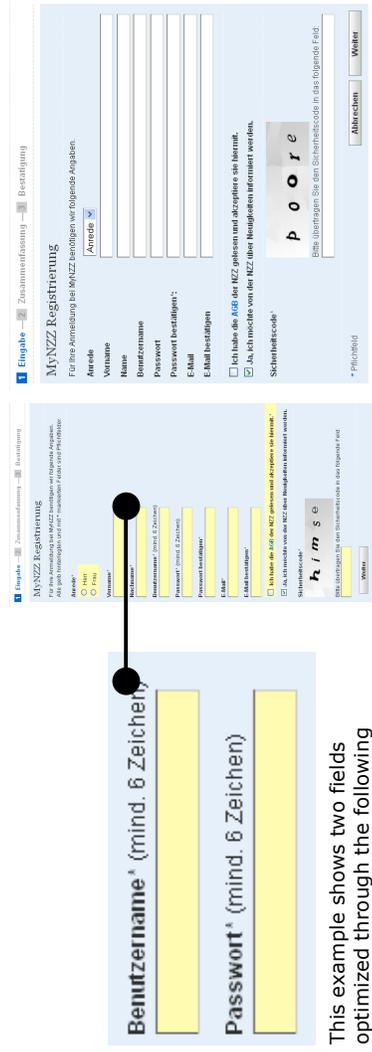
This example shows two fields optimized through the following three guidelines [3]:

- Guideline 4: If possible and reasonable, separate required from optional fields and use color and asterisk to mark required fields.
- Guideline 5: To enable people to fill in a form as fast as possible, place the labels above the corresponding input fields.
- Guideline 13: If answers are required in a specific format, state this in advance communicating the imposed rule (format specification) without an additional example.

Figure 1. Optimized form on the left, original form on the right side.

kappa = 0.70). Additionally, 14 usability experts rated each of the 20 guidelines on how serious the consequences of a violation would be for a potential user (from 1 = not serious to 5 = serious; Cronbach's α =.90).

Based on the two ratings we ranked the forms from good to bad and selected three for our main study: One of rather good quality (Spiegel.de; ranked #11), one of medium quality (nzz.ch; #13) and one of rather bad quality (sueddeutsche.de; #18). We did not select any form from the first third (rank 1 to 8), since these forms had only minor violations and hence little potential for improvement. By means of reverse engineering we built a copy of the original

form and an optimized version according to the 20 guidelines (see Fig. 1 for an example). Thereby, the number of optional and required fields was retained.

Measurements

User experience was assessed by means of user performance and subjective ratings. User performance: time efficiency (task completion time, number of fixations) and effectiveness of corrections (number of trials to submit a form). Eye-tracking data were collected with a SMI RED eye-tracker using Experiment Center 3.2.17 software, sampling rate = 60 Hz. Subjective Ratings: general satisfaction, NASA Task Load Index (TLX) [9], SUS [2], After Scenario Questionnaire (ASQ) [12], Form Usability Scale (FUS) [1] and interview data.

Procedure

After filling in a baseline form, participants were randomly assigned to one of the experimental conditions (original vs. optimized). The baseline form was the same for all participants and served as practice trial. Participants then were forwarded to a landing page that featured general information about one of the selected newspapers and a link to the registration form. Participants were instructed to follow that link and to register for the online magazine. After filling in and successfully submitting the form, they had to evaluate the form by means of a set of questionnaires. This procedure was repeated for all online forms (in a random sequence). In the end participants were interviewed on how they experienced the interaction with the forms. In these interviews we focused on aspects of the form that participants found especially annoying or easy to fill in.

Results

User Performance

As expected, users predominantly performed better with the optimized version of the forms. In two out of three forms they needed fewer trials to successfully submitting the form (until all fields were filled in correctly): Sueddeutsche ($X^2 = 7.34$, $p = .003$), NZZ ($X^2 = 3.49$, $p = .031$), and Spiegel ($X^2 = 1.16$, $p = .142$). See Table 1 for corresponding figures.

Also in regard to task completion time the optimized version of the forms performed better than the original ones. An independent sample t-test hints at potential effects with large magnitudes for the Sueddeutsche ($t(21) = 1.64$, $p = .058$, Cohen's $d = .72$) and the NZZ form ($t(21) = 1.63$, $p = .059$, $d = .71$). No effect was found for the Spiegel form ($t(21) = 0.10$, $p = .462$, $d = .04$). Note that the p-values don't reach significance due to the small sample size. Table 2 shows the average task completion times for all forms.

Moreover, the eye tracking data show a similar picture (see Table 3). Participants assigned to the optimized form condition needed fewer fixations to successfully filling in the forms, with exception for the Spiegel form: Sueddeutsche ($t(20) = 3.07$, $p = .005$, $d = 1.37$), NZZ ($t(18) = 2.04$, $p = .028$, $d = .91$), and Spiegel ($t(18)= 0.02$, $p = .492$, $d = .01$).

Subjective Ratings

In order to account for inter-individual differences we first baseline-corrected all questionnaire ratings by subtracting the ratings of the forms from the ratings of the baseline form (which was for all participants the same). These scores were then used to compare the optimized vs. the original versions of the forms by means of independent t-tests.

As expected all optimized forms received better ratings than their original counter parts (see Table 4). Participants perceived the optimized versions as more usable (ASQ, FUS, SUS), as less demanding (NASA-TLX) and were more satisfied with them (Satisfaction). Although not all comparisons are significant, effect size calculations (Cohen's d) revealed that most effects were of medium to large magnitude ($d = .50$, respectively $d = .80$). This means that increasing our sample size to 20-34 participants per group would make most of the results significant. Only the SUS showed small effects ($d = .20$) for two forms. According to a power analysis one would require a sample of 71 to 148 participants per group to achieve a significant result for the SUS.

Form	Trials	Orig.	Opt.
Suedd.	1	3	10
	≥ 2	8	2
NZZ	1	4	9
	≥ 2	7	3
Spiegel	1	7	10
	≥ 2	4	2

Table 1. Number of trials until form was successfully submitted.

	Original n=11 M (SD)	Optimized n=12 M (SD)
Suedd.	113 (40)	90 (26)
NZZ	99 (60)	71 (20)
Spiegel	103 (89)	91 (32)

Table 2. Average task completion time in seconds.

	Original n=10 M (SD)	Optimized n=10-12 M (SD)
Suedd.	182 (58)	121 (28)
NZZ	121 (46)	88 (20)
Spiegel	118 (38)	118 (48)

Table 3. Number of fixations until the form was successfully filled in.

Scale	Form	Improv.	p	d
ASQ	Suedd.	16%	.05	.74
	NZZ	23%	.03	.90
	Spiegel	14%	.07	.67
FUS	Suedd.	9%	.09	.61
	NZZ	20%	.00	1.28
	Spiegel	12%	.04	.79
SUS	Suedd.	5%	.26	.29
	NZZ	16%	.02	.94
	Spiegel	8%	.17	.42
NASA-TLX	Suedd.	-8%	.05	.75
	NZZ	-8%	.05	.73
	Spiegel	-7%	.05	.76
Satisfaction	Suedd.	12%	.09	.60
	NZZ	21%	.02	.99
	Spiegel	20%	.04	.82

Table 4. Effects on subjective ratings: relative impact from the original to the optimized version of the forms.

