Empirical-based Guidelines for Usable Web Form Design

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Abstract

As a result of existing empirical research and recommendations by usability experts, 20 guidelines on how to design usable web forms are postulated. They include the domains of choosing the correct input types, form submission, entry formats, layout, and error messages. All guidelines were examined whether they had been empirically tested or not. As a result, two studies were conducted for those two guidelines that lacked an empirical investigation. In a first study, the use of checkboxes versus list boxes for choosing multiple answers was compared with 106 participants. Results showed that subjects were faster and more satisfied using checkboxes compared to using list boxes. However, the functionality of the list box was understood as there were no differences in the number of answers given between the two input types. The second study compared six different versions to design input fields for date entries. The results of this study with 172 participants revealed that the version using a drop-down menu is best when format errors must be avoided, whereas using only one input field and placing the format requirements left or inside the text box led to faster completion time. Finally, the usefulness of the postulated guidelines and the potential for further examination of their application are discussed.

Introduction

In many web applications such as online shops, the design of online forms can be a crucial factor for the success of an online transaction. Before a sale can be completed, the customer has to provide address and payment information. In the web, this is often realized through an online form. The problem is that many people do not like filling in forms and they do not go to a website with the intention or goal of filling in a form. Instead, once they have chosen the items they wish to buy they want to complete their shopping as quickly and easily as possible. Therefore a form is often regarded as hurdle. If that form is difficult to use, it may even lead to the customer aborting the sale, which results in a loss of profit for the business (Wroblewsky, 2008).

Besides checkout forms for online shops, there are many other web applications, which make use of online forms. In social networking systems such as facebook.com, it is common to have to fill in a registration form in order to be allowed to use the service. In this case too, users did not visit the Internet site with the goal of completing a form; rather they wished to enter the network and make new friends as soon as possible. Here again, the form can be regarded as an obstacle (Wroblewsky, 2008).

According to Wroblewsky (2008), a successful revision and redesign of an online form can cause an increase in the completion rate in the range of 10%-40%. The eBay User Experience and Design Group reported that a redesign of the eBay registration form made a significant contribution to eBay's business and user success (Herman, 2004). In addition, users were more satisfied because they were more successful in completing the registration process.

A higher completion rate leads to more registrations and, in the case of online shops, to more sales and profit for the business. Therefore it is important that online forms do not deter customers from completing a purchase, but help them to submit their information as easily and quickly as possible.

Many guidelines have been proposed on how to make online forms more usable. Some of these have been empirically tested; others instead have derived from experience and best practice of usability experts. The goal of this work is to collect and postulate a set of basic guidelines for usable web form design. In addition, each guideline is examined whether it has been empirically tested or not. For the guidelines that have not yet been tested, it is determined whether they need to be tested or whether they are sufficiently based on commonsense. As a result, two of the postulated guidelines have been examined empirically by the author and the two corresponding studies will be described in this work.

Theoretical Background

As technologies are growing and the Internet is becoming more important, awareness is also growing that user-centered design is the way to build usable and successful websites. With user-centered design, the user is taken into account in every step of the development of a website (Garrett, 2003). The product is built to match the user's expectations and needs. According to Garrett (2003), understanding what people want and need is crucial to designing usable websites and ensuring that users come back and use the website. In the case of online forms, usability may even play a more important role, because of the dry and unpleasant nature of filling in forms. Therefore it is important that users can fill in forms as quickly and easily as possible, so that they do not become annoyed and abandon the form.

There are many different aspects to consider when designing web forms. One of the basic guidelines of user-centered design is to map the natural environment, which is already familiar to the user, as closely as possible to the virtual one (Garrett, 2003). If users are familiar with a concept in real life, it is probable that they will also understand this concept if it is applied to the online environment. In the case of web forms, this can for example be realized by providing a label and textboxes for giving answers, similar to paper forms. Beaumont, James, Stephens and Ullman (2002) even state that users' preferred input types for providing answers online are textboxes. For answers that only the user knows, no other elements than textboxes can be used. According to the Keystroke-Level Model by Card and Moran (1980), a shift from one input device (e.g., the keypad for filling in textboxes) to another—such as the mouse for selecting radio buttons—takes additional time. A demonstration by Nielsen (2000) showed that providing a drop-down menu for entering the street type (e.g., road, street, avenue) caused people to turn back to the previous field because they naturally typed the street type into the textbox for the address. Miller and Jarrett (2001) also recommend not using too many different input types in one form as this can cause confusion. Another possibility for making it easier for users to fill in an online form is to keep an intuitive order of the questions, e.g., first ask for the name, then the address and at the end for the telephone number (Beaumont et al., 2002).

Keeping forms simple and fast to fill in is one of the main goals of usable web form design. The shorter a form, the less time it takes to complete it. Beaumont et al. (2002) recommend asking only those questions that really need to be answered, e.g., the shipping address in the case of an online shop. Other "nice-to-know" questions only annoy users and demand more time to fill in the form. On the other hand, these questions may provide insight into the user population and may be helpful for marketing purposes or to know the user better.

Some stakeholders may not want to renounce these questions. If this is the case, there is still the possibility to distinguish between required and optional fields (Wilhelm & Rehmann, 2006). Here, it is important to make clear in advance which fields are required and which are optional (Linderman & Fried, 2004). Today, this is often realized through the use of an asterisk for indicating required fields. Pauwels, Hübscher, Leuthold, Bargas-Avila, and Opwis (2009) examined whether highlighting required fields by color coding leads to faster completion time in an online banking system compared to an asterisk next to required fields. They discovered that people were faster in filling in the form, made fewer errors and were more satisfied when the required fields were highlighted in color. Another study by Tullis and Pons (1997) found out that people were fastest in filling in required fields when the required and optional fields were separated from each other.

