SUMMARY

- Proposes a framework for analyzing the characteristics of heuristics for Web design
- Demonstrates the value of the framework by analyzing three existing sets of guidelines

Characterizing Web Heuristics

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INTRODUCTION

The World Wide Web has grown rapidly and has become a widely used means of communication. Yet little is known about "what works" in Web site design. Designers of any communication system, product, or policy try to apply the best available knowledge from fields such as linguistics, social and cognitive psychology, and human factors research. But the research findings of these fields are often contradictory; furthermore, it is questionable whether findings from research in these fields can be generalized to the design problem at hand. They rarely are so specific that they can help the designer in making decisions during a particular project.

Web designers, even more than designers of other communication products, have difficulties deciding about functions, audiences, content, tone, words, images, sound, and so forth (van der Geest, in press). Compared with designers in traditional paper media, who present information through text and graphics, the Web designer has an even wider range of presentation modes and variables to choose from, options that interact and mutually influence effectiveness. Additionally, the medium is so novel that almost any solution is a nonstandard solution, especially because until now, most attention about Web design has focused on the technical development rather than on its character as a means of communication. It is not surprising that many Web designers resort to Web design guidelines that capture the knowledge and experience of others.

A quick Internet search using the keyword *Web design* produces 754,904 hits. A search within those hits using the keywords *design guidelines*, *design principles*, *design rules*, *design criteria*, or *heuristics* produces a total of 384 hits. These 384 hits form a broad collection of guidelines on the technology and tools that make the Web run (for example, Javascript or HTML), galleries of images and sounds, user interface design principles, page and site design guidelines, and style guides for the Web pages of specific companies and organizations. Imagine the poor Web designer who wants to make sensible choices from this jumble of guidelines. Which of these to choose?

The term *Web heuristics* is used to refer to all the sets of process guides, principles, criteria, tips and tricks, and guidelines that are available to support Web designers. A heuristic is a discovery aid. It helps "problem solvers" (and we consider Web designers as such) to identify a problem, to get an overview of the range of options to choose from, and to make sensible choices. We assume that designers are using some kind of heuristic if they use an aid or procedure that helps them to choose in a well-reasoned way a particular design approach or a particular design option, or if it helps them to assess the qualities of an option. Heuristics may be prescriptive or instructive, and they usually take the form of lists of questions, principles, or checkpoints. In our use of the term heuristic, we follow common terminology such as *heuristic evaluation*—that is, evaluation on the basis of a defined set of principles.

Heuristics help designers by directing their attention and promoting exploration of the range of options from a particular perspective. That capability, however, implies that heuristics limit other possible areas of attention or perspectives (Byard 1991). Therefore, designers should have a feeling for the underlying assumptions of the heuristics they are using.

Our goal for this article is to make Web designers more aware of the qualities of heuristics by presenting a framework for analyzing the characteristics of heuristics. This framework is meant to support Web designers in choosing among alternative heuristics. We hope that better knowledge of the backgrounds, potentials, and limitations of heuristics will contribute to the professional expertise in the field. Our second goal is to make those who develop and present heuristics more aware of the information their users need. Thus, we have tried to increase the usability of heuristics.

A FRAMEWORK FOR CHARACTERIZING HEURISTICS

Whereas heuristics are being developed and presented to help Web designers focus their attention on various aspects of Web site quality, our framework seeks to help Web

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designers asses the usefulness and usability of the heuristics themselves. The framework consists of four main categories. The first deals with the information covered by the heuristics: Which aspects of Web site quality do the heuristics focus on? The second concerns the validity of heuristics: What do we know about their background and justification? The third concerns the presentation format: How are heuristics presented to the Web designer? And the last category deals with the—often implicit—assumptions about the way heuristics are to be used in practice. An overview of the framework is presented in Appendix 1.

INFORMATION COVERED BY THE HEURISTICS

A good starting question about heuristics is what the set of heuristics is all about. What topics are covered by the guidelines, questions, or criteria? To what kinds of Web sites are the heuristics to be applied?

Specificity

First is the issue of specificity: To what kinds of Web sites and site characteristics do the heuristics apply? Heuristics may be designed for general use, thus suggesting that they are a suitable tool for all kinds of Web sites and site characteristics. But there may also be two kinds of limitations in scope.

1. Heuristics may be genre-specific, focusing on a particular type of Web site such as a digital store or a product information site.

2. They may be feature-specific, focusing on certain site characteristics such as navigation, graphics and layout, or accessibility for people with disabilities.

Both general and specific heuristics may be useful tools for Web designers. It is important, however, to know their limitations.

Exhaustiveness

Given the degree of specificity, to what extent can the heuristics be expected to cover everything of interest? Heuristics may range from an exhaustive selection of items, representing at least the most important aspects of the domain, to a more or less arbitrary selection of items. Although the idea of heuristics fully covering everything of interest in a certain domain is hard to achieve in practice, the reverse—an entirely random selection of items—is far from desirable.

There are various ways of reducing arbitrariness. If the heuristics are based on empirical research, there may be a rationale in the underlying empirical data. Nielsen (1994, p. 30), for instance, based his heuristics on a factor analysis of 249 problems frequently found in usability tests of software interfaces. The claim of the resulting heuristics may be that they cover most of the usability problems that occur in practice. Oliver, Wilkinson, and Bennett (1997) used another empirical strategy to account for their selection of items in their information quality heuristics. They asked a panel of experienced Internet users to rate the importance of an exhaustive list of quality indicators and selected the indicators with the highest importance ratings.

