

# Towards Determinants of User-Intuitive Web Interface Signs

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**Abstract.** User interfaces of web applications encompass a number of objects like navigation links, buttons, icons, labels, thumbnails, symbols, etc. which are defined in this paper as interface signs. Designing interface signs to be intuitive to the users is widely accepted to have a significant effect on enhancing web usability. Interface signs design principles are semiotics by nature, as semiotics is the doctrine of signs. Thus, the fundamental objective of this study is to reveal the determinants of user-intuitive interface signs for enhancing web usability from a semiotics perspective. To attain this research objective, an extensive user study was conducted with twenty six participants following a semi-structured interview approach. The preliminary results provide a number of determinants and their attributes to interpret properly the meaning of interface signs.

**Keywords:** Semiotics, interface sign, web usability, user interface design, web sign ontology.

## 1 Introduction

The smallest elements of web user interfaces such as navigational links, small images, thumbnails, short text, command buttons and the like are called interface signs in this research. Interface signs act as communication artifacts in the UI to convey web content and system functionalities. Designing intuitive interface signs is essential in order to achieve user satisfaction, proper task performance, user communication, system learnability, effective and efficient use, etc... i.e., according to usability standards [1],[2],[3],[4]. These interface signs' design principles are semiotics by nature as semiotics is considered as the science of signs [5].

Semiotics can be defined as “the study of signs, signification, and signifying systems” [6]. A semiotic model proposed by Peirce [5] consists of a triadic relationship containing the *representamen* (the sign itself that stands for something to somebody in some respect or capacity), the *object* (actual thing the sign stands for) and the *interpretant* (created in the mind of the interpreter an equivalent or more developed sign). A sign requires the existence of these three constituents concurrently. According to semiotics theories an interface sign (*representamen*) needs

to be designed intuitively so that it creates a sense in the perceiver's (*interpretant*) mind to understand the actual meaning (*object*) of this sign. Therefore, semiotics research on web interface in particular focuses mainly on the language of the web interface and its usability.

The interface signs are designed as encoded form in the UI. End users decode these signs in order to obtain the desired information or to perform specific tasks. End users can perform the desired task or obtain the information accurately only when end users' interpretant matches the referential object of the interface signs with the designer's interpretant. There is no one-to-one link between the sign and its referential object [7]. Moreover, different interpreters may interpret a sign in a number of ways. As a result, some signs might be very easy to interpret for some users while some others may not. Therefore, the fundamental objective of this study is to reveal the determinants of user-intuitive interface signs for boosting web usability from semiotics point of view. A fundamental research question for this research is formulated as "What are the determinants of user-intuitive user interface signs from a semiotics perspective in order to improve web usability?".

This paper is organized as follows. Previous works related to this study are discussed briefly in section 2. In section 3, the study method is presented. The study results are discussed in section 4. The conclusion and ideas for future work are presented in the final section.

## 2 Related Research

Some research related to semiotics perception in user interfaces has been conducted in the HCI research area in the last decade [8]. This section provides a brief overview of a few selected research related to this study.

Bolchini et al. [9] included 'interface signs' as one of the design and evaluation dimensions of web user interface. They proposed a set of heuristics to be used as an additional toolkit to evaluate web interface signs. Andersen [10] provides a methodological framework to analyse HCI rooted in the semiotics. In his work, Andersen showed how computer based signs mediated peoples' interaction with the computer systems.

De Souza [1] introduced semiotic engineering in HCI, where she treated HCI as a new triangle consisting of the user, the designer, and the system. De Souza et al. [11] proposed a semiotic engineering evaluation method in HCI named Semiotic Inspection Method (SIM), encompassing five core steps [12]: (i) inspection of the metalinguistic signs, (ii) inspection of the static signs, (iii) inspection of the dynamic signs, (iv) comparison of the designers' meta-communication message produced in the prior three steps, and (v) summary evaluation of the quality of entire meta-communication of designer to user.

A user study conducted by Islam [13] showed that users' inaccurate interpretations of interface signs were significantly aligned with usability problems and, as a consequence, with their effects on overall web usability. In another study, he investigated issues related to web interface signs' re-design and their meaning's intuitiveness [14], [15]. These study results provide a set of semiotics considerations to design and evaluate web interface signs.