Form Usability Scale FUS

The FUS is a validated questionnaire to measure the usability of online forms [1]. It consists of 9 items each to be rated on a Likert-Scale ranging from 1 (strongly disagree) to 6 (strongly agree). The total FUS score is obtained by computing the mean of all items.

Items: (1) I perceived the length of the form as appropriate. (2) I was able to fill in the form quickly. (3) I perceived the order of the questions in the form as logical. (4) Mandatory fields were clearly visible in the form. (5) I always knew which information was expected of me. (6) I knew at every input which rules I had to stick to (e.g. possible answer length, password re-quirements). (7) In case of a problem I was instructed by an error message how to solve the problem. (8) The purpose and use of the form was clear. (9) In general I am satisfied with the form.

Interview data

The analysis of the interview data showed that the most mentioned issues are the layout of the forms, the identification of required and optional fields and, if indicated, format specifications. The most reported favorable factors of the optimized forms were therefore the clearly structured and concise layout, the arrangement and marking of required and optional fields in separate groups and the format specification especially for passwords and usernames.

Discussion

This study showed that with the application of the web form optimization guidelines all three web forms were improved regarding user performance and subjective ratings. Eye-tracking data revealed furthermore that the original forms needed more fixations than the optimized forms. Most of the effects were significant even with a small sample size and in addition effect sizes showed mostly medium to large magnitude.

Our findings highlight the importance for web designers to apply web form guidelines. A closer look at the form submission trials shows that there is great potential for increasing the number of successful first form submissions by applying form guidelines. Thereby website owners can minimize the risk that the user leaves their site as a consequence of an unsuccessful form submission. Furthermore, data for the task completion time shows an improvement by 10 to 25%. Finally, subjective ratings could be improved by up to 23%. To sum up, the effort to optimize the web forms is relatively low compared to the impact on user experience as shown by these results.

Further work

In the future we will continue this study adding more participants and extend the analysis of the data (e.g., explore the correlation between subjective and objective data). It would be interesting to know on more detailed level how the guidelines work. It also may be worth to explore the implications outside the lab and perform extended A/B testings in collaboration with website owners. Moreover, we could explore if the findings from this study can be replicated with other type of forms (e.g. longer forms with more than one site or other use cases such as web shops or social networks). Additionally, from an economical standpoint it would be important to know how the guidelines influence not only user experience aspects, but also conversion rates.

Conclusion

This study shows how form optimization guidelines can help improve the user experience of web forms. In contrast to former research that focused on the evaluation of single guidelines, the present study shows in a controlled lab experiment the combined effectiveness of 20 guidelines on real web forms. As our sample forms showed, even forms on high traffic websites can benefit from an optimization through the guidelines.

References

[1] Aeberhard, A. (2011). *FUS - Form Usability Scale. Development of a Usability Measuring Tool for Online Forms.* Unpublished master's thesis. University of Basel, Switzerland.

[2] Brooke, J. (1996). SUS: A Quick and Dirty Usability Scale. In: P. W. Jordan, B. Thomas, B. A. Weerdmeester & I. L. McClelland (Eds.), *Usability Evaluation in Industry* (pp. 189 - 194). London: Taylor & Francis.

[3] Bargas-Avila, J. A, Brenzikofer, O., Roth, S., Tuch, A. N., Orsini, S., & Opwis, K. (2010). Simple but Crucial User Interfaces in the World Wide Web: Introducing 20 Guidelines for Usable Web Form Design. In: R. Matrai (Ed.), *User Interfaces* (pp. 1 - 10). InTech, ISBN: 978-953-307-084-1.

[4] Bargas-Avila, J. A., Brenzikofer, O., Tuch, A. N., Roth, S. P., & Opwis, K. (2011). Working towards usable forms on the World Wide Web: Optimizing date entry input fields. *Advances in Human Computer Interaction,* Article ID 202701.

[5] Bargas-Avila, J. A., Brenzikofer, O., Tuch, A. N., Roth, S. P., & Opwis, K. (2011). Working towards usable forms on the World Wide Web: Optimizing multiple selection interface elements. *Advances in Human Computer Interaction,* Article ID 347171.

[6] Bargas-Avila, J. A., Orsini, S., Piosczyk, H., Urwyler, D., & Opwis, K. (2010). Enhancing online forms: Use format specifications for fields with format restrictions to help respondents, *Interacting with Computers,* 23(1), 33 - 39.

[7] Christian, L., Dillman, D., & Smyth, J. (2007). Helping respondents get it right the first time: the influence of words, symbols, and graphics in web surveys. *Public Opinion Quarterly,* 71(1), 113 - 125.

[8] Couper, M., Tourangeau, R., Conrad, F., & Crawford, S. (2004). What they see is what we get: response options for web surveys. *Social Science Computer Review,* 22(1), 111 – 127.

[9] Hart, S., & Staveland, L. (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. P. A. Hancock & N. Meshkati (Eds.). *Human mental workload* (pp. 139 - 183). Amsterdam: Elsevier Science.

[10] Idrus, Z., Razak, N. H. A., Talib, N. H. A., & Tajuddin, T. (2010). Using Three Layer Model (TLM) in web form design: WeFDeC checklist development. *Computer Engineering and Applications (ICCEA),* 385 - 389.

[11] Kaljuvee, O., Buyukkokten, O., Garcia-Molina, H., & Paepcke, A. (2001). Efficient web form entry on PDAs. *Proc. WWW,* 663 - 672.

[12] Lewis, J. R. (1991). Psychometric evaluation of an after-scenario questionnaire for computer usability studies: The ASQ. *SIGCHI Bulletin,* 23(1), 78 - 81.

[13] Money, A. G., Fernando, S., Elliman, T., & Lines, L. (2010). A trial protocol for evaluating assistive online forms for older adults. *Proc. ECIS,* Paper 90.

[14] Pauwels, S. L., Hübscher, C., Leuthold, S., Bargas-Avila, J. A. & Opwis, K. (2009). Error prevention in online forms: Use color instead of asterisks to mark required fields. *Interacting with Computers,* 21(4), 257 - 262.

[15] Seckler, M., Tuch, A. N., Opwis, K., & Bargas-Avila, J. A. (2012). User-friendly Locations of Error Messages in Web Forms: Put them on the right side of the erroneous input field. *Interacting with Computers,* 24(3), 107 - 118.

[16] Wroblewski, L. (2008). *Web Form Design: Filling in the Blanks.* Rosenfeld Media.

Designing Usable Web Forms – Empirical Evaluation of Web Form Improvement Guidelines

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ABSTRACT

This study reports a controlled eye tracking experiment (N = 65) that shows the combined effectiveness of 20 guidelines to improve interactive online forms when applied to forms found on real company websites. Results indicate that improved web forms lead to faster completion times, fewer form submission trials, and fewer eye movements. Data from subjective questionnaires and interviews further show increased user satisfaction. Overall, our findings highlight the importance for web designers to improve their web forms using UX guidelines.