Another strategy to reduce arbitrariness could be a systematical approach. Heuristics may be designed to systematically explore every aspect of a Web site from a certain perspective. In the case of genre-specific heuristics, they may be based on a selection of usage scenarios; in the case of feature-specific heuristics, overall concepts may be systematically broken down into a set of lower-level criteria. Whatever strategy is used, Web designers should understand the rationale behind the heuristics.

VALIDITY OF THE HEURISTICS

Heuristics may look quite impressive as they are presented to the practitioner. But Web designers should not select heuristics just on first impression. Four questions may help to judge the validity of heuristics—that is, the extent to which they can be expected to contribute to effective Web site design.

Foundations

What kind of support is offered for the various heuristic items? Heuristics can be distinguished on the basis of their foundations.

- **Standards-based heuristics** These heuristics are based on official, agreed-on rules for Web design, and compliance with them may lead to some kind of certification. In this respect, standards-based heuristics are valid by definition, although agreed-on rules do not necessarily have a strong relationship to the usability and effectiveness of Web sites. Some of the heuristics focusing on accessibility for people with disabilities come close to being standards. The Web Content Accessibility Guidelines by W3C (1999), for instance, encourage Webmasters to mention the level of conformance to the standards. Based on the same guidelines, an evaluation tool called Bobby was developed to enable Webmasters to automatically evaluate their site's accessibility and—in the case of a positive result—include a "Bobby Approved" icon on their site (CAST 1999).
- **Theory-based heuristics** These heuristics are adapted from general, well-known, and accepted theories. As the research into the use and effectiveness of Web sites is just emerging, many of these theories might be adapted from other relevant areas—for example, human-computer interaction, text comprehension, rhetoric, or visual design. One of the few examples of theory-based heuristics are the Cognitive Engineering Principles by Gerhardt-Powals

(1996), focusing on "cognitive friendly" user interfaces, that seem applicable to the World Wide Web as well.

- **Research-based heuristics** These heuristics are based on specific research that puts the usability and effectiveness of Web sites to the test. One can think of the aggregated results of a series of usability tests—as Nielsen (1994) did for user interfaces—or the results of experimental research comparing the effects of design variations. Evans (2000) describes the difficult process of translating the results of empirical research into a set of heuristics. Again, many of the heuristics available for Web design originate from research with more or less similar communication products—for example, hypertext, multimedia, and user interfaces.
- **Practitioners' heuristics** These heuristics refer to guidelines that are not supported by standards, theory, or research, but instead reflect the views and experiences of professional Web designers or the directions given in handbooks on Web design. Many of the heuristics mentioned throughout this article are in fact practitioners' heuristics.

It is not easy to draw the line between the types of heuristics characterized here. Often, heuristics are partly based on theories and research, with the remainder drawn from practitioners' views. Heuristics from all four categories may contain valuable clues for improving the quality of Web sites. Yet it is important that the users of heuristics be informed about the rationale behind and empirical support for the heuristic items. The relationship between specific heuristic items and their motivation or evidence should be much tighter than is the case with many existing heuristics.

Novelty

In addition to the foundations of heuristic items, it is also important to consider the way in which they evoke and expand the design knowledge of the practitioner using the heuristics. On the one hand, heuristics may have high novelty value, drawing attention to new and surprising insights on Web design. These appear to be meant for experienced Web designers, who have internalized the basics of Web design. On the other hand, heuristics may have low novelty value, primarily giving an overview of the existing body of knowledge regarding Web design. These may be very informative for beginning designers or serve as a mnemonic device for practitioners, helping them to consider all relevant aspects of Web design. Both novel and familiar sets of heuristics can be useful in practice.

Room for interpretation

To what extent do the benefits of heuristics depend on the idiosyncratic intuitions, insights, and experiences of the individuals who use them? This question, of course, closely relates to the traditional methodological concept of reliability—that is, the extent to which the results are stable. Some heuristics are more or less mechanistic, and different users are most likely to arrive at the same conclusions. Some can even be applied automatically: Web designers need only type in a URL and the computer applies the heuristics, analyzes the site, and provides feedback—like WebSAT (NIST 1999; Scholtz, Laskowski and Downey 1998) and the previously mentioned Bobby (CAST 1999). On the other hand, many heuristics are expert-mediated. They are meant to focus Web designers' attention on certain aspects, but they cannot guarantee at all that different professionals will come to the same conclusions about these aspects.

Two items from the Web-site Design Audit of the University at Buffalo (W-SDA 1997) may illustrate the difference between more or less mechanistic and typically expert-mediated heuristic items.

- "Can users change information they have entered in a form before they have submitted it?" This is a more or less mechanistic item. It is easy for Web designers to check whether a site meets this criterion, and the result of that check is likely to be quite unambiguous.
- "Are multimedia, animation, and graphics used only when necessary?" This item requires an expert's judgment. Different Web designers may have different views about the necessity of multimedia, animation, and graphics in a particular site, and may therefore come to different conclusions about a site.

An advantage of mechanistic heuristics is their reliability compared with expert-mediated heuristics, but there is also an important drawback. The need for unambiguous and measurable items may impose serious constraints on the aspects of site quality that can be addressed, and hence on the validity of the heuristics. So there may be a tradeoff between the reliability and the validity of heuristics.