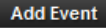



An empirical study conducted by Islam & Tétard [16], showed that integrating semiotic perception in usability testing produced a set of benefits that contributed to the usability evaluation such as providing an overall idea of interface signs' intuitiveness, helping to find usability problems, recommending possible solutions, and conveying the understandability of interface signs.

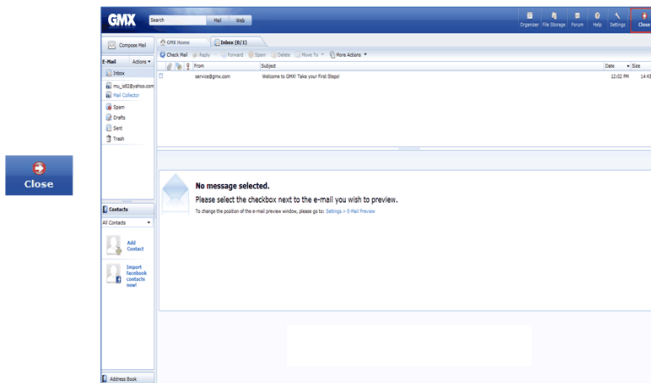
### 3 Research Method

A user study following a semi structured user interview research method was conducted to attain the research objective. The following steps were followed to perform the user study effectively as well as efficiently.

1. *Define the study objective* – the objective of this study was to reveal the factors of users' interpretations of interface signs. In other words, to observe the determinants why some interface signs are more intuitive to the end users while some others are not.
2. *Develop study instrument* -
  - *Selecting the web interface signs* – interface signs were retrieved from the user interfaces of two web application domains (online calendar and email application) and two web domains (university and museum websites that belong to educational and cultural heritage web domains respectively). A total of 18 interface signs were selected from each domain thus a total of 72 interface signs were selected for this test. In this stage, webpage snapshots for each of the 72 signs were taken and stored. A few heuristics were employed to select the interface signs. These were: (*h1*) signs used to provide most common information or functionalities in a particular application; (*h2*) signs provide same information or functionalities but only differ by its representamen; (*h3*) signs which did not fit with heuristics *h1* & *h2* but seemed important for this study. A list of selected example signs is shown in Table 1.
  - *Prepare pre-test questionnaires* – a set of questions were prepared to obtain the data related to the participants' demographic profile, their experience and familiarity with selected web applications, and the like.
  - *Develop interview question* – the questions were developed based on the main objective of this study. Three types of questions: open ended, probing, and closed questions were developed following the interview guidelines suggested by Stanton & Young [17]. In this stage, a data collection sheet is also prepared to make it easy to transcribe and store the transcribed data. An example set of questions is presented in Table 2.
3. *Piloting the test* – a pilot test was conducted with two test subjects. Pilot test's outcomes were considered to finalize the order of the questions, make clear and concise questions, order the display of interface signs, and the like.
4. *Recruit appropriate test-subjects* – a total of 26 students were recruited as test subjects for this research project since (i) users who have internet access facility as well as are familiar with web browsing could be considered as the potential users of the selected web applications, (ii) the study was planned to be conducted on web user interface, (iii) it was easy to access students as test subjects.

**Table 1.** A list of selected example interface signs

| Interface sign  | Application/Website | Domain            | Heuristic |
|---|---------------------|-------------------|-----------|
|  | University of Oulu  | educational       | <i>h1</i> |
|  | Design Museum       | cultural heritage | <i>h1</i> |
|  | Yahoo! calendar     | online calendar   | <i>h2</i> |
|  | Hotmail calendar    |                   |           |
|  | Google calendar     |                   |           |
|  | Yahoo! mail         | e-mail            | <i>h3</i> |

**Fig. 1.** A sign presented without context (left side) and with context marked by rectangle (right side), snapshot taken from www.gmx.com dated on September, 2012

5. *Conduct test* – the actual test was conducted with 26 participants at the usability laboratory at Åbo Akademi University during late 2012. Each test was conducted one by one. The following activities were followed in each test session with each participant. Firstly test subjects filled up pre-test questionnaires; secondly a short lecture was given to inform the test subjects about the test in general like test procedure, test participants' roles, etc.; and finally test subjects seated in front of a computer and gave answers to a set of questions (see Table 2) for each interface sign presented to them. Selected interface signs were presented to test subjects in two arrangements through the presentation software Microsoft® PowerPoint: (i) *sign without context*, where only the sign was presented without the source webpage and only retaining the original size and color, and (ii) *sign with context*, where the source webpage snapshot was presented and the interface sign was marked by a red-color rectangle. Test subjects were not allowed to click on the signs, they were only supposed to respond to a number of questions for each interface sign. Each test session was audio and video recorded. An example of a user's response for a sign is presented in Table 2.