Author Keywords

Web Forms; Form Guidelines; Form Evaluation; Internet; World Wide Web; Form Interaction

ACM Classification Keywords

H.3.4 Systems and Software: Performance evaluation; H.5.2 User Interfaces: Evaluation/methodology; H.5.2 User Interfaces: Interaction styles

INTRODUCTION

Technological development of the Internet has changed its appearance and functionality drastically in the last 15 years. Powerful and flexible technologies have added varying levels of interactivity to the World Wide Web. Despite this evolution, web forms – which offer rather limited and unilateral ways of interaction [14] – remain one of the core interaction elements between users and website owners [29]. These forms are used for registration, subscription services, customer feedback, checkout, to initiate transactions between users and companies, or as data input forms to search or share information [31]. Web forms stand between users and website owners and can therefore be regarded as gatekeepers. Due to this gatekeeper role, any kind of problems and obstacles that users experience during form filling can lead to increased drop-out rates and data

loss. Accordingly, website developers should pay special attention to improving their forms and making them as usable as possible.

In recent years, an increasing number of publications have looked at a broad range of aspects surrounding web form interaction to help developers improve their forms. These studies shed light on selected aspects of web form interaction, but rarely research the form filling process using holistic approaches. Therefore, various authors have gathered together the different sources of knowledge in this field and compiled them as checklists [17] or guidelines [7, 18, 21]. Bargas-Avila and colleagues, for instance, present 20 rules that aim at improving form content, layout, input types, error handling and submission [7]. Currently there is no empirical study that applies these guidelines in a holistic approach to web forms and shows whether there are effects on efficiency, effectiveness and user satisfaction.

It is this gap that we aim to close with the present study. The main research goal is to conduct an empirical experiment to understand whether improving web forms using current guidelines leads to a significant improvement of total user experience. For this we selected a sample of existing web forms from popular news websites, and improved them according to the 20 guidelines presented in Bargas-Avila et al. [7]. In a controlled lab experiment we let participants use original and improved forms, while we measured efficiency, effectiveness and user satisfaction.

This work contributes to the field of HCI in three ways:
(1) The findings of this paper are empirically tested guidelines that can be used by practitioners.
(2) Thanks to the applied multi-method approach, we were able to better understand the impact of the individual guidelines on different aspects of user experience.
(3) Finally, our study shows that there is a difference between how experts estimate the relevance of the individual guidelines for user experience and how these guidelines actually affect the users' experience.

RELATED WORK

An online form contains different elements that provide form filling options to users: for instance text fields, radio-buttons, drop-down menus or checkboxes. Online forms are used when user input is required (e.g. registration forms, message boards, login dialogues).

The usability of such forms can vary vastly. Small variations in form design can lead to an increase or decrease of interaction speed, errors and/or user satisfaction. It was shown, for instance, that the placement of error messages impacts efficiency, effectiveness and satisfaction. Locations near the erroneous input field lead to better performance than error messages at the top and the bottom of the form – placements that have been shown to be the most wide spread in the Internet [29].

Due to the importance of form usability, there is a growing body of research and guidelines published on how to make online forms more usable. These include topics such as error message improvement [2, 5, 29], error prevention [6, 26], improvement of various form interaction elements [3, 4, 10, 11], improvement for different devices [27], or accessibility improvement [23]. Some publications present empirical data, whereas others are based on best practices of experts in the fields of Human-Computer Interaction and User Experience [18, 19, 31].

There are extensive reviews on form guidelines research such as publications from Nielsen [24], Jarrett and Gaffney [19], and Wroblewsky [31]. One review that focuses particularly on guidelines that are based on published empirical research is provided by Bargas-Avila et al. [7]. Based on their review, the authors derive a set of 20 practical guidelines that can be used to develop usable web forms or improve the usability of existing web forms (see

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Web Form Design Guidelines

Form content
  1. Let people provide answers in a format that they are familiar with from common situations and keep questions in an intuitive sequence.
  2. If the answer is unambiguous, allow answers in any format.
  3. Keep the form as short and simple as possible and do not ask for unnecessary input.
  4. (a) If possible and reasonable, separate required from optional fields and (b) use color and asterisks to mark required fields.

Form layout
  5. To enable people to fill in a form as quickly as possible, place the labels above the corresponding input fields.
  6. Do not separate a form into more than one column and only ask one question per row.
  7. Match the size of the input fields to the expected length of the answer.

Input types
  8. Use checkboxes, radio buttons or drop-down menus to restrict the number of options and for entries that can easily be mistyped. Also use them if it is not clear to users in advance what kind of answer is expected from them.
  9. Use checkboxes instead of list boxes for multiple selection items.
  10. For up to four options, use radio buttons; when more than four options are required, use a drop-down menu to save screen real estate.
  11. Order options in an intuitive sequence (e.g., weekdays in the sequence Monday, Tuesday, etc.). If no meaningful sequence is possible, order them alphabetically.
  12. (a) For date entries use a drop-down menu when it is crucial to avoid format errors. Use only one input field and place (b) the format requirements with symbols (MM, YYYY) left or inside the text box to achieve faster completion time.

Error handling
  13. If answers are required in a specific format, state this in advance, communicating the imposed rule (format specification) without an additional example.
  14. Error messages should be polite and explain to the user in familiar language that a mistake has occurred. Eventually the error message should apologize for the mistake and it should clearly describe what the mistake is and how it can be corrected.
  15. After an error occurred, never clear the already completed fields.
  16. Always show error messages after the form has been filled and sent. Show them all together embedded in the form.
  17. Error messages must be noticeable at a glance, using color, icons and text to highlight the problem area and must be written in a familiar language, explaining what the error is and how it can be corrected.

Form submission
  18. Disable the submit button as soon as it has been clicked to avoid multiple submissions.
  19. After the form has been sent, show a confirmation site, which expresses thanks for the submission and states what will happen next. Send a similar confirmation by e-mail.
  20. Do not provide reset buttons, as they can be clicked by accident. If used anyway, make them visually distinctive from submit buttons and place them left-aligned with the cancel button on the right of the submit button.

Table 1. 20 guidelines for usable web form design (from Bargas-Avila et al. [7]).

Table 1). The overall application of these guidelines is meant to improve the form's usability, shorten completion times, prevent errors, and enhance overall user satisfaction [7]. To the authors' best knowledge, there has been no empirical evidence that the usage of these guidelines accomplishes the established claims. Therefore a carefully designed experiment was conducted to answer this question.

METHOD

Study Design

In order to investigate as to how forms can be improved by the application of the guidelines compiled by Bargas-Avila et al. [7], we conducted an eye tracking lab study, where participants had to fill in either original or improved versions of three online forms taken from real company websites (between-subject design). Usability was measured by means of objective data such as task completion time, type of errors, effectiveness of corrections as well as eye tracking data (number of fixations, total fixation duration and total time of saccades), but also by subjective ratings on satisfaction, usability, cognitive load and by short interviews about quality of experience.