Validation research

A shortcut for avoiding some of the problems mentioned above may be found in *validation research* to back up the heuristics. The validation studies should demonstrate the benefits of the heuristics for professional designers. The most convincing proof of benefit would be seen when a study demonstrates that a site designed with a set of heuristics is better than one designed without heuristics. Such a study was conducted in the domain of interface design by Gerhardt-Powals (1996). She compared an interface designed according to her Cognitive Engineering Principles with two alternative interfaces that were designed without explicit reference to the principles. The cognitively engineered interface proved to be superior in use situations, thus supporting the validity of her heuristics.

Another way to validate heuristics is by comparing their yield with the yield of other forms of evaluation. Nielsen (1994, pp. 36–55), for example, compared the results of a heuristic evaluation by 11 usability specialists with the problems found in a small-scale usability test (with four users). The heuristic evaluation revealed more than 80 percent of the 21 user problems detected in the usability test and overlooked only 4 user problems. However, Nielsen's study was flawed because the number of usability test participants and usability experts was not balanced. In another study, heuristic evaluation made a less favorable impression (Desurvire 1994). The heuristic evaluation by the experts in that study revealed fewer than half of the observed user problems, missing serious problems more often than minor annoyances. A problem with this type of validation study is that the criterion for success, overlap of detected problems, is debatable. Must heuristic evaluation results and results of usability testing always overlap? It could well be that different methods help to detect different problems.

All in all, little is known yet about the validity of existing heuristics for Web design. Many of the available heuristics appear to make sense, but Web designers are rarely provided with enough information about the background and proven benefits of heuristics. General justifications are given where specific evidence for particular items is needed—as for example in "The information used to create W-SDA has been collected from various sources including traditional sources for Human Computer Interaction Guidelines and Internet sites devoted to Web-site design guidelines" (W-SDA 1999). Validation research into the merits and restrictions of particular heuristics should, in our view, be placed higher on the research agenda.

PRESENTATION FORMAT OF THE HEURISTICS

So far, our questions about the heuristics have dealt with their content. But their presentation format, at the level of both the whole set and the individual items, may also be an important factor for successful use. Our inventory of heuristics showed that they are presented in many different forms, defined by structure, formulation, type of answers, and level.

Structure

Some sets of heuristics seem to have a random organization; others are meaningfully structured. A meaningful structure should help a Web designer to view a site from an overall perspective and to "read between the lines." Topics that are not exactly covered by one of the heuristic items can be detected all the same if the Web designer comprehends the overall intention of the heuristics. A meaningful structure is also important if practitioners are expected to internalize the heuristics. Dividing heuristics into sections is a fruitful way of creating a meaningful structure. The Web heuristics of Human Factors International (1999), for instance, are divided into sections on color, wording, and layout. However, within the sections, the items of these heuristics sometimes seem to be ordered randomly, perhaps because of arbitrary selection.

Formulation of items

Basically, there are three commonly used sentence structures. Heuristics can be formulated as:

- Instructions ("Use color and highlighting sparingly.")
- Questions ("Is the contrast between the background and the foreground high?")
- Requirements ("The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.")

Little is known yet about the effect that formulation has on the use and yield of heuristics. There might be a relation with the stage of a Web design process in which the heuristics are applied: Instructions seem to be most appropriate for the design stage; questions, for the evaluation stage; and requirements may take an intermediate position.

Types of answers

A distinction can be made between open and closed heuristic items. Typical examples of open items are "Who are the important users?" and "What is their purpose for accessing the site?" Closed items are often worded in a "yes-no-n/a" format, and laid out as a checklist. Their form suggests that items can be straightforwardly answered by the Web designer, but that is not always the case (for example, "Are multimedia, animation and graphics used only when necessary?"). Again, little is known about the pros and cons of closed versus open heuristic items.

Level of heuristics

Wright (1985) differentiates low-level and high-level guidelines. High-level items present Web designers with possible problem areas in a Web site, for which they must find a solution—for example, "Make sure the graphic used (decorative, representational, organizational, or explanative), and accompanying text matches the kinds of activities you want viewers to do with them" (Ameritech 1996). Low-level items present Web designers with specific design guidelines rather than with the problems they are intended to solve—for example, "Use short sentences" (Human Factors International 1999).

According to Wright, both kinds of items have their own weaknesses. Low-level items suffer, for instance, from being too normative and prescriptive, suggesting that Web sites must always be designed in a certain way, and thus disregarding the many fruitful exceptions to the rules. A multitude of low-level items are needed to cover one as-

pect of Web design, thus reducing the usability of the heuristics. In addition, it is impossible to formulate low-level heuristics to cover every aspect of a particular Web site. Finally, low-level heuristics make it hard for Web designers to "read between the lines." High-level items, on the other hand, leave much to the interpretation and insights of the Web designer using them, and hardly present Web designers with specific design options for usable and effective Web sites.

With regard to the presentation format, the structure and the level of the heuristics are especially important. In general, it seems desirable that heuristic items be presented in a meaningful structure, enabling the Web designer to gain an overview and to judge a site in line with the spirit of the heuristics. In this line of thought, it may be fruitful to have a combination of high-level and low-level guidelines, in which the low-level items can function to generate ideas, suggest solutions, or serve as examples for more general high-level items. With respect to the two remaining issues—that is, the formulation and openness of the items—many variations are seen in practice, but we can as yet only speculate about the effects they might have on the usability of heuristics.

USE OF THE HEURISTICS

The way heuristics are used or are meant to be used—in fact the usability of heuristics—is hardly addressed in the literature. The usability of heuristics is a crucial success factor that should have a major impact on the way heuristics are designed and presented. Successful use of heuristics can be assured only if they are geared to realistic use situations.