**Table 2.** An example of a test-subject's responses

| Sign presented without context (see left side one in figure 1) |  |
|--|--|
| Q1:  | What could be the referential meaning of this sign?  |
| A:   | <i>"It seems difficult to me. 'Right arrow' icon is conflicting with the word 'close'. Why close used in email. Generally it uses in computer to close a folder, but i do not know whether in email there is any necessity to close the window. However, since this sign is taken from email application, it may used to close an open email."</i> |
| Q2:  | Why do you think this as the referential meaning of this sign?   |
|  | <i>"Familiarity with computer uses, where I used this sign close an open window."</i>  |
| Q3:  | How much complicacy / difficulty do you feel to interpret this sign? [score: 1(very easy) - 7(extremely difficult)]  |
|  | <i>"4"</i>   |
| Q4:  | How certain/confident are you that you are right in your interpretation? [score: 1(very low) - 7(very high)]   |
|  | <i>"5"</i>   |
| Q5:  | Do you have any suggestion to re-design this sign to be more intuitive to interpret its meaning?   |
|  | <i>"No, I do not have."</i>  |
| Sign presented with context (see right side one in figure 1)   |  |
| Q1:  | Do you think the referential meaning of this sign is the same as you told before? If not, what is the referential meaning of this sign?  |
| A:   | <i>"I do not understand why this close sign is at this position. why it is? Where is the sign out option? No sign out option is available here, that means it may be sign-out."</i>  |
| Q2:  | Why do you think this as the referential meaning of this sign?   |
|  | <i>"There is no sign out option in this page and the position of this sign."</i>   |
| Q3:  | How much complicacy / difficulty do you feel to interpret this sign? [score: 1(very easy) - 7(extremely difficult)]  |
|  | <i>"6"</i>   |
| Q4:  | How certain/confident are you that you are right in your interpretation? [score: 1(very low) - 7(very high)]   |
|  | <i>"6"</i>   |
| Q5:  | Do you have any alternate suggestions for redesigning this sign that might be comparatively more intuitive to interpret its meaning properly?  |
|  | <i>"It is better to use a sign 'Sign-out'."</i>  |
| Q1:  | Why do you think that this (proposed alternative sign) sign is more intuitive than the said one?   |
| A:   | <i>"The word 'close' is mostly used for closing window not for signing out. Moreover, icon of 'right arrow' is not clear to me. If a cross or back arrow icon is used here, then it still will not make the sense properly. Better not to use any icon. Use only the text 'Sign-out'."</i>   |

6. *Transcribe and gather interview data* – the test videos were then replayed and transcribed fully into text. Transcribed data were gathered in a Microsoft® Excel spreadsheet. Data was organized in columns (asked questions) and rows (participants' responses) for each participant. Both qualitative and quantitative data were collected through this test. Interface signs were presented in two arrangements (*with context* and *without context*), minimum number of questions answered was 4 for each presented sign thus a large volume of data [26

(participants) x 72 (interface signs) x 2 (sign presented with and without context) x 4 (minimum no. of questions responded)] was collected from this test.

7. *Analysis of the study data* – Marshall [18] suggests that a careful reading and summarization of descriptive text can be sufficient for a general evaluation of qualitative data. Therefore, firstly a careful reading and summarization of descriptive text was performed. The study data were then preliminary analyzed following a basic process of qualitative data analysis model named *noticing, collecting & thinking* model suggested by Seidel [19].






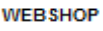
## 4 Study Results

The preliminary results help us identify a number of determinants and their attributes to interpret the meaning of interface signs from a semiotics perspective. These determinants and attributes could be used as semiotics considerations for the design and evaluation of user-intuitive interface signs. The determinants and their attributes observed so far are briefly presented in this section.