Participants

Participants were recruited from an internal database, containing people interested in attending studies. In total 65 participants (42 female) took part in the study. Thirty-two were assigned to the original form and 33 to the improved form condition (see below). The mean age of the participants was 27.5 years (SD = 9.7; range = 18-67) and all indicated to be experienced Internet users (M = 5.4, SD = 0.9 with 1 = "no experience"; 7 = "expert"). Participants received about 20$ or course credits as compensation.

Independent sample t-tests showed no significant differences between the two experimental groups regarding age, level of education, computer knowledge, web knowledge, online shopping knowledge and Internet usage. A chi-square test indicated that there are also no significant differences regarding gender distribution.

Selection and Improvement of Web Forms

By screening www.ranking.com for high traffic websites we ensured getting realistic and commonly used web forms to demonstrate that the 20 guidelines work not only for an average website with a form or even for poorly designed forms but also for frequently used ones. We focused on top ranked German-language newspapers and magazines that provide an online registration form (N = 23). We chose high traffic news websites because they often include web forms with the most common input fields (login, password and postal address) and are of decent overall length. Subsequently, we evaluated these forms with the 20 design guidelines provided by Bargas-Avila et al. [7]. Moreover,

Nr.	Guideline	Expert Rating M (range)	Violated by*
15	Never clear the already completed fields.	5.00 (5-5)	-
11	Order options in an intuitive sequence.	4.71 (3-5)	Spiegel (1)
19	Provide a confirmation site.	4.64 (4-5)	-
14	Texting of error messages: (…)	4.57 (3-5)	Suedd (2)
16	Show all error messages after sending the form.	4.29 (3-5)	Spiegel (2), Suedd (2)
20	Do not provide reset buttons.	4.14 (1-5)	NZZ (2)
13	State a specific format in advance.	4.14 (3-5)	Spiegel (1), NZZ (2), Suedd (1)
18	Disable the submit button as soon as it has been clicked.	4.07 (2-5)	Spiegel (2), NZZ (2), Suedd (2)
4a	Separate required from optional fields.	4.07 (2-5)	NZZ (2)
9	Use checkboxes instead of list boxes (…)	3.86 (2-5)	-
8	Use checkboxes, radio buttons or drop-down (…)	3.86 (2-5)	-
3	Do not ask for unnecessary input.	3.86 (1-5)	Spiegel (1), Suedd (1)
1	Let people provide answers in a familiar format.	3.79 (2-5)	-
12a	Date entries (…)	3.57 (2-5)	Suedd (1)
17	Show error messages in red at the right side.	3.57 (2-5)	Spiegel (2), NZZ (2), Suedd (2)
2	If the answer is unambiguous (…)	3.50 (2-5)	-
6	(…) only ask for one input per column.	3.36 (1-5)	Spiegel (2), Suedd (2)
7	Match the size of the input fields (…)	3.29 (2-5)	NZZ (2), Suedd (2)
12b	(…) the year field shoud be twice as long (…)	2.79 (1-5)	Suedd (2)
5	(…) place the lables above the input field	2.71 (1-5)	NZZ (2)
10	Use of radio buttons and drop-down menu: (…)	2.36 (1-4)	Spiegel (2), NZZ (2), Suedd (2)
4b	Use color to mark required fields.	2.21 (1-4)	Spiegel (2), NZZ (2), Suedd (2)

*Note: (1) partial violated, (2) fully violated

Table 2. Expert ratings and guideline violations for each form.

we screened the literature to update this guideline set. As result, we refined guideline 17 [29].

Two raters independently rated for each form whether a guideline was fully, partially or not violated (Cohen's kappa = 0.70). Additionally, 14 HCI experts rated independently each of the 20 guidelines on how serious the consequences of a violation would be for potential users (from 1 = not serious to 5 = serious; Cronbach's α = .90). See Table 2 for these expert ratings.

Based on these two ratings we ranked the forms from good to bad and selected three of different quality: One of rather

This example (password and repeat password) shows two fields improved through the following two guidelines:

- Guideline 4: If possible and reasonable, separate required from optional fields and use color and asterisk to mark required fields.

- Guideline 13: If answers are required in a specific format, state this in advance communicating the imposed rule (format specification) without an additional example.

Figure 1. Copy of the original Spiegel™ form (left), improved form (middle), improvement example (right)

good quality (Spiegel.de; ranked #11), one of medium quality (nzz.ch; #13) and one of rather poor quality (sueddeutsche.de; #18). Nonetheless, the pool of websites in our ranking is based on top traffic websites – we expect that our three web forms represent rather high quality examples. In total, the NZZ and the Spiegel form violated 9 guidelines each, while the Sueddeutsche form violated 12. See Table 2 for guideline violations for each form.

We refrained from selecting any form from the top third (rank 1 to 8), since these forms had only minor violations and hence showed little to no potential for improvement. By means of reverse engineering of the structure, function and operation, we built a copy of the original form and an improved version according to the 20 guidelines (see Figure 1 for an example). We refrained from applying guideline 3 ("Keep the form as short and simple as possible and do not ask for unnecessary input") in this study, as this would have required in-depth knowledge of the companies' business strategies and goals.

Measurements

Usability was assessed by means of user performance and subjective ratings. User performance included: time efficiency (task completion time, number of fixations, total fixation duration and total time of saccades) and effectiveness of corrections (number of trials to submit a form, error types). Furthermore, we used the KLM Form Analyzer Tool [20] to compare the different form versions. Eye tracking data were collected with a SMI RED eye tracker using Experiment Center 3.2.17 software, sampling rate = 60 Hz, data analysis using BeGaze 3.2.28.

We used the following subjective ratings: The NASA Task Load Index (TLX) for mental workload [15], the System Usability Scale (SUS) [8] and After Scenario Questionnaire (ASQ) [22] for perceived usability in general, and the Form Usability Scale (FUS) [1] for perceived form usability. Moreover, we conducted a post-test interview consisting of

two questions: (1) "What did you like about the form?" and (2) "What did you perceive as annoying about the form?".

As the FUS is not a published questionnaire yet, this is a short introduction. The FUS is a validated questionnaire for measuring the usability of online forms [1]. It consists of 9 items each to be rated on a Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The total FUS score is obtained by computing the mean of all items. Items: (1) I perceived the length of the form to be appropriate. (2) I was able to fill in the form quickly. (3) I perceived the order of the questions in the form as logical. (4) Mandatory fields were clearly visible in the form. (5) I always knew which information was expected of me. (6) I knew at every input which rules I had to stick to (e.g. possible answer length, password requirements). (7) In the event of a problem, I was instructed by an error message how to solve the problem. (8) The purpose and use of the form was clear. (9) In general I am satisfied with the form.

Procedure

At the beginning, participants had to fill in a practice trial form. The quality of this form was medium (rank #14; Computerbase.de). Afterwards, participants were randomly assigned to one of the experimental conditions (original vs. improved). Participants were then sent to a landing page with general information about the selected newspapers and a link to the registration form. They were told to follow that link and to register. After successful completion of the form, participants rated the form with a set of questionnaires. This procedure was repeated for each online form. At the end participants were interviewed on how they experienced the interaction with the forms. The study investigator asked first for positive (what was pleasing) experiences and the participants could answer for as long as they wanted. Then they were asked for negative experiences (what was annoying).