An interesting example of Web heuristics with usability flaws is the Web-site Design Audit (W-SDA 1999), of which Figure 1a and Figure 1b show two successive screens. The heuristics take the form of "yes/no" questions, and the explanations for the items are hidden behind hyperlinks. Throughout the set of heuristics, both a "yes" and a "no" answer to heuristic items may indicate a violation of a certain design rule. So there are at least two serious usability problems here.

1. The heuristics force Web designers to constantly click between heuristic items and explanations.

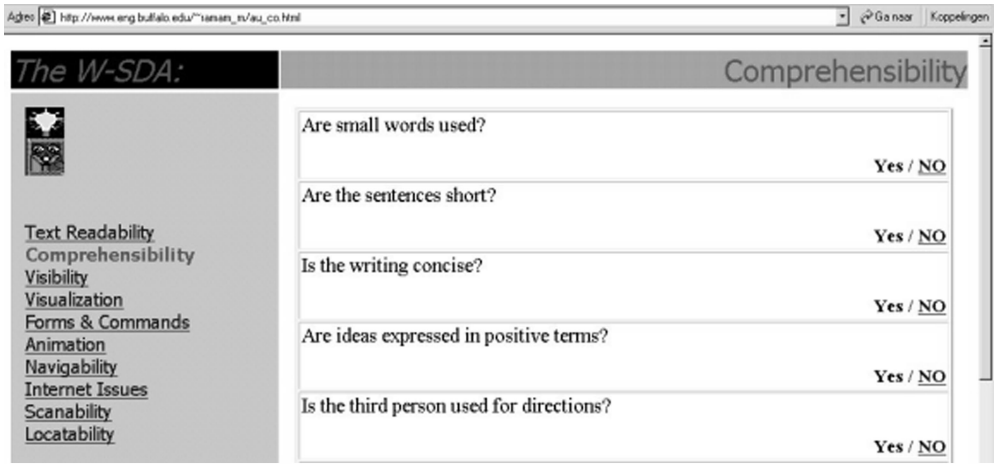


Figure 1a. Heuristics with yes/no answer format (W-SDA 1997).

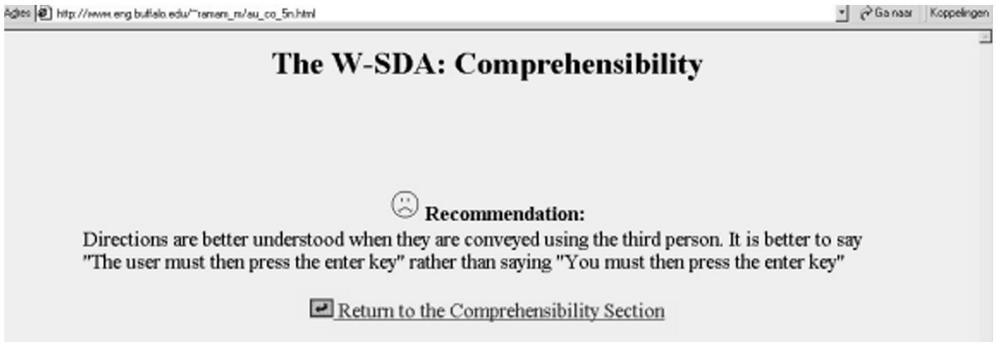


Figure 1b. Explanation of No-answer to the last question, "Is the third person used for directions?" (W-SDA 1997).

2. The " yes" and " no" answers do not correspond unambiguously to positive and problematic site characteristics.

Besides the usability problems, the recommendation in Figure 1b, of course, also reveals a major validity problem. The advice to use the third person in directions is contrary to what we know about effective instructions.

Phase in the design process

The first issue of context of use is the phase in the design process in which the heuristics are meant to be employed. A distinction can be made between planning-oriented and evaluation-oriented heuristics. Planning-oriented heuristics are used to generate global or specific requirements during the actual design and production of a Web site; evaluation-oriented heuristics are for evaluating and improving a draft or an existing Web site.

Planning-oriented heuristics should facilitate designers in switching between two activities that are hard to combine—consulting the heuristics and actually building the site. Three solutions can be considered:

- The heuristics may aim at internal representation, that is, at being memorized and remembered easily.
- The heuristics may be process-oriented and thus interfere less with actually building the site.
- The heuristics may be structured in a way that corresponds to specific design activities—instead of a feature-based organization like text readability, visualization, or navigation, the heuristics may focus on clearly identifiable parts of a Web site, such as home page, forms, or menus.

Evaluation-oriented heuristics can be used for assessing and improving the quality of Web sites ranging from early designs and paper prototypes to Web sites that are already online. The heuristics may be more elaborate, and may even take the form of a long checklist. The feature-based organization described above might be very fruitful in evaluation-oriented heuristics, as it forces evaluators to view a Web site from entirely different perspectives than the ones that were dominant during planning and production.

Focus of support

Heuristics can be process-oriented and product-oriented. The focus of support for most of the heuristics we have seen was on the product—the heuristics contained characteristics of effective and user-friendly Web sites. Other heuristics combine a number of process recommendations—concerning the planning phase, the testing, and the maintenance of a Web site—with product guidelines (see IBM 1999; van der Geest, in press). Especially in the case of planning-oriented heuristics, process guidelines may be a fruitful way to support Web designers.