User's presupposed knowledge: The user's presupposed knowledge refers to the user's pre-familiarity with interface signs and their referential meaning. A user can interpret a sign because of his/her familiarity with that sign. For instance, a user can easily understand and interpret the meaning of the sign 'Inbox' because of his/her familiarity with this sign in some email applications. In such case, the basis for interpreting the sign's meaning accurately is the presupposed knowledge of the web application domain. This study found a set of user presupposed knowledge to interpret interface signs such as: (i) user's presupposed knowledge of internet or web use; (ii) web application domain; (iii) website's / application's real world environment; (iv) web application domain's real world environment; (v) computer use; (vi) mobile phone uses, etc... An instance of user response for a sign 'Logout' is presented in Table 3. A user response to this sign showed that the bases of the user's accurate interpretation with high confidence and no complexity were (i) all kinds of web application have this sign, i.e., pre-familiar with this sign in other web applications, (ii) underlining of the sign which refers to its interactivity. This example of user response showed how a user's presupposed knowledge of internet/web use helped to interpret the 'Logout' sign.


Interface signs' interactivity: This study found that web interface signs could be used for different purposes such as (i) decorative or aesthetic (sign used only for aesthetic purpose); (ii) indicative (one cannot interact with this sign and the sign is used only to provide suggestions or hints in the UI, e.g., a webpage title could be treated as an indicative sign); (iii) interactive (one can interact with this sign only for getting some indication or hints, not for performing a task, e.g., there might be some interface signs in UI that may provide some messages or hints only if a cursor put or move on these signs); (iv) functional (e.g., interactive sign to perform a task such as to submit an online form); and (v) navigational (e.g., interact with sign to go through to further details information, e.g., navigate to other pages to access related information). The interactive, functional and navigational interface signs could have

**Table 3.** Examples of user responses for six interface signs (presented without context)


| Sign and Domains   | Meaning   | Basis  | Conf | Comp |
|--|---|--|------|------|
| <br>(email application) | “It means log out from email application. It’s a hyperlink as it has underline.”  | “All kind of web application has this sign. Underline refers to hyperlink since the 19s internet.”   | 7    | 1    |
| <br>(university web)    | “It is navigational. Its for the library of university where you can get many services like read books, rent books.”  | “I have seen this before. For the icon it helps me more. Otherwise I may thought it as a programming library.”   | 7    | 1    |
| <br>(university web)    | “It means twitter. what i linked it with the twitter, a social media.”  | “It is colored. So I am more confident it is twitter. Only the confusion is whether it is for sharing or visiting the university social network page.” | 5    | 2    |
| <br>(university web)    | “Button for function.”  | “I guess it. This letter <i>f</i> is used in mathematics for function.”  | 1    | 6    |
| <br>(museum web)        | “For the shopping site. Not the online shop but it is a tourist shop at the museum. It is a navigational label. I will not surprised more if it is web shop but in that case probably I will give it names as webshop.” | “Interpret based on the word meaning.”   | 5    | 2    |
| <br>(museum web)      | “it refers to online museum shop. It is navigational.”  | “The word and my familair with web uses.”  | 7    | 1    |

two states: active (one can click on it) and inactive (one cannot click on it). An instance of user response for the sign ‘Logout’ presented in Table 3 showed how the underline helped the user to interpret and understand its interactive purpose.

Ontological classification: From a designer’s perspective, a set of knowledge presupposed and pointed by an interface sign (i.e. a semiotic unit) is defined as ‘Ontology’ [2]. Speroni also listed a set of web sign ontologies in [2] such as interlocutor ontology, website ontology, commonsense ontology, web domain ontology, internet ontology, topic ontology, and context ontology. Based on Speroni’s definition and concept of ontology, interface signs were classified into different ontological signs in this study. The study observed that the interpretation accuracy, confidence and complexity of users’ interpretations of interface signs varied depending on different ontological signs. Thus interface sign ontology is treated as a


determinant to interpret sign meaning. For instance, the '' sign (see Figure 1) belongs to website ontology [2], as this sign is not commonly used in email or any other online applications and is very specific to GMX email application. The 'Logout' (see Table 3) sign belongs to internet ontology [2], as this sign is commonly used in many online applications. These both signs actually stand for signing out from an online system. But this study showed that, while presented without context, these two signs were interpreted differently by two test subjects (see Table 2 and 3). Their interpretations showed that the sign belonging to internet ontology was interpreted accurately with high confidence and no complexity whereas the sign belonging to website ontology was interpreted inaccurately (confused) with comparatively less confidence and high complexity. A more detailed about this determinant is discussed in [20]).