RESULTS

For all statistical tests an alpha level of .05 was used. Moreover, all data were checked to ensure that they met the requirements for the statistical tests. All time metrics had to be log-transformed to achieve normal distribution.

User Performance

Number of form submission
As expected, users performed better with the improved version of the forms. In all three forms they needed fewer trials to successfully submit the form: Suddeutsche (χ^2 = 11.20, p < .001), NZZ (χ^2 = 12.93, p < .001), and Spiegel (χ^2 = 3.29, p = .035). See Table 3 for corresponding data.

Form	Trials	Original	Improved
Sueddeutsche	1	10	24
	≥ 2	22	9
NZZ	1	9	24
	≥ 2	23	9
Spiegel	1	22	28
	≥ 2	11	4

Table 3. Number of trials until form was successfully submitted.

Initial errors
Descriptive data showed that errors due to missing format rules specifications were frequent for the NZZ form (see Table 4). Chi-square tests showed that this error type was significantly more prevalent for the original condition than all other error types for NZZ ($\chi2$ = 7.17, p = .007). For the two other forms, no significant differences between the different error types and conditions were found.

Error types	Original	Improved
Missing specification	17	2
Field left blank	1	1
Captcha wrong	0	2
Mistyping	1	4
Error combination	4	0

Table 4. Initial errors for the NZZ form.

Consecutive errors
Significant differences for errors made after the form has been validated once (consecutive errors, see Bargas-Avila et al. [5]) were found for the two conditions of Sueddeutsche, p = .033 (Fisher's exact test). Descriptive data showed that in the original condition participants often ignored the error messages and resubmitted the form without corrections (see Table 5). No significant differences between error types were found for the two other forms.

Error types	Original	Improved
No corrections	14	0
No input	0	1

Table 5. Consecutive errors for the Sueddeutsche form.

Task completion time
As a consequence of the number of submissions, improved versions of all forms also performed better regarding task completion time than their original counterpart (see Table 6). An independent sample t-test showed significant differences for NZZ (t(63) = 4.39, p < .001, Cohen's d = 1.00) and for Sueddeutsche (t(63)= 3.91, p < .001, Cohen's d = .93). No significant effect was found for Spiegel (t(63)= 1.23, p < .111, Cohen's d = .38).

Form	Condition	N	M (SD)	Time improvement
Suedd.	original	32	113 (36)	
	improved	33	85 (25)	- 25%
NZZ	original	32	105 (46)	
	improved	33	70 (20)	- 33%
Spiegel	original	32	104 (66)	
	improved	33	85 (30)	- 18%

Note: Reported values are not log-transformed; statistical tests are based on log-transformed data.

Table 6. Average task completion time in seconds.

To further compare task completion times of the two form conditions, we checked the two forms with the Keystroke Level Model (KLM) [9]. We used the KLM Form Analyzer Tool from Karousos et al. [20] with the default settings except for running the analysis with the option "average typist". For all improved forms the KLM predicted time was lower than for the original forms (see Table 7). Nonetheless, participants in our study needed more time than predicted by the KLM analyzer.

Form	KLM predicted time (sec)		Improvement
	original	improved	
Suedd.	68	52	-23%
NZZ	53	49	-8%
Spiegel	91	84	-7%

**Table 7. KLM form analyzer predicted time.**

Eye Tracking
The eye tracking data were analyzed using non-parametric Mann-Whitney U tests, as data were not normally distributed. The data shown in Table 8 support results found with the user performance data. Participants assigned to the improved form condition were able to fill in the form more efficiently and needed significantly fewer fixations for the first view time (load until first submission) for Sueddeutsche and NZZ, but not for the Spiegel form: Sueddeutsche (Z = 2.57, p < .005, r = .322), NZZ (Z = 4.10, p < .001, r = .525), Spiegel (Z = 1.50, p = .067, r = .192). The total amount of time participants spent fixating a form before the first submission was shorter in the improved condition, indicating that they needed less time to process the information on screen. Total fixation duration was significantly shorter for Sueddeutsche (Z = 1.71, p = .044, r = .214) and NZZ (Z = 3.29, p < .001, r = .421). No significance difference could be shown for Spiegel (Z = 0.59, p = .277, r = .076).

Form	Number of fixations M (SD)	Fixation duration in sec M (SD)	Saccades total time in sec M (SD)
Suedd. orig. (N=31)	157 (54)	62 (23)	7 (6)
Suedd. improv. (N=33)	126 (41)	53 (18)	4 (3)
NZZ orig. (N=30)	155 (70)	62 (28)	9 (9)
NZZ improv. (N=31)	96 (37)	41 (15)	4 (3)
Spiegel orig. (N=30)	146 (70)	58 (34)	6 (4)
Spiegel improv. (N=31)	121 (43)	50 (20)	5 (4)

Table 8. Eye tracking measures for the original and the improved condition by form.

Analyzing the total time of saccades shows that participants in the original form of the Sueddeutsche ($Z = 2.20$, $p = .014$, $r = .275$) and the NZZ form ($Z = 3.88$, $p < .001$, $r = .497$) spent more time searching for information. For the Spiegel form no significant differences could be shown ($Z = 1.18$, $p = .119$, $r = .151$). Figures 2 and 3 visualize scan paths of participants in the original and the improved condition (duration 38 seconds). The participants filling in the improved form show a much straightforward scan path without unnecessary fixations whereas the side-by-side layout with left-aligned labels of the original form provoked longer saccades and more fixations for participants to orient themselves.

Figure 2. Sample extract of a scanpath in the original version of the NZZ[TM] form.

Figure 3. Sample extract of a scanpath in the improved version of the NZZ[TM] form.

Subjective Ratings

As not all data follow normal distribution, we applied the non-parametric Mann-Whitney U test to investigate the differences between the improved and the original versions of the forms. Overall, the improved forms received better ratings than their original counter parts. Participants perceived the improved versions as more usable (ASQ, $Z = 2.29$, $p = .011$; FUS, $Z = 2.71$, $p < .001$; SUS, $Z = 2.89$, $p < .001$), as less demanding (NASA-TLX, $Z = 1.85$, $p = .032$) and were more satisfied with them (i.e., FUS item 9), $Z = 1.99$, $p = .024$). However, when analyzing the three different forms separately, differences emerge. As shown in Table 9, only the NZZ form received significantly better ratings on all scales. The Sueddeutsche form, in contrast, only shows higher ASQ ratings. For the Spiegel form none of the comparisons turn out significant. Nevertheless, one should notice that all comparisons between the original and improved versions of the forms show a tendency towards the expected direction.