Function in the design process

Heuristics can have troubleshooting and verifying functions, a distinction that can be found in the literature on document evaluation (see de Jong and Schellens 1997). All the heuristics we studied have a troubleshooting function—that is, they are meant to support the detection and diagnosis of problem areas in a Web site. Some heuristics have an additional verifying function. They can be used to certify whether Web sites or Web site characteristics meet an explicit or implicit criterion. Examples of heuristics with an extra verifying function are the aforementioned Bobby (CAST 1999) and the Web content accessibility guidelines of W3C (1999).

Alexander and Tate (1999b, p. 116) acknowledge both functions for their checklists for informational Web sites: "Answering the following questions will help a user determine whether the information on a Web page is coming from an authoritative, accurate, and reliable source. . . . The questions can also be used by Web authors as a guide to creating pages that can be recognized as originating from a reliable, trustworthy source."

The Web site evaluation checklist by Information &

Navigation	Compliance			
	Always	Sometimes	Never	Notes
There is a clear indication of the current location	❑	❑	❑	
There is a clearly-identified link to the Home page	❑	❑	❑	
All major parts of the site are accessible from the Home page	❑	❑	❑	
If necessary, a site map is available	❑	❑	❑	
Site structure is simple, with no unnecessary levels	❑	❑	❑	
If necessary, an easy-to-use Search function is available	❑	❑	❑	

Functionality	Compliance			
	Always	Sometimes	Never	Notes
All functionality is clearly labelled	❑	❑	❑	
All necessary functionality is available without leaving the site	❑	❑	❑	

Figure 2. Sample from usability evaluation checklist by Information & Design (1998).

TABLE 1: HEURISTICS USED TO DEMONSTRATE THE APPLICATION OF THE FRAMEWORK

Heuristics	Coverage	Presentation format
IBM (1999)	General (process and product)	Instructions
Instone (1997b)	Specific: User interface design	Principles
Alexander and Tate (1999b)	Specific: Information quality	Questions

Design (1998; see Figure 2) is an example of heuristics without a clear function. On the one hand, the items seem to be meant to identify problems in a Web site—at least, they cannot be summarized into overall judgments about the quality of a site. On the other hand, the checklist format seems to distract from specific problems, requiring the users only to specify whether a Web site "always," "sometimes," or "never" complies with the guidelines.

Apart from the two functions mentioned above, there is also a third function, which is not very prominent in the literature on document evaluation. Heuristics may also have an idea-generating function. In addition to helping Web designers find the problems visitors may have, the heuristics can also present designers with possible design options and solutions they were not aware of.

Assumptions about actual use

Regrettably, many Web heuristics remain vague when it comes to the way Web designers are supposed to use them in practice. Some heuristics may be designed for internal representation: They are to be internalized by the Web designer before application. The number of heuristic items must be small to be remembered, or, if larger, the heuristics must be well structured.

Given the number of different items contained in them, most of the heuristics we encountered seem to be designed for external representation: They are to be used as a checklist during the evaluation activities. Particularly with the large checklists, applying all the heuristic items to the entire contents of a Web site seems almost unfeasible. For instance, based on Nielsen's 10 usability heuristics, Pierotti (1995) compiled an elaborate checklist for evaluating systems or interfaces, containing 296 items—for example, "Does every display begin with a title or header that describes screen contents?" and "Is there a consistent icon design scheme and stylistic treatment across the system?" Each item requires an evaluator to check the entire system. The complexity of such evaluation tasks—moving through an entire site and moving through an entire checklist—can be expected to have an adverse effect on the usability of heuristics in practice.

CHARACTERIZING THE RANGE OF HEURISTICS

In this section we show how to apply the framework presented above and demonstrate what it can reveal about Web design heuristics. At the same time, we present three existing heuristics that together give a good impression of the range of heuristics that we found. We selected these three on the basis of their coverage (general or specific, and if specific, the site characteristics they focus on) and their presentation format (see Table 1).

Example 1: IBM guidelines for designing easy-to-use Web sites

Some heuristics or guidelines try to cover both the complete Web design process and the resulting prototype or product. The IBM Web design guidelines are an example of this kind (IBM 1999). In the left-hand frame in Figure 3, the authors of the IBM guidelines divide the design process into four stages: Planning, Design, Production, and Maintenance. For each of those stages, information about several sub-processes is given. Overall, the IBM heuristic contains 104 items, each of which has the form of an instruction accompanied by explanations of why and how.

Information covered The IBM guidelines claim to "provide information about user-centered design methods and recommendations on a variety of issues that challenge Web developers." They are general in the sense that the guidelines are organized according to a process approach, with product guidelines to be found within the Design section of the process model. Designers are supposed to apply the guidelines in the order presented, since some guidelines build on results of previous guidelines. The guidelines are meant for "your organization's Web site," without specific attention to the type of Web site the organization might be developing.

At first sight, the IBM guidelines appear to be comprehensive. The Web design process instructions draw from the methodology of software engineering and project management, and follow the process models from that domain. At a more detailed level, the selection of items within the guidelines is arbitrary at times. For example, the instruc-