*Amplification Features of Interfaces Signs:* This study observed that a few features of interface signs assisted users in interpreting interface signs accurately with comparatively less complexity and high confidence. These are listed here as amplification features. These features are individually not enough to express the meaning properly and generally append with other signs. The attributes of amplification features are (i) appended small image, (ii) appended thumbnail, (iii) appended icon with textual sign, (iv) appended short text, (v) appended indicative text with iconic sign, (vi) appended abbreviated letter (e.g., e, m, i, etc.) with textual sign, etc... For instance (see Table 3), the sign 'Shop' in museum website will not make complete sense as it may be confusing to the user whether the sign refers to the information of a physical museum shop or whether it will bring the user to the online museum shop. Again a sign 'Webshop' refers to the same thing and the user grasp its meaning without any confusion only because of the word 'web'. The word 'web' separately does not make any sense but when appended with another word 'shop', it strengthens the user's interpretation of a sign.

*Interface Sign Position:* The position of a sign in the user interface assists in making sense when interpreting a sign's meaning. This study observed a few attributes of this feature such as user habit, neighbor signs, etc. Users are used to see some interface signs in some particular positions in web pages for instance interface signs that provide accessibility features for disabled people (e.g., sign for resizing text) are mostly placed in the upper left side of a webpage. Neighbor signs make sense when interpreting a sign, even if the user may not be familiar with this sign. For instance, the sign 'Agendum' is not familiar to a user and therefore a user may be unable to interpret the sign's meaning without context whereas in context user may be able to interpret the meaning properly only because of the understanding of the neighbor signs - 'Day', 'Week', 'Month', etc. These neighbor signs help the user making sense about the meaning of 'Agendum' sign in Hotmail application. Again the sign '' (see Figure 1 and Table 2) was accurately interpreted by a user when presented with context. The position of this sign on the web page was one of the bases to interpret this sign accurately, since the user was used to interface signs located at this specific position for signing out in some other online applications.



*Sign Color:* Sign colors positively affect user interpretations of interface signs. Color, light, and contrast are also often used to express the interactivity of interface signs. In other words, interface signs color helps users understanding whether a sign is active or inactive, currently visited or already visited. This study observed a few attributes of this feature such as color contrast, user attention, brand color, interactivity suggestions, sign importance, etc. For instance, the Facebook sign (see Table 3) was interpreted as a mathematical function since in mathematics ‘Function’ is represented by the symbol  $f$  and the sign is presented as black grey color. The same user interpreted the Twitter sign (see Table 3) accurately. The user was familiar with Facebook use and had an idea about social media in general but failed to interpret the sign only because of its lack of brand color (blue). The Twitter sign held its brand color and was therefore interpreted accurately.

*Matching Features of Interface Sign:* An accurate interpretation of interface signs depends on the matching of interpretant and object. The interface sign’s object and the user’s interpretant need to match to interpret the meaning of interface sign properly. There are a few attributes of this matching feature such as (i) conventions, (ii) underline reality, (iii) clearness of designer’s motivation, (iv) correspondence with the real world object, (v) functional similarities, etc. The concepts of paradigm and syntagm could be used here. For instance, a user accurately interpreted the interface sign ‘’ (see Table 3). According to him, the sign might have been interpreted it as a programming library if the sign only used the word ‘Library’, since the word ‘Library’ refers to both concepts (university library service and programming library) in the educational web domain. The small images of books motivated him to interpret the sign accurately (i.e., to access the university library services). Thus the matching attributes like clearness of designer’s motivation (by the appended small images) and correspondence with the real world object (as how the images look like) assisted him in making sense when interpreting the sign meaning.

## 5 Conclusion and Future Work

This empirical user study provided a set of determinants and their attributes for interpreting web interface signs and grasping their referential meaning. The observed determinants and attributes could be used as semiotics consideration for designing and evaluating user-intuitive interface signs to enhance web usability. For instance, the attribute ‘brand color’ of the ‘interface sign color’ determinant provided a semiotic consideration in the form of a design guideline: ‘maintain the interface sign’s brand color, if it exists’. However, these are not claimed to be a complete set of determinants and attributes. Therefore, the author intends (i) to perform a rigorous analysis on the study data and (ii) to consider the outcomes of other studies conducted through user observation and expert inspection to produce a complete set of determinants for designing user-intuitive interface signs. The findings of these (comparative study, user tests) studies will be converged to propose a semiotic mode for user interface sign design and evaluation. In the final phase, an empirical user study will be conducted to validate and refine the semiotic model.

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