Another question in web form design relates to which input type should be used. As mentioned before, Beaumont et al. (2002) recommend using textboxes as often as possible. However, if the number of possible answers has to be restricted, e.g. because there are only three different room types available, radio buttons, checkboxes or drop-down menus can be used (Linderman & Fried, 2004). These input types are also recommended for avoiding errors and preventing users from entering an unavailable option. They are also helpful when it is not clear in advance to the user what kind of answer is expected and only the presented options make it obvious. Radio buttons and drop-down menus are defined for choosing only one option (single choice); with checkboxes users can select as many options as they like. With multiple selections, there also exists the possibility of using a list box instead of checkboxes, which saves screen real estate. Further investigation about the effect of using list boxes instead of checkboxes is needed, and will be reported in detail in section 4. Concerning the difference between the use of drop-down menus and radio buttons, Miller and Jarrett (2001) see the advantage of radio buttons in the fact that all options are visible at once whereas the advantage of drop-down menus lies in the saving of screen real estate. With the help of the Keystroke-Level Model (Card et al., 1980), it can be theoretically calculated that interaction with a drop-down menu takes longer than interaction with radio buttons, because of the additional click needed to open the drop-down menu. In an empirical study, Healey (2007) found out that on the single-question level, radio buttons were faster to choose from than drop-down menus, but the use of drop-down menus instead of radio buttons did not affect the overall time to fill in the whole questionnaire. Hogg and Masztal (2001) could not find any differences in the time needed to select answers between radio buttons and drop-down menus. Arnoux, Arnoux, Atanasiu, Chresta, and Fontana (2008) on the other hand found a significant

difference in the time needed and in the number of incorrect answers between the two input types. In their study, subjects were faster and made fewer errors using radio buttons compared to using drop-down menus. A study by Heerwegh and Loosveldt (2002) found that people needed significantly more time to select options from drop-down menus than from radio buttons, but these findings could not be replicated in a second study. Concerning the drop-out rate, no differences between radio buttons and drop-down menus could be found (Healey, 2007; Heerwegh & Loosveldt, 2002; Hogg & Masztal, 2001). According to Miller and Jarrett (2001), radio buttons should be used when two to four options are available; with more than four options they recommend using drop-down menus. When drop-down menus are used, Beaumont et al. (2002) suggest arranging the options in an order with which the user is already familiar (e.g. for weekdays, the sequence Monday, Tuesday, etc. should be used). Where there is no intuitive sequence, an alphabetical order should be considered.

A further issue concerning the decision which input type should be picked is the design of date entries. With date entries, it is important that they are entered in the expected format to avoid confusion between month and day. There exist many different ways of designing input fields for date entries and many possibilities for how they have to be completed. Christian, Dillman, and Smith (2007) examined a version where the month and year field consisted of two separate text boxes. Their study revealed that 92.9%-95.8% of people provided their answer in the correct format of two digits for the month and four digits for the year when symbols (MM and YYYY) rather than words (Month and Year) were used to state the restrictions. The rate of correct answers did not change significantly according to whether the symbols were positioned to the left, to the right or above the text boxes, as long as they were associated with the corresponding input field. Grouping all symbols together to the right of the year field led to less satisfactory results. Linderman and Fried (2004) suggest using drop-down menus to ensure that no invalid dates are entered. There exist many other ways of designing date entries and their format requirements, e.g., placing the requirements inside the answer boxes or using a single textbox. No studies are known to the author that compare these different versions; they will therefore be examined in section 5. Concerning the formatting of other answers, it is recommended to accept entries in every format as long as this does not cause ambiguity (Myers, 2006; Linderman & Fried, 2004). This prevents the user from having to figure out which format is required and avoids unnecessary error messages. If formatting regulations are required, they should always be communicated to the user in advance (Bargas-Avila, 2009a). Bargas-Avila's (2009a) study compared three versions of presenting format requirements to the user. The conditions consisted of providing a

description, providing an example and providing both. Additionally, these versions were compared to providing no requirements at all. They showed that users made fewer errors in the three versions where format requirements were stated in advance compared to the version without requirements. However, all three versions with format requirements performed equally well.

Penzo (2006) examined the position of labels relative to the input field in a study using eye-tracking methodology. He compared left-aligned, right aligned and top-aligned labels and came to the conclusion that with left-aligned labels people needed nearly twice as long to complete the form as with right-aligned labels. Additionally, the number of fixations needed with right-aligned labels was halved compared to left-aligned labels. The fastest performance however was reached with top-aligned labels, which required only one fixation to capture both the label and the input field at the same time. As a result of this study, Wroblewsky (2008) recommends using left-aligned labels for unfamiliar data were one wants users to slow down and consider their answers. On the other hand, if the designer wants the user to complete the form as quickly as possible, top-aligned labels are recommended. Another advantage of top-aligned labels is that the label length does not influence the placement of the input fields. However, left-aligned labels can result in a lot of white space between a label and its input field because of long labels in the same set of questions.

In terms of the layout of forms, Robinson (2003) states that a form should not be divided into more than one column. A row should only be used to answer one question. Concerning the length of input fields, Wroblewsky (2008) recommends matching the length of the field to the length of the expected answer. This provides a clue or affordance to users as to what kind of answer is expected from them. In Christian et al.'s (2007) study, which examined the date entry with two separate text fields for month and year, people gave more answers in the expected format (two characters for the month and four for the year) if the field for the month was half the size of the one for the year than when both fields were the same size. In another study by Couper, Traugott, and Lamias (2001), people gave more incorrect answers if the size of the input field did not fit the length of the expected input.