Effects on single items of the FUS

The original versions of the three forms have different usability issues. Therefore we analyzed the forms separately on single item level of the FUS, which is a questionnaire designed to measure form usability. Figure 4 shows that applying the guidelines on the Sueddeutsche form leads to improvements regarding the user's ability to fill in the form

Scale	Form	Original (n=32)		Improved (n=32)		Z	r^1	Improvement
		M	SD	M	SD			
ASQ	Suedd.	5.03	1.24	5.71	1.18	2.48	**.31**	10%
	NZZ	5.40	1.46	6.35	0.70	3.00	**.38**	14%
	Spiegel	5.79	1.56	5.93	1.03	0.60	.07	2%
FUS	Suedd.	4.60	0.87	4.83	0.62	0.77	**.10**	6%
	NZZ	4.75	0.81	5.49	0.44	3.84	**.48**	14%
	Spiegel	5.17	0.73	5.32	0.70	0.94	.12	5%
SUS	Suedd.	3.86	0.78	4.13	0.50	0.88	.11	5%
	NZZ	4.14	0.70	4.71	0.35	3.80	**.47**	11%
	Spiegel	4.17	0.74	4.36	0.71	1.39	.17	4%
NasaTLX*	Suedd.	22.11	15.12	17.11	12.74	1.61	.20	-5%
	NZZ	18.98	14.40	12.29	8.29	2.21	**.28**	-7%
	Spiegel	18.49	15.56	16.25	13.67	0.40	.05	-2%
Satisfaction (last FUS item)	Suedd.	4.50	1.11	4.56	1.05	0.12	.01	6%
	NZZ	4.72	1.37	5.47	0.88	2.57	**.32**	16%
	Spiegel	4.84	1.11	5.06	1.13	0.98	.12	8%

Note. *Lower values show lower workload. Values in bold are significant at the .05 level (one-tailed test), [1]effect size *r* Mann-Whitney U test ($r \geq .10$ = small, $r \geq .30$ = medium, $r \geq .50$ = large [12]).

Table 9. Descriptive statistics for questionnaire scales.

quickly (*r* = .23) and the user's perception of the helpfulness of error messages (*r* = .56). The NZZ form shows improvements on five items: "I was able to fill in the form quickly" (*r* = .38), "Mandatory fields were clearly visible in the form" (*r* = .34), "I always knew which information was expected" (*r* = .46), "I knew at every input which rules I had to stick to" (*r* = .64), and "In the event of a problem I was instructed by an error message how to solve the problem" (*r* = .41). Finally, the improved version of the Spiegel form shows higher ratings only on the item "I knew at every input which rules I had to stick to" (*r* = .49).

Effects on single items of the NASA-TLX
As the NASA-TLX measures workload in a rather broad sense, it might be that its overall score is not able to capture the subtle differences in design between the original and improved versions. Therefore we conducted an analysis on single item level of the NASA-TLX. Results show that the improved version of both, the Sueddeutsche and the NZZ form, is perceived as being significantly less frustrating (*r* = .23, resp. *r* = .37) and users feel more successful in performing the task with it (*r* = .34, resp. *r* = .36). There are no effects on workload with the Spiegel form.
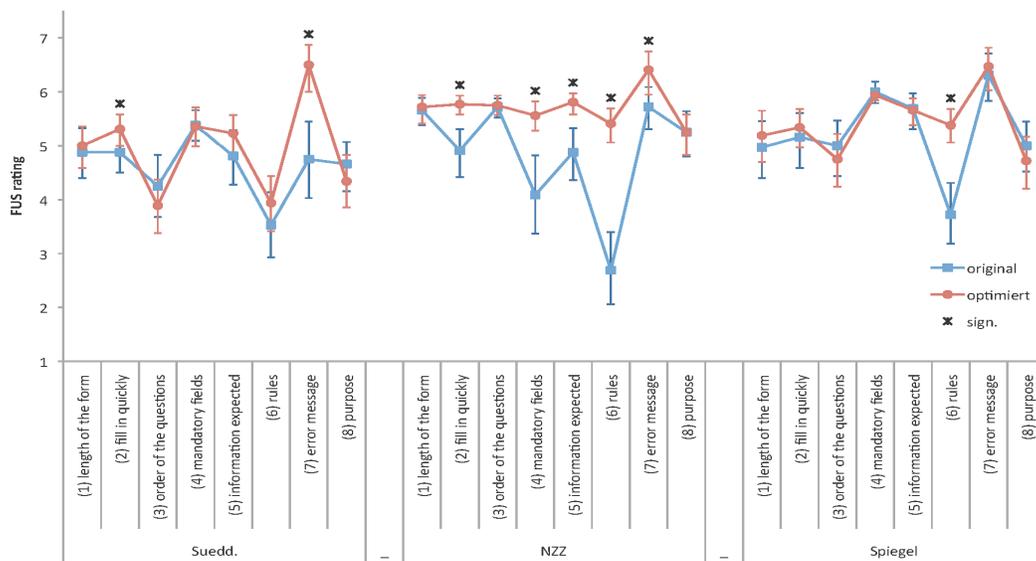

Figure 4. Single item analysis of all FUS questions for original and improved versions.

Interview data

Most frequently mentioned issues
All interview data were analyzed by grouping similar issues for positive and negative comments

- Example of a positive comment: *"I think the form is clear, I immediately knew what I had to fill in and where. And I got an error message telling me how to do it right."*

- Example of a negative comment: *"It was annoying not to know the rules for the username and password first but only learn about them in the second step."*

We further made subgroups for each form and version. In a first step, we counted the number of issues per group showing that the most mentioned issues over all original forms were missing format specifications, insufficient identification of required and optional fields and that there were too many fields overall. Positive comments regarding the original forms were about easy and fast filling, clear identification of required and optional fields, and well-structured and clearly arranged forms. The most frequently reported negative aspects over all improved forms were: unappealing design of the whole site, too many fields, and the cumbersome Captcha fields. The positive comments concerned easy and fast filling in, clear identification of required and optional fields, and the logical sequence of the fields. See Table 10 for details.

Differences between the two versions in issues mentioned
As the most mentioned issues differ between the original and original versions, we analyzed the comments by means of chi-square tests. Participants assigned to the original form condition mentioned significantly more often missing format specifications ($\chi2 = 7.74$, $p = .003$) and insufficient identification of required and optional fields ($\chi2 = 4.93$, $p = .013$) than participants assigned to the improved form versions. Detailed analysis considering the three different forms separately shows that these results are mainly due to the differences between the two versions of the NZZ form (missing format specifications: $\chi2 = 13.54$, $p < .001$ and insufficient identification of required and optional fields: *Fisher's p* = .002).

Unexpectedly, participants assigned to the improved forms mentioned significantly more often not liking the design of the whole site (as the forms were totally on the left and on the right were advertisements), $\chi2 = 7.74$, $p = .005$ instead of expressing negative comments about the forms themselves. Detailed analysis considering the three different forms separately shows that these results are due to differences between the two versions of the Sueddeutsche, $\chi2 = 5.85$, $p = .016$. No significant differences were found for the other most frequently mentioned issues.

DISCUSSION
This study showed that by applying the 20 web form improvement guidelines, all three web forms showed improvements in regard to user performance and subjective ratings. Eye tracking data revealed furthermore that the original forms needed more fixations, longer total fixation duration and longer total saccade duration than the improved forms.