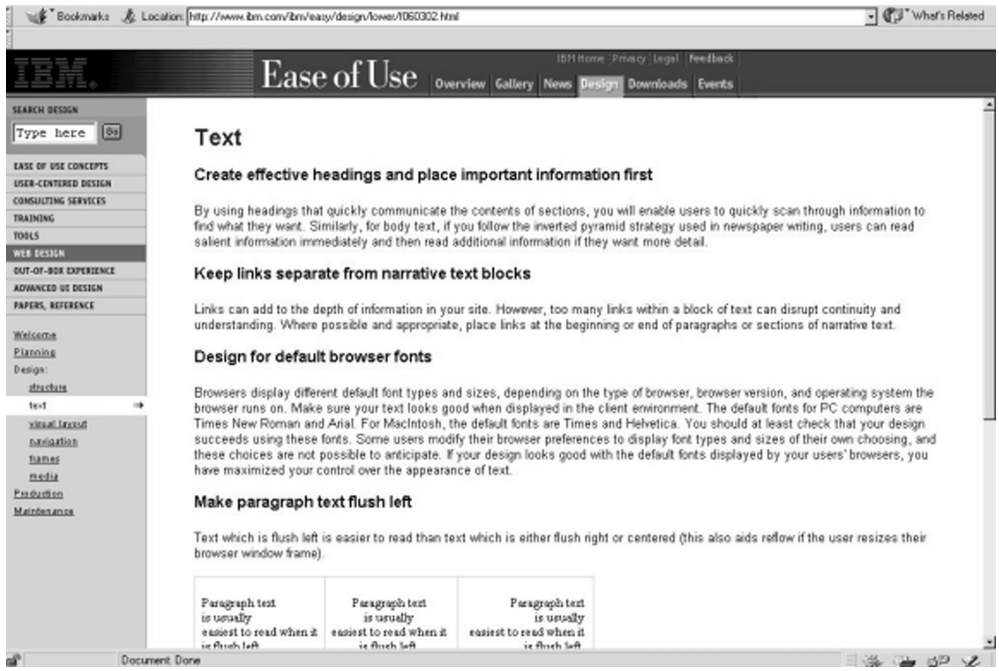


Figure 3. Sample screen of the IBM guidelines (IBM 1999).

tions about text within the Design section contain the following items:

- Create effective headings and place important information first.
- Keep links separate from narrative text blocks.
- Design for default browser fonts.
- Make paragraph text flush left.
- Test for readability.
- Provide a means for users to print groups of related pages.

It appears that the IBM text guidelines focus on text display on screens only, and not on the many other aspects of text use, such as style or comprehensibility.

Validity The introductory note in the IBM guidelines is quite clear about their foundation: "These guidelines stem primarily from our expertise in process and methodology. . . . They also borrow from our experience exploring new interface designs and developing one of the most used Web sites in the world." The guidelines' authors claim that their information can be particularly valuable for novices and intermediate level developers. Yet the guidelines show large variations in the expertise required to apply them. Some are mechanistic and do not require any expertise at all when applied in a design or review process, such as the guideline "Make paragraph text flush left." Others, however, assume design expertise, intuition, and creativity that is not carried over in the guideline—for example, "Design in a style that will appeal to your audience's tastes." Although the advice makes perfect sense, it does not give a designer much of a clue about what to do or which design option to choose.

Presentation format The IBM guidelines are presented as a combination of instructions and explanations (see Figure 3), structured by process stage. The instructions in the headings are procedural, such as "Create an audience/user profile." The explanatory text that follows elaborates on why one should perform the suggested activity and how to perform it. Even when particular items are product-oriented (such as those on Visual Layout and Elements), they sometimes contain process recommendations, such as the advice to test the visual design with users. The instructions and explanations have an open format. The formulation of most items within the heuristics is high-level rather than low-level, with low-level items particularly to be found in the product-oriented items. Those describe product details rather than a problem observed.

Use The IBM guidelines contain no information about how they are supposed to be used. They are meant to be applied throughout the design process. Their function seems to be both idea-generating and troubleshooting. They help to generate ideas about what activities to plan

and conduct in the design process, and thus can also be an evaluation tool for a post-design process evaluation. The product-oriented guidelines within the Design section of the guidelines might be most useful when reviewing design proposals or prototypes. The IBM guidelines are lengthy and at some points very detailed. A printout contains over 40 pages. Thus, we can assume that the heuristics will be used "externally," as a handbook that guides designers through the design and development process.

Our evaluation Most of the IBM process guidelines will work well to make novice and intermediate developers aware of sensible activities in the design process, activities that indeed will help them to create user-centered Web sites and pages. We doubt whether the product-oriented guidelines will work well because their quality varies considerably, both in terms of validity and in terms of novelty value for designers. Therefore, the guidelines might disappoint Web designers who are seeking clear product guidelines. We like the combination of concise instructions and adequate explanations, and expect that it will work well in practice, particularly for the process-supporting items in the heuristics. Because of the process focus, the length of the guidelines will not be prohibitive for those who use the guidelines during an extended design process. For Web designers who are looking for a handbook on the Web design process (rather than on the product), the IBM guidelines are a good choice.

A number of heuristics that came up in our search resemble the IBM guidelines in coverage or in presentation format. Just like IBM, corporations like Ameritech (1996), Sun (1995), and many smaller players on the market have published their corporate Web style guides. Some of these are very product-oriented, in fact describing the corporate graphic house style for sites; others are more general. The process approach underlying the IBM guidelines is somewhat similar to the Yale guide for designing Web sites (Lynch and Horton 1997) and the Hackos and Stevens checklists for publishing online information for the Web (Hackos and Stevens 1997).

Example 2: Instone's usability heuristics for the Web

The field of human-computer interaction design (HCI) focuses on the design of highly "usable" systems. Usability can be broadly defined as "ease of use," including such measurable attributes as learnability, speed of user task performance, user error rates, and subjective user satisfaction. One of the most prolific writers about interface usability is Jakob Nielsen (see, for example, 1993, 1999, 2000). He summarized findings of interface usability studies into 10 principles that he says are the crucial determiners of usability (Nielsen 1994). Keith Instone translated Nielsen's 10 principles into Web heuristics (Instone 1997b). Figure 4 shows a sample page with Nielsen's principles and Instone's adaptation of them for the Web. The screen capture demonstrates how Instone builds on the content and format of Nielsen's guidelines (in bold on the screen).