In the context of web forms, it is always important to guide the user as quickly and error free as possible through the form. The best way is to avoid errors from the start by explaining restrictions in advance. But often errors cannot be avoided; in this case, it is important to help the user to recover from it as quickly and easily as possible. It is crucial to tell the user that an error has occurred. To assure usable error messages in the web, Nielsen (2001) and Linderman and Fried (2004) state that an error message must be written in a

familiar language and clearly state what the error is and how it can be corrected. Nielsen (2001) also advises never deleting the completed fields after an error occurred, as this can be very frustrating for the user. In a study by Tzeng (2004), subjects were happier with a game program if the message telling users that they have failed started with an apology than when it did not. Therefore, starting an error message with a short apology should be considered. Bargas-Avila, Oberholzer, Schmutz, De Vito, and Opwis (2007) compared six different ways of presenting an error message, including inline validation, pop-up windows and embedded error messages. People made fewer errors when the error messages appeared embedded in the form next to the corresponding input fields or one by one in a pop-up window. But this was only the case if the error messages showed up at the end after clicking the send button. If the error messages appeared at the moment the incorrectly filled in input field was left (inline validation), the subjects made significantly more errors completing the form. Observations during the test sessions revealed that the subjects simply ignored or, in the case of pop-up windows, even clicked away the appearing error messages. The authors concluded that people can be in two different mental modes while they are filling in forms. During "completion mode" they fill in the input fields of the form knowing that there might be mistakes. After submitting the form, they change into "revision mode", where they acknowledge error messages, check and correct their answers. Bargas-Avila (2009b) further examined in another study the best way of presenting embedded error messages. He compared four different presentation styles, which varied from each other by having a red border around the error message, the input field and the label, and by the error message being placed above or under the corresponding input field. Subjects made fewer consecutive errors when the error message was presented under the input field with the red border.

At the end of the fill-in process, the form has to be submitted. This is usually realized through a button with an action label. Linderman and Fried (2004) suggest disabling the submit button as soon as it has been clicked to avoid repeated submissions, which can occur when long loading time leads to clicking the button several times. According to them, this can also be avoided by making appear a process indicator, which says "please wait while your form is being submitted". The authors also postulate that after submitting a form it is important to make a confirmation site appear that states whether the form has been received and what will happen next. Some web forms also offer a reset or cancel button in addition to the submit button. Many experts recommend eliminating such a button as it can be clicked by accident and does not provide any real additional value (Robinson, 2003, Linderman & Fried, 2004, Wroblewsky, 2008). If there really is a need for a reset button, however, a study by

Wroblewsky (2008) showed that people were the fastest and made the fewest errors while completing a form when both buttons were left aligned, when the submit button was to the left of the cancel button, and the two buttons did not differ in appearance. However, the subjects reported to be more satisfied with the version where the cancel button was visually distinctive from the submit button.

20 Guidelines for Usable Web Form Design

From the above-summarized theoretical and empirical background, 20 guidelines for usable web form design have been derived.

Regarding the *input type* for answers, the following guidelines are proposed:

Guideline 1: Let people provide answers in a format that they are familiar with from common situations.

- Whenever possible use textboxes for information that only users can provide.
- Keep questions in an intuitive sequence.

Guideline based on: Beaumont et al., 2002; Card et al., 1980; Miller and Jarrett, 2001.

Guideline 2: 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.

Guideline based on: Linderman and Fried, 2004.

Guideline 3: Use checkboxes instead of list boxes.

Guideline based on: Study 1: Checkbox or list box (see section 4).

Guideline 4: 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.

Guideline based on: Arnoux et al., 2008; Healey, 2007; Heerwegh and Loosveldt, 2002; Miller and Jarrett, 2001.

Guideline 5: Order options in an intuitive sequence (e.g., weekdays in the sequence Monday, Tuesday, etc.). If no meaningful sequence is possible, order them alphabetically.

Guideline based on: Beaumont et al., 2002.

To ensure usability when *submitting* a form, these guidelines are suggested:

Guideline 6: Disable the submit button as soon as it has been clicked to avoid multiple submissions.

Guideline based on: Linderman and Fried, 2004.

Guideline 7: After the form has been sent, show a confirmation site, which expresses thanks for the submission and states what will happen next.

Guideline based on: Linderman and Fried, 2004.

Guideline 8: 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.
Guideline based on: Linderman and Fried, 2004; Robinson, 2003; Wroblewsky, 2008.

Concerning the *formatting of entries,* these guidelines are suggested:

Guideline 9: If the answer is unambiguous, allow answers in any format.
Guideline based on: Linderman and Fried, 2004.

Guideline 10: If answers are required in a specific format, state this in advance through the use of advice and/or examples.
Guideline based on: Bargas-Avila, 2009a.

Guideline 11: If date entries are split into separate text fields, use symbols (MM, YYYY) and position these either left, right or above the corresponding input field. In addition, the year field should be twice as long as the fields for month and day.
Guideline based on: Christian et al., 2007.

To ensure that the *layout* of a form does not cause problems to the user, the following guidelines are suggested:

Guideline 12: To enable people to fill in a form as fast as possible, place the labels above the corresponding input field.
Guideline based on: Penzo, 2006.