Our findings highlight the importance for web designers to apply web form guidelines. A closer look at the form submission trials shows that there is great potential for increasing the number of successful first-trial submissions by applying the guidelines. Thereby website owners can minimize the risk that users leave their site as a consequence of unsuccessful form submissions. Especially guideline 13 (addressing missing format specifications) and guideline 17 (addressing the location and design of error messages) had a remarkable effect on submission trials. This finding is in line with previous research on form guidelines [4, 29].

Furthermore, data for task completion times show an improvement between 18% and 33%. These values are even better than predicted by the Keystroke Level Model Analyzer Tool from Karousos et al. [20] that predicts improvements between 7% and 23%. Eye tracking data also indicate that participants could fill in the improved forms more efficiently as they needed fewer fixations and saccades [13, 16]. This indicates that participants needed

	Original			Improved		
Positive comments	Suedd.	NZZ	Spiegel	Suedd.	NZZ	Spiegel
easy and fast filling in	14	17	10	12	16	12
well-structured and clearly arranged	3	7	7	5	7	7
clear identification of required and optional fields	5	1	13	3	9	14
logical sequence of the fields	1	5	5	6	10	4
Negative comments						
missing format specifications	5	15	2	4	2	2
insufficient identification of required and optional fields	1	10	2	2	0	1
too many fields	6	1	6	4	1	6
design of the whole site	3	0	5	11	5	6
Captcha	4	8	0	4	5	0

Table 10. Number of positive and negative comments for original and improved versions.

less time looking for specific information during form filling in the improved versions and further supports the performance data. This result is comparable to findings of former usability studies on forms [25].

Subjective ratings showed improvement of up to 16%. Items with a relation to guideline 17 (error messages, see [2, 5, 29]) and guideline 13 (format specification, [4]) showed frequent significant improvements. Finally, interview comments showed that the two conditions differed also regarding subjective feedback. While participants assigned to the original form condition mentioned significantly more often missing format specifications and insufficient identification of required and optional fields, participants assigned to the improved form condition more often criticize the layout of the whole site and not issues about the form itself. Therefore, it can be concluded that from the users' point of view, guideline 13, (addressing missing format specifications) and guideline 4 (highlighting the importance of clear identification of required and optional fields), are the most important. These findings support results of former usability studies on form guidelines [4, 26, 30].

Furthermore, our study shows that the ratings of experts and users differ remarkably. While participants assigned to the original form condition mentioned most often missing format specifications and insufficient identification of required and optional fields, experts rated these two aspects as only moderately important (as seventh and ninth out of 20, respectively). Furthermore, although Spiegel and Sueddeutsche violate two of the five most important expert-rated guidelines (see Table 2), these two forms often performed better than the NZZ form.

To sum up, the effort to improve web forms is relatively small compared to the impact on usability, as shown by our study results.

LIMITATIONS AND FURTHER RESEARCH
There are two important limitations regarding this study. First, the study took place in a lab and therefore controlled aspects that may arise when people fill in forms in real world situations. Distracting context factors were reduced to a minimum and participants concentrated on filling in forms and did not work in parallel on other tasks. Furthermore, the study focuses on newspaper online registration forms. Further research is needed to explore whether the findings from this study can be replicated with other type of forms (e.g. longer forms with more than one page or other use cases such as web shops, social networks or e-gov forms). Moreover, it would be interesting to study the implications outside the lab and perform extended A/B testings. Additionally, from an economic standpoint it would be important to know how the guidelines influence not only usability aspects, but also conversion rates. Another emerging topic that will be relevant for the future will be guidelines tailored for mobile applications.

CONCLUSION
This study demonstrates how form improvement guidelines can help improve the usability of web forms. In contrast to former research that focused on the evaluation of single aspects, the present study uses a holistic approach. In a controlled lab experiment we were able to show the combined effectiveness of 20 guidelines on real web forms. The forms used were taken from real websites and therefore reveal that web forms are often implemented in suboptimal ways that lead to lower transaction speed and customer satisfaction. In the worst case, users may not be able to complete the transaction at all. Our results show that even forms on high traffic websites can benefit from an improvement. Furthermore, we showed the advantages of a multi-method approach to evaluate guidelines. We hope this paper animates other researchers to empirically validate existing or new guidelines.

REFERENCES
1. Aeberhard, A. (2011). FUS - Form Usability Scale. Development of a Usability Measuring Tool for Online Forms. Unpublished master's thesis. University of Basel, Switzerland.

2. Al-Saleh, M., Al-Wabil, A., Al-Attas, E., Al-Abdulkarim, A., Chaurasia, M., Alfaifi, R. (2012). Inline immediate feedback in arabic web forms: An eye tracking study of transactional tasks. In *Proc. IIT 2012*, 333-338.

3. Bargas-Avila, J. A., Brenzikofer, O., Tuch, A. N., Roth, S. P., & Opwis, K. (2011a). Working towards usable forms on the World Wide Web: Optimizing date entry input fields. *Advances in Human Computer Interaction*, Article ID 202701.

4. Bargas-Avila, J. A., Brenzikofer, O., Tuch, A. N., Roth, S. P., & Opwis, K. (2011b). Working towards usable forms on the World Wide Web: Optimizing multiple selection interface elements. *Advances in Human Computer Interaction,* Article ID 347171.

5. Bargas-Avila, J.A., Oberholzer, G., Schmutz, P., de Vito, M. & Opwis, K. (2007). Usable Error Message Presentation in the World Wide Web: Don't Show Errors Right Away. *Interacting with Computers*, 19, 330-341.

6. Bargas-Avila, J. A., Orsini, S., Piosczyk, H., Urwyler, D., & Opwis, K. (2010a). Enhancing online forms: Use format specifications for fields with format restrictions to help respondents, *Interacting with Computers,* 23(1), 33-39.

7. Bargas-Avila, J. A, Brenzikofer, O., Roth, S., Tuch, A. N., Orsini, S., & Opwis, K. (2010b). Simple but Crucial User Interfaces in the World Wide Web: Introducing 20 Guidelines for Usable Web Form Design. In: R. Matrai (Ed.), *User Interfaces*, 1-10. InTech.

8. Brooke, J. (1996). SUS: A Quick and Dirty Usability Scale. In: P. W. Jordan, B. Thomas, B. A. Weerdmeester & I. L. McClelland (Eds.), *Usability Evaluation in Industry* (pp. 189-194). London: Taylor & Francis.

9. Card, S. K., Moran, T. P., & Newell, A. (Eds.) (1983). *The psychology of human computer interaction*. Routledge.

10. Christian, L., Dillman, D., & Smyth, J. (2007). Helping respondents get it right the first time: the influence of words, symbols, and graphics in web surveys. *Public Opinion Quarterly*, 71(1), 113 - 125.

11. Couper, M., Tourangeau, R., Conrad, F., & Crawford, S. (2004). What they see is what we get: response options for web surveys. *Social Science Computer Review,* 22(1), 111 – 127.

12. Field, A. (2009). Non-parametric tests. In Discovering statistics using SPSS (third edition., pp. 539-583). London: SAGE.