Information covered Instone's heuristics on the surface appear to be general, but in fact are specific. With regard to the genre, they certainly are general; they are even applicable to a much broader range of user interfaces than Web sites alone. With regard to the site features, however, there are limitations in scope, although Instone does not explicitly acknowledge this fact. For instance, the heuristics hardly focus on the selection of content for Web sites, or the comprehensibility of text. They address usability of interfaces in a narrow sense: The usefulness of the site for users is not a topic for Instone. His remark that the "overriding theme for applying those heuristics to the Web is to use links effectively" demonstrates his shallow view of usability.

While Nielsen's underlying 10 principles are based on a factor analysis of usability problems in software interfaces (Nielsen 1994), Instone's adaptation for the Web reduces some of the principles in an arbitrary way. For example, one of Nielsen's principles is about the match between the system and the real world (see Figure 4). In his annotation of the principle, Nielsen translates "match" into three instructions:

- The system should speak the users' language.
- It should follow real-world conventions.
- It should make information appear in a natural and logical order.

Instone's adaptation of this principle for the Web reads: "On the Web, you have to be aware that users will probably be coming from diverse backgrounds, so figuring out their 'language' can be a challenge." One can wonder what exactly is the nature of the advice given here. We have the feeling that Nielsen's second and third instruction are not addressed, and that the first instruction is addressed with a different interpretation. And what exactly are Web designers expected to do or consider when confronted with Instone's advice?

Validity Nielsen's basis for his 10 principles is made clear (Nielsen 1994), but it remains unproven whether those problems also are valid for Web sites. Instone does not explain the basis on which he adapted the principles for Web sites. We assume that his adaptations are practice-based, rather than theory or research-based. The ten principles leave designers and reviewers much room for their own interpretation. One of the principles, for example, is: "Error prevention. Even better than good error messages is a careful design which prevents a problem from occurring

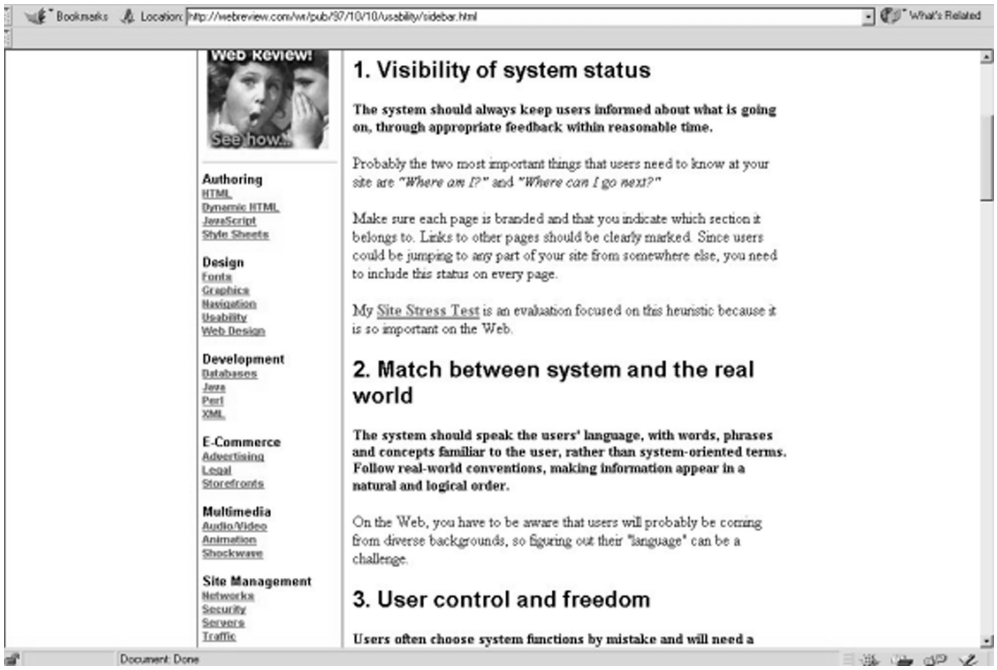


Figure 4. Sample screen of Instone's usability heuristics for the Web (Instone 1997b).

in the first place." Such an instruction does not work well as an aid to avoid problems. What must Web designers do to prevent problems from occurring? Instone's elaborations for the Web vary with regard to the room they leave for interpretation by the evaluator. Sometimes he points out problem areas in general—for instance, when he remarks "Probably the two most important things that users need to know at your site are '*Where am I?*' and '*Where can I go next?*'" At other times, he gives detailed instructions, such as "Consider using GET instead of POST on your forms."

As in all heuristics, the novelty value depends on the experience the user brings to the task. Instone himself is not too optimistic about the novelty of his heuristics: "If you look at these heuristics and think 'these are obvious,' then good" (Instone 1997a). He views the heuristics as a way for reviewers to formally consider each rule to make sure that they are not forgetting anything. Yet the fact that they transfer knowledge from one specific field (designing usable interfaces) to another field (designing usable Web sites and pages) might make them novel for some designers.