Guideline 13: Keep the form as short and simple as possible and do not ask for unnecessary input.
Guideline based on: Beaumont et al., 2002; Wroblewsky, 2008.

Guideline 14: If possible, separate required from optional fields and use color to mark required fields.
Guideline based on: Pauwels et al., 2009; Tullis and Pons, 1997.

Guideline 15: Do not separate a form into more than one column and only ask for one input per column.
Guideline based on: Robinson, 2003.

Guideline 16: Match the size of the input fields to the expected length of the answer.
Guideline based on: Christian et al., 2007; Couper et al., 2001, Wroblewsky, 2008.

Regarding a usable *error message* presentation, the following guidelines are proposed:

Guideline 17: 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.
Guideline based on: Linderman and Fried, 2004; Nielsen, 2001; Tzeng, 2006.

Guideline 18: After an error occurred, never clear the already completed fields.
Guideline based on: Nielsen, 2001.

Guideline 19: Always show error messages after the form has been sent. Show them all together embedded in the form.
Guideline based on: Bargas-Avila et al., 2008.

Guideline 20: Show embedded error messages in red under the corresponding input field surrounded by a red border.
Guideline based on: Bargas-Avila, 2009b.

Table 1 lists the proposed guidelines and shows whether they have been empirically tested or not. A "no" in the column "empirical test needed" means that the guideline either has already been tested or is based on common sense and does not need to be tested. If the column "empirically tested by" is empty, the guideline has not been tested yet. Guidelines with a "yes" in the column "empirical test needed" means that empirical studies have been conducted and will be presented in the following sections.

Table 1

The 20 postulated guidelines for usable web form design, the author(s) of the empirical tests and whether the guidelines need to be tested.

No.	Guideline	Empirically tested by	Empirical test needed
1	Let people provide answers in a format that they are familiar with from common situations.		No

No.	Guideline	Empirically tested by	Empirical test needed
1a	Whenever possible use textboxes for information that only users can provide.		No
1b	Keep questions in an intuitive sequence.		No
2	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.		No
3	Use checkboxes instead of list boxes.		Yes
4	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.	Healey (2007) Arnoux et al. (2008) Heerwegh & Loosveldt (2002)	No
5	Order options in an intuitive sequence (e.g. weekdays). If no meaningful sequence is possible, order them alphabetically.		No
6	Disable the submit button as soon as it has been clicked to avoid multiple submissions.		No
7	After the form has been sent, display a confirmation site, which expresses thanks for the submission and states what will happen next.		No
8	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.	Wroblewsky (2008)	No

No.	Guideline	Empirically tested by	Empirical test needed
9	If the answer is unambiguous, allow answers in any format.		No
10	If answers are required in a specific format, state this in advance through the use of advice and/or examples.	Bargas- Avila (2009a)	No
11	If date entries are split into separate text fields, use symbols (MM, YYYY) and position these either left, right or above the corresponding input field.	Christian et al. (2007)	No
12	To enable people to fill in a form as fast as possible, place the labels above the corresponding input field.	Penzo M. (2006)	No
13	Keep the form as short and simple as possible and do not ask for unnecessary input.		No
14	If possible, separate required from optional fields and use color to mark required fields.	Tullis & Pons (1997) Pauwels et. al (2009)	No
15	Do not separate a form into more than one column and only ask for one input per column.		No
16	Match the size of the input fields to the expected length of the answer.	Christian et al. (2007) Couper et al. (2001)	No
17	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.	Tzeng (2004)	No

No.	Guideline	Empirically tested by	Empirical test needed
18	After an error occurred, never clear the already completed fields.		No
19	Always show error messages after the form has been sent. Show them all together embedded in the form.	Bargas-Avila et al. (2007)	No
20	Show embedded error messages in red under the corresponding input field surrounded by a red border.	Bargas-Avila (2009b)	No

Study 1: Checkbox or List Box?

Theoretical Background

When a user is required to choose from a predefined set of answers, this can be realized with the help of checkboxes, radio buttons, drop-down menus or a list box. If the user is allowed or asked to choose more than one answer from this set, checkboxes or list boxes come into play, because with radio buttons and drop-down menus only one option can be chosen. The advantage of checkboxes over a list box is that all answers are visible at the same time, unless they take more space than screen estate provides. This gives a list box the advantage, because it allows putting all options into one box of definable size. The invisible options can be reached with the help of a scrollbar, which allows saving screen real estate. On the other hand, a list box is harder to use and requires pressing an additional key on the keyboard in order to select more than one option. Not all users are familiar with the use of list boxes and many might not even notice the possibility of selecting more than one answer. An instruction on how to use the list box is usually needed. The use of checkboxes, on the other hand, is rather intuitive and they are easier to handle. Apart from the question of ease of use, it can be expected that with checkboxes people are faster in choosing their answers. No study is currently known to the author that has empirically tested the usage of checkboxes versus list boxes. The goal of the present study is to test whether people understand the use of a list box compared to using checkboxes. It is hypothesized that subjects select more options when using checkboxes. It is further hypothesized that users are quicker in providing their answers and more satisfied when using checkboxes than when using a list box.

Method

Design.

The testing of the hypotheses is realized through the use of an unrelated sample design. The independent variable input type consists of the two conditions checkbox and list box. The following measures are recorded as dependent variables: number of answers selected, time to select the answers and user satisfaction.

Participants.