13. Duchowski, A. T. (2007). *Eye tracking methodology: Theory and practice* (Vol. 373). Springer.

14. Harms, J. (2013). Research Goals for Evolving the 'Form' User Interface Metaphor towards more Interactivity. *Lecture Notes in Computer Science*, 7946, 819-822.

15. Hart, S., & Staveland, L. (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. P. A. Hancock & N. Meshkati (Eds.). *Human mental workload* (pp. 139-183). Amsterdam: Elsevier Science.

16. Holmqvist, K., Nyström, M., Andersson, R., Dewhurst, R., Jarodzka, H., & Van de Weijer, J. (2011). *Eye tracking: A comprehensive guide to methods and measures*. Oxford University Press.

17. Idrus, Z., Razak, N. H. A., Talib, N. H. A., & Tajuddin, T. (2010). Using Three Layer Model (TLM) in web form design: WeFDeC checklist development. *Computer Engineering and Applications (ICCEA)*, 385-389.

18. James, J., Beaumont, A., Stephens, J., Ullman, C. (2002). Usable Forms for the Web. Glasshaus, Krefeld.

19. Jarrett, C. & Ganey, G. (2008). Forms that work: Designing web forms for usability. Morgan Kaufmann.

20. Karousos, N., Katsanos, C., Tselios, N., & Xenos, M. (2013). Effortless tool-based evaluation of web form filling tasks using keystroke level model and fitts law. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems*, 1851-1856. ACM.

21. Koyani, S. (2006). Research-based web design & usability guidelines. US General Services Administration, Washington.

22. Lewis, J. R. (1991). Psychometric evaluation of an after-scenario questionnaire for computer usability studies: The ASQ. *SIGCHI Bulletin*, 23(1), 78-81.

23. Money, A. G., Fernando, S., Elliman, T., & Lines, L. (2010). A trial protocol for evaluating assistive online forms for older adults. *Proc. ECIS*, Paper 90.

24. Nielsen, J. (2005). Sixty Guidelines From 1986 Revisited. <http://www.nngroup.com/articles/sixty-guidelines-from-1986-revisited/>

25. Nielsen, J., & Pernice, K. (2010). *Eyetracking web usability*. New Riders.

26. Pauwels, S. L., Hübscher, C., Leuthold, S., Bargas-Avila, J. A. & Opwis, K. (2009). Error prevention in online forms: Use color instead of asterisks to mark required fields. *Interacting with Computers,* 21(4), 257-262.

27. Rukzio, E., Hamard, J., Noda, C., & De Luca, A. (2006). Visualization of Uncertainty in Context Aware Mobile Applications. In *Proc. MobileHCI'06*, 247-250.

28. Seckler, M., Heinz, S., Bargas-Avila, J.A., Opwis, K., & Tuch, A.N. (2013). Empirical evaluation of 20 web form optimization guidelines. In *Proc. CHI '13*, 1893-1898.

29. Seckler, M., Tuch, A. N., Opwis, K., & Bargas-Avila, J. A. (2012). User-friendly Locations of Error Messages in Web Forms: Put them on the right side of the erroneous input field. *Interacting with Computers*, 24(3), 107-118.

30. Tullis, T., Pons, A., 1997. Designating required vs. optional input fields. In: Conference on Human Factors in Computing Systems. ACM New York, NY, USA, pp. 259–26

31. Wroblewski, L. (2008). *Web Form Design: Filling in the Blanks*. Rosenfeld Media.

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Publications (peer-reviewed)

2015

Seckler, M., Heinz, S., Forde, S., Tuch, A. N., & Opwis, K. (2015). Trust and distrust on the web: User experiences and website characteristics. *Computers in Human Behavior, 45*, 39–50. doi: 10.1016/j.chb.2014.11.064

2014

Seckler, M., Heinz, S., Bargas-Avila, J. A., Opwis, K., & Tuch, A. N. (2014, April). Designing usable web forms: empirical evaluation of web form improvement guidelines. In *Proceedings of the 32nd annual ACM conference on Human factors in computing systems* (pp. 1275-1284). ACM. doi: 10.1145/2556288.2557265

Linxen, S., Heinz, S., Müller, L. J., Tuch, A. N., & Opwis, K. (2014, April). Mental models for web objects in different cultural settings. In *CHI'14 Extended Abstracts on Human Factors in Computing Systems* (pp. 2557-2562). ACM. doi: 10.1145/2559206.2581209

Iten, G. H., Heinz, S., Stöcklin, M. K., Hübscher, R., & Opwis, K. (2014). The Impact of Interactive Visual Simulations on Learning Statistics. In *CHI '14 Extended Abstracts on Human Factors in Computing Systems* (pp. 2251–2256). ACM. doi: 10.1145/2559206.2581208

2013

Heinz, S., Hug, M., Nugaeva, C., & Opwis, K. (2013, April). Online ad banners: the effects of goal orientation and content congruence on memory. *In CHI'13 Extended Abstracts on Human Factors in Computing Systems* (pp. 1875-1880). ACM. doi: 10.1145/2468356.2468692

Seckler, M., Heinz, S., Bargas-Avila, J. A., Opwis, K., & Tuch, A. N. (2013, April). Empirical evaluation of 20 web form optimization guidelines. In *CHI'13 Extended Abstracts on Human Factors in Computing Systems* (pp. 1893-1898). ACM. doi: 10.1145/2468356.2468695

2012

Heinz, S., & Mekler, E. D. (2012, October). The influence of banner placement and navigation style on the recognition of advertisement banners. In Proceedings of the 7th Nordic Conference on Human-Computer Interaction: Making Sense Through Design (pp. 803-804). ACM. doi: 10.1145/2399016.2399156

2009

Schmutz, P., Heinz, S., Métrailler, Y., & Opwis, K. (2009). Cognitive Load in Ecommerce Applications: Measurement and Effects on User Satisfaction. *Advanced in Human-Computer Interaction*, *2009*, 3:1–3:9. doi: 10.1155/2009/121494

Poster and presentations

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Grossert, A., Heinz, S., Berger, T., Gaab, J., Alder, J., Hess, V., & Urech, C., (2014). Web-based psychological stress management program (STREAM) for newly diagnosed cancer patients: An ongoing randomized, wait-list controlled intervention study – Usability evaluation. Poster presented at IPOS 2014 (16th World Congress of Psycho-Oncology Psychosocial Academy) in Lissabon, Portugal.

Heinz, S., (2014). Kulturelle Unterschiede bei mentalen Modellen für Webobjekte. Talk presented at DGPs (49. Kongress der Deutschen Gesellschaft für Psychologie) in Bochum, Germany.

Heinz, S., (2014). Kulturelle Unterschiede bei mentalen Modellen für Webobjekte. Talk presented at TeaP (Tagung experimentell arbeitender Psychologen) in Giessen, Germany.

2013

Heinz, S., Presentation at Tagung für Hirnverletzte 2013. Mensch-Maschine-Interaktion - Zugrundeliegende psychologische Konzepte und mögliche Anwendungen in der Neurorehabilitation. Talk presented at Rehab, Basel, Switzerland.