A total of 106 subjects took part in the study. In the checkbox condition, there were 54 subjects of whom 19 were male and 35 were female. In the list box condition, 52 subjects

took part of whom 18 were male and 34 female. The mean age was 28.7 years (*SD* = 8.94), with the oldest person being 64 and the youngest 16 years old. Participants were recruited through a university database and contacted by e-Mail. As an incentive, they had the chance of winning one of three i Pod shuffles.

Procedure and Materials.

The study was conducted online. The participants were directly led to the study by clicking on a link in the recruiting mail. On the first site, they received an introduction in which they received advice on what tasks they would have to complete. They were told that they would be presented 15 questions that they should answer as sincerely as possible. Then, subjects were assigned to either the condition with checkboxes or the one with a list box. The 15 questions in the form of "Which kind of books do you like?" were presented one after another in randomized order. For each question 12 answer options were presented, of which the subjects could select as many as they liked. The answer options were presented either as checkboxes or as list boxes, depending on which condition the participants had been assigned to. In the list box condition, a text next to the list box explained that multiple answers could be selected by keeping the CTRL key pressed while selecting the options. Figures 1 and 2 show a sample question for one of the two conditions. Subjects could move to the next question by clicking on a button. After the 15 questions had been answered, participants were asked to rate three further questions on a six-point Likert-scale: "Selecting my answers was comfortable", "I could select my answers quickly and efficiently" and "I selected all answers that applied to me". At the end, subjects were asked for their gender and age and thanked for their participation.

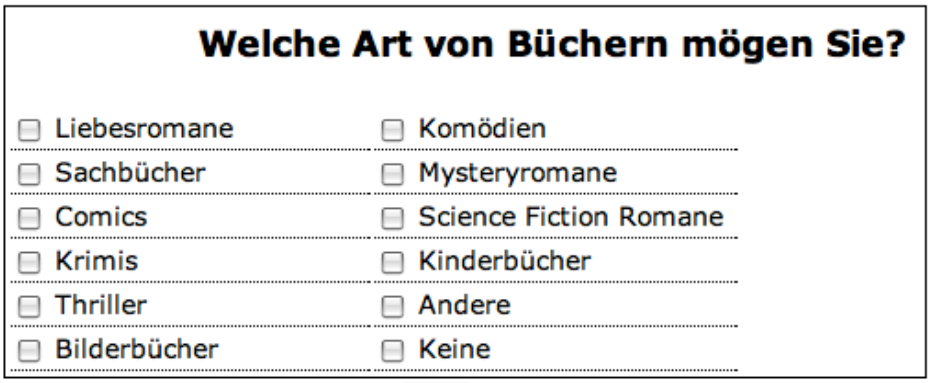

Figure 1. Example for a question with the input field type checkbox.

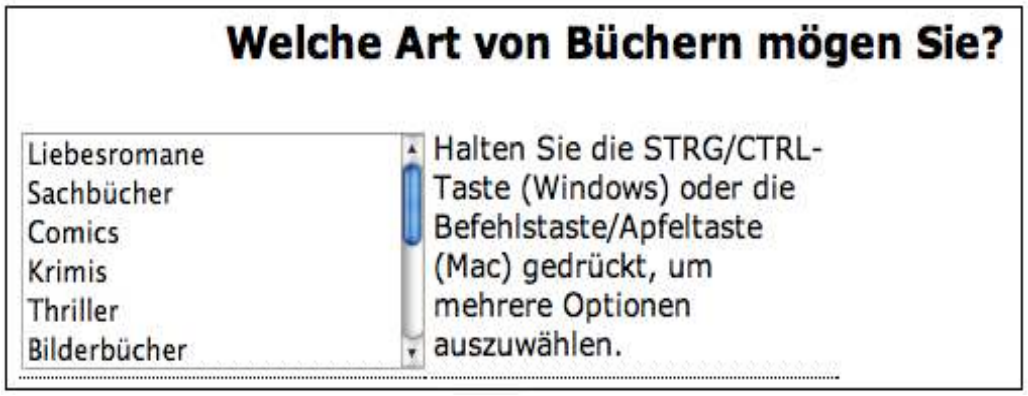

Figure 2. Example for a question with the input field type list box.

Results

An outlier analysis led to one subject being excluded. An alpha-level of .05 was used for all statistical tests.

To test whether subjects in the checkbox condition selected more options than the ones in the list box condition, an independent *t*-test was conducted. Results of the one-tailed test show that there is no significant difference in the number of selected options between the conditions checkbox ($M = 5.42$, $SD = 1.24$) and list box ($M = 5.19$, $SD = 1.36$), $t\,(103) = .910$, $p = .182$. A second one-tailed *t*-test with the logarithmic transformed mean response time to select the answers revealed that the subjects using checkboxes ($M = 9.72$, $SD = .39$) were significantly faster than those using a list box ($M = 9.88$, $SD = .41$), $t\,(103) = -2.00$, $p = .024$.

In the analysis of the satisfaction scales, one-tailed Mann-Whitney U test revealed that the condition with checkboxes ($M = 4.53$, $SD = .78$) was perceived to be significantly more pleasant for selecting options than the list box condition ($M = 3.88$, $SD = 1.53$), $U(53, 52) = 1104$, $p = .023$. Concerning the perceived efficiency, there was no significant difference between the two conditions (checkbox: $M = 4.53$, $SD = .78$; list box: $M = 4.04$, $SD = 1.50$; $U(53, 52) = 1228$, $p = .131$). Again, no significant difference between the two conditions could be found for the question as to whether all answers that applied to oneself had been selected, (checkbox: $M = 4.72$, $SD = .60$; list box: $M = 4.58$, $SD = 1.19$), $U(53, 52) = 1360$, $p = .432$.

Discussion

The results show that there is no difference in the number of selected answers between the two conditions. The hypothesis that people choose fewer answers when confronted with a list box could not be confirmed. It seems therefore that the type of input fields used does not have an influence on the number of selected answers. It was hypothesized that list boxes are harder to use and not all people know that they can select multiple options by pressing an additional key. In the study an assistant text, which explained how to select multiple answers, was placed next to the list box. It is supposed that most subjects read the text and therefore knew that there was the possibility of selecting more than one answer. To test whether people know by themselves how a list box works and would not need an explanatory text, a third condition consisting of a list box without assistant text should have been added.

As almost all of the subjects in the list box condition seemed to know how to select more than one answer; it seems that the additional effort of having to press a key did not affect motivation to select all options that applied to oneself. Besides the objective measure of the number of answers selected, this is also supported by the fact that no significant difference could be found in the answer to the question “I selected all answers that applied to me”. But as hypothesized, the use of list boxes had a negative influence on the time needed to choose the answers. People needed significantly more time to choose their answers with a list box than with checkboxes. The additional time needed with list boxes could be caused on the one hand by the additional text the subjects had to read, or on the other hand by the more complicated interaction mechanisms of pressing an additional key and having to scroll to be able to see all answers. It is supposed that all these factors cause an increase in needed time. In addition, list boxes were perceived to be significantly less comfortable for selecting answers.

As a result, using checkboxes instead of a list box whenever possible is recommended . If there are too many options, taking up too much screen real estate when presented as checkboxes, Beaumont et al. (2002) recommend using a hyperlink that opens a new window with all the possible options. This saves screen real estate and makes all options visible at once. In addition, it is supposed that this form of interaction is easier to use than a list box and does not need explanatory text.

Study 2: Date Entry

Theoretical Background

In date entry on the www there can be ambiguities, especially in global contexts. In most European countries for example, dates are written in the format day/month/year whereas in America the day follows the month. In an online environment, where a date is filled into an input field, it is therefore important to state in which format the date has to be entered to avoid confusion.

There are many ways of stating how the date entry has to be formatted. The study by Christian et al. (2007) examined one version consisting of two separate input fields for the month and the year. They compared using the words "Month" and "Year" versus the characters "MM" and "YYYY" above the corresponding input fields. They found that people provided more answers in the desired format in the condition using the characters. Another factor that led to more answers in the correct format was when the year field was twice as long as the month field. Their experiment also showed that the way the question was asked, namely "when" versus "what month and year", had no influence on the number of correctly formatted answers. Also, the position of the symbols – left, above or right to the corresponding input fields – did not significantly change the percentage of correct answers. Using a half-size month-box, separating the month- from the year-box, and grouping a symbolic instruction with the corresponding input field led to a rate of between 92.9% and 95.8% of participants reporting the date in the desired format. A good way to design input fields for dates seems therefore to divide them into separate fields for day, month and year, use characters above, right or left to the corresponding input fields, and match the size of the fields to the expected length of the answer. Lindermann and Fried (2004) also state that using separate text boxes eliminates doubt on how an answer should be provided.

Other possibilities for designing input fields for date entries with formatting requirements are using one textbox and placing the requirements in form of characters associated with the label or inside the textbox. Two other versions, where no formatting requirements need to be stated, are drop-down menus and pop-up calendars. As the author knows of no other study that tested the performance of these possibilities, a study was conducted to test which version performed best in terms of time needed to fill in the input fields and number of answers provided in the correct format.

Method

Design.

Six different possibilities were compared using a related sample 1 x 6 design. The six conditions are illustrated and explained in Figure 3 and 4.

Version 1 (separate): Three separate input fields are used for day, month and year and symbols above of the corresponding input field state how many digits have to be entered. The year field is twice the size of the month and day field.

Version 2 (drop-down): Three separate drop-down menus are used for day, month and year. The menu for the year includes dates from 1900 to 2007.

Version 3 (left): Only one input field is used. The formatting requirements are stated in form of symbols to the left of the input field.

Version 4 (inside, permanent): The formatting requirement is placed inside the input field. It stays visible when the user clicks inside the field and has to be overwritten.

Figure 3. Condition 1 to 4 of the independent variable: Input types for date entries.

Version 5 (inside): The formatting requirement is placed inside the input field. It disappears when the user clicks into the input field.

Version 6 (calendar): A calendar pops-up when the icon right to the input field is clicked.

Figure 4. Condition 5 and 6 of the independent variable: Input types for date entries.

As dependent variables, the metrics number of errors (date entries in an incorrect format), time needed to fill in the dates and number of dates that did not correspond to the ones required (e.g. 20th June instead of 21st June) were recorded. A satisfaction questionnaire measured whether entering the date was perceived as being comfortable and efficient.

Participants.

A total of 172 subjects took part in the study. Fifty-three of the participants were male, 113 were female and six did not specify their gender. The mean age was 30.33 years (*SD* = 12.07), with the youngest person being 15 and the oldest 68 years old. All participants were recruited through a university database and contacted by e-Mail. As an incentive, they had the chance of winning an i Pod shuffle or one of 10 USB memory sticks.

Procedure and Materials.

The study was conducted online. Participants had to fill in a total of 30 dates. There were five different dates, each of which was presented once in every condition, leading to 30 cycles, which were presented in randomized order to the participants. The presentation on each screen consisted of the date to fill in and the corresponding input field. Figure 5 shows an example for condition 1.

Figure 5. Example on how the task was presented to the user.

The task for participants was to fill in the date presented into the input field as fast as possible and to click on the button to proceed to the next screen. In line with the stated format requirements, dates had to be entered using two digits for the day and the month and four digits for the year. At the end, a post-test questionnaire appeared with each condition presented again on the same screen and the questions "Filling in the date was comfortable" and "I could fill in the date quickly and efficiently" were placed under each condition. Subjects had to rate these two questions for each condition on a six-point Likert-scale. Finally, participants were asked for their age and gender and thanked for their participation.

Results

An outlier analysis revealed that one subject took an abnormally long time to answer in condition 2. Therefore this subject was excluded from further analyses.

To analyze the differences between the six conditions, the mean of the five dates was calculated for each input type. In the sixth condition, where there was the possibility of choosing the date via the pop-up calendar, only data where the calendar was used were included into the calculation. An alpha level of .05 was used for all statistical tests.

To test whether the six conditions differed in the number of answers that were given in an incorrect format, a Friedman ANOVA was performed. Results indicate that there were significant differences in the dependent variable between the six conditions, $\chi 2$ (5) = 168.86, $p < .000$. As shown in Table 2 the conditions "drop-down menu" and "calendar" performed significantly better than the other four conditions. They both had zero entries in an incorrect format, because these versions make it nearly impossible to enter a date in an incorrect format. There was no difference between the other four conditions; they all led to the same number of incorrectly entered dates.

Table 2

Number of participants, mean and standard deviation for entries in an incorrect format

Version	*N*	*M*	*SD*
Version 1 (separate)	126	0.18	0.30
Version 2 (drop-down)	126	0.00	0.00
Version 3 (left)	126	0.22	0.34
Version 4 (inside, permanent)	126	0.22	0.33
Version 5 (inside)	126	0.26	0.33
Version 6 (calendar)	126	0.00	0.00

To test whether there were significant differences between the six conditions for the time needed to fill in the dates, a one-way analysis of variance (ANOVA) for related samples was conducted. Again, for the calendar condition only data where the calendar was used were included into the analysis. The global analysis revealed significant differences in the logarithmic transformed mean time between the six conditions, $F(2.72,339.49) = 112,07$, $p < .000$, with the conditions drop-down and calendar requiring more time to be filled in than the other four conditions, $F(1,125) = 289.84$, $p < .000$. The fastest performance was reached with condition 3 (left) and condition 5 (inside), which were both faster than condition 1 (separate) and 4 (inside, permanent), $F(1,170) = 32.46$, $p < .000$. Mean values for the time needed to fill the dates are shown in Table 3.

Table 3

Number of participants, logarithmic transformed mean and standard deviation for the six conditions for the time needed to fill in the dates

Version	*N*	*M* (ln)	*SD*
Version 1 (separate)	126	9.05	0.30
Version 2 (drop-down)	126	9.34	0.23
Version 3 (left)	126	8.99	0.30
Version 4 (inside, permanent)	126	9.08	0.27
Version 5 (inside)	126	8.97	0.28
Version 6 (calendar)	126	9.38	0.37

When analyzing the number of incorrect dates entered Friedman's ANOVA revealed that in condition 6, consisting of the calendar ($M = .18$, $SD = .30$), more dates that were different

from the ones required were entered than in the other five conditions, $\chi 2(5, N = 122) = 43.36$, $p = .000$.

To compare the subjective evaluation, a Friedman ANOVA was conducted. Concerning the question whether the action of entering the dates was perceived as being comfortable, the global analysis revealed significant differences between the six conditions $\chi 2(5, N = 161) = 86.04$, $p < .000$, with version 4 (inside, permanent) being perceived significantly less comfortable than each of the other versions. There was no significant difference between the other five versions in the perceived comfortableness. The mean and standard deviation for each version can be seen in Table 4. Significant differences were found between the six conditions as far the perceived efficiency and speed of entering the dates was concerned, $\chi 2(5, N = 155) = 93.40, p < .000$. Again, Version 4 was perceived as being less efficient than the other versions. Version 2 was perceived as being less efficient than versions 3 and 5. In addition, version 3 was rated significantly more efficient than the calendar version. The means and standard deviations of each version can be found in Table 4.

Table 4

Number of participants, mean ratings and standard deviation for the subjective evaluation about the comfortableness and the speed and efficiency of the six conditions (1 = doesn't apply; 6 = applies)

	Comfortableness			Speed & Efficiency		
Version	*N*	*M*	*SD*	*N*	*M*	*SD*
Version 1 (separate)	161	3.75	1.71	155	3.80	1.71
Version 2 (drop-down)	161	3.65	1.85	155	3.30	1.74
Version 3 (left)	161	4.04	1.44	155	4.23	1.44
Version 4 (inside, permanent)	161	2.66	1.38	155	2.72	1.39
Version 5 (inside)	161	3.95	1.39	155	4.10	1.50
Version 6 (calendar)	161	3.70	1.82	155	3.35	1.73

Discussion

The results show that with the versions drop-down and calendar, no formatting errors are registered. Concerning the other four versions, none of them performed better or worse than the other for the mean number of formatting errors made. But if the time needed to fill in the dates is analyzed, the two versions that performed best in number of formatting errors (drop-down and calendar) were the slowest. Therefore, there is a trade-off in the number of formatting errors and completion time. If it is important that no formatting errors occur, either the calendar or the drop-down version should be used at the expense of more time needed by the user to fill them in. If, on the other hand, completion time is a more important factor than correctly formatted answers, one of the other versions can be considered. There was no difference in the number of formatting errors between versions 1, 3, 4 and 5 but when analyzing completion time, versions 3 (left) and 5 (inside) performed best. They also received the highest ratings in both satisfaction ratings. Therefore when formatting errors are secondary, using one of these two versions is recommended. For version 5, where the format advice disappears as soon as the field is activated, it may be argued that in using the tab key the user might accidentally delete the format requirement. This is a legitimate argument, which could not be tested in this study as there was only one input field per screen and tabbing was not possible or necessary. Version 1 (separate), which has been proposed by Beaumont et al. (2002) and Christian et al. (2007), did not lead to fewer formatting errors and took more time to be filled in than version 3 (left) and 5 (inside). Version 4 (inside, permanent) was rated as being significantly less comfortable and efficient than the other versions. As it does not seem to prevent formatting errors any better than other versions, using this type of date entry field is not recommended .

Concerning the difference between drop-down and calendar version, using the drop-down menu to ensure that fewer errors occur is recommended. In the calendar version of our study, it was also possible to enter a date manually without using the calendar. For this reason, it could be that people either did not see the calendar icon or decided not to use it. In the study, 28% of the subjects never used the calendar and only 25% used it for all five dates they had to enter. If a designer wants to force use of the calendar, it has to be implemented in such a way that the calendar automatically pops up when clicking into or activating the corresponding input field. In some cases, however, it is not practical to use a calendar to enter a date. For example, entering one's birth date with a calendar that has no incorporated drop-down for selecting the year and month can be very time consuming. A calendar that can be activated by the user, however, can be very helpful for date entries where it is important to

know the exact weekday of the date. This type of calendar is, for example, commonly used on travel websites to book flights and hotels.

The reported findings should be tested in a complete form to see whether these rules also apply in a natural environment. The interaction with the labels should be taken into account, especially in version 3 (left), where the label and the formatting advice are placed to the left of the input field. In this case, it should also be tested as to whether the formatting advice should be associated with the label or the input field.

General Discussion

Twenty guidelines for usable web form design have been presented. They consist of recommendations by usability experts, some of which have been empirically tested. These guidelines need to be confirmed in the long term to see whether they really lead to a better usability which manifests itself by faster form completion time, fewer errors, and higher user satisfaction.

The guidelines leave some points open; for example, it is still not clear where the format requirements for date entries should be placed. To make sure that format errors do not occur, drop-down menus should be used. However, they need more time for completion and guideline 1 recommends using text fields whenever possible. The fastest way to enter a date has been shown to be when the format requirements are placed to the left of the input field or inside of it, where it disappears when the user clicks inside the field. As mentioned before, the performance in a real form has to be tested, in particular the interaction with the label and the performance with the tabbing function.

A further issue is the fact that the comparison of radio buttons and drop-down menus led to ambiguous results. In practice, there does not seem to be a clear advantage of radio buttons over drop-down menus. In Arnoux et al. (2008), the task was to find a target word between the available options as fast as possible. Here, the authors found a clear advantage of radio buttons over drop-down menus in the time needed to select the answers and the number of errors. Hogg and Masztal (2001), on the other hand, compared radio buttons and drop-down menus using a more realistic task of making subject fill in a form. In this scenario, no significant differences were found between the two input types. It seems therefore that both input types are appropriate for use in web forms, with a slight tendency of radio buttons being faster to choose from. With a high number of options, however, the advantage of radio buttons clearly seems to be outweighed by the amount of screen real estate needed. The suggestion of Miller and Jarrett (2001) of using radio buttons with few options (up to 4) and drop-down menus when more are available seems to be reasonable and practical.

The problem of too many available options can also cause problems with checkboxes. If they take up to much screen real estate, usability suffers. In our study, the alternative (consisting of a list box) performed suboptimally in the time needed to select the options and in satisfaction ratings. It remains to be tested whether the suggested version by Beaumont et al. (2002) of using a hyperlink will perform better than a list box.

Concerning the distinction of required and optional fields it remains to be seen whether color coding required fields will establish itself in the web, given that the use of an

asterisk is commonly used across the web and seems to have become standard. Changing a well known mechanism can be difficult in the beginning because it costs the user reorientation and time. Using color to code required fields may also cause accessibility problems, as blind people may have difficulties separating the colored fields from the white ones and, also, screen resolutions with insufficient contrast and those without color may result in problems (Beaumont et al., 2002). Beaumont et al. (2002) further note that in an online environment color alone should never be relied on to convey a message. If no color can be displayed, it should still be possible to distinguish optional from required fields. It is therefore suggested that an asterisk should continue to be used for marking required fields, but additionally the required fields should be highlighted using color. Tullis and Pons' (1997) study also included the condition of highlighting required fields by using color. Additionally, they also tested a version using chevrons in front of the label, which was the one most similar to using an asterisk. Their results did not find any differences between color coding required fields and using chevrons in front of the label in the time needed to complete the form, but the satisfaction ratings showed that color was preferred over chevrons. Pauwels et al. (2009) used an asterisk placed between the label and the input field whereas Tullis and Pons (1997) placed the chevrons in front of the label, which further reduces the comparability of the two studies. It remains to be examined whether placing an asterisk in front of the label or in between the label and input field makes a difference.

Future research is needed to show whether the postulated guidelines lead to a higher completion rate of web forms. In a further study, it is planned to apply these guidelines to existing forms and simultaneously publish both the modified and the original version online. Through this method, the drop-out rate and time needed to fill in the form can be compared and whether the postulated guidelines lead to an improvement can be assessed.

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