Presentation format The 10 items in the Instone heuristics consist of the issues and their explanation (as formulated by Nielsen) with Web-focused additions and elaborations by Instone. They are exclusively product-oriented. Nielsen's 10 principles are by their nature very open—for example, "Visibility of system status." His explanations are formulated as system requirements ("The system should . . .") or required system effects on users ("Users should not have to wonder . . ."). Instone's additions are both high level and low level: descriptions of problem areas, instructions, and sometimes very detailed suggestions for solutions. His focus on solutions rather than problems, in our view, restricts the usefulness of the heuristics. The heuristics contain 10 items that are numbered but not ordered in any way. They can be applied in a random order when designing or reviewing a site.

Use The Instone heuristics are meant to support reviewing a design prototype (heuristic evaluation). The formulation of the items as issues could support the use of the heuristics in the design stage, whereas the explanation in instructive text points to usage as a problem detection and diagnosis tool. Given the limited number of items (10) within the heuristics, one may expect Web designers and developers to internalize them. The lack of coherence and order between the items, however, reduces the chance that designers or reviewers can "read between the lines" and detect problems that are in line with the heuristics but not explicitly covered by the items.

Instone describes how he expects the heuristics to be used. In his view, a few experts or people with just an hour of training are to be given information about the intended

audience and purpose of the site or the prototype to be evaluated. Additional scenarios or a site map are to be offered to help the evaluators become acquainted with the site. "Then the evaluators make a few passes through your design and after a short while, they can start listing the usability problems they found" (Instone 1997a). Instone stresses that each individual evaluation is "an opinion and should be treated as such." Hence, his next step is combining 3–5 evaluations and compiling them in a list of problems that evaluators then rate for severity. This list helps designers to prioritize what to focus on during revision.

Our evaluation Our framework helped us to see that Nielsen's 10 principles are not straightforwardly applicable to Web design. For Web designers, the information covered by the 10 underlying interface usability principles is specific and hence only appropriate for particular contexts of use. Furthermore, we think Instone's adaptation of the principles is arbitrary and reduces the value of the 10 principles as heuristics rather than enhances them. We regret that one of the very few heuristics that is based on more than practitioners' experiences and that provides an explanation of how it should be used is so unsatisfactory in many other regards.

Instone's list with 10 principles is much shorter than the IBM guidelines in example 1, a fact that increases the chance that evaluators and designers will internalize the principles and indeed apply them. It reduces the task of evaluating a Web site to checking a Web site against a list of 10 specific requirements. Such a reduction could possibly lead to the detection of usability problems in a narrow sense (which is the purpose of the 10 principles), but it does not say much about the overall quality of the site. Although the list of principles is designed as an evaluation tool, it might actually work better in the planning stages of a design process to focus a designer's attention.

Most of the heuristics that we found through our Internet search seem to come from the same field as the Instone/Nielsen heuristics: the field of user interface design and usability studies (see, for example, Story 1999; Tognazzini 1998). They often include a limited number of items, a fact that makes them arbitrary or simplistic in light of the many factors that can influence the usability of a Web site.

Example 3: The Alexander and Tate checklists for information quality

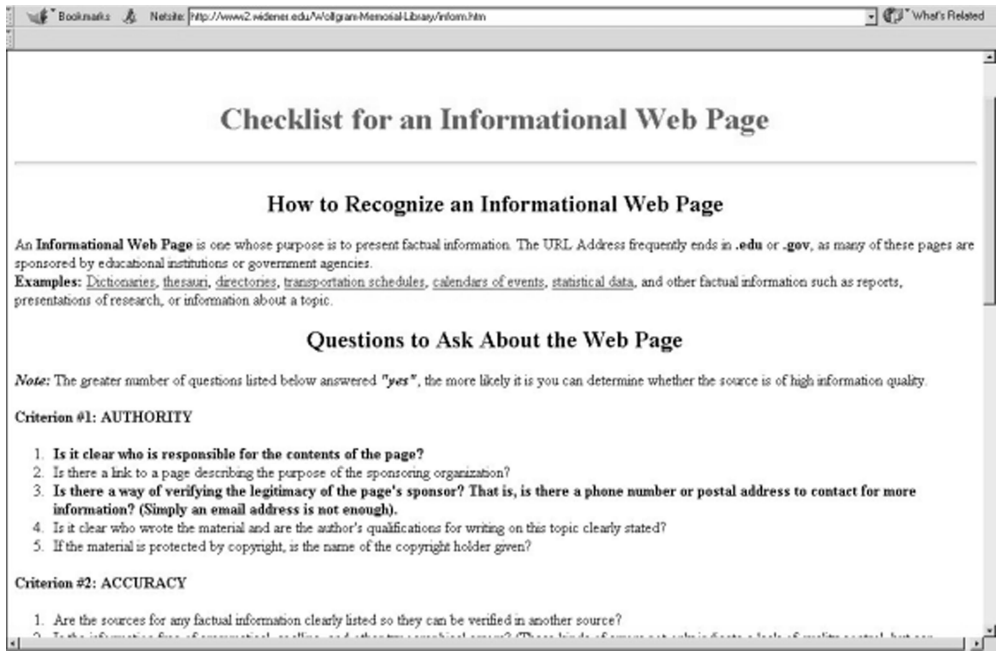
Our third example comes from a discipline that has dealt with assessing value and distributing information sources long before the Web came into existence—that is, the field of Information or Library Sciences. Alexander and Tate (1999b) have recently published a book on how to evaluate and create information quality on the Web. Their book concludes with two appendixes containing checklists intended to help the user determine whether the information on a Web page is derived from an authoritative, accurate, and reliable source. Similar but less extensive heuristics can be found on their Web site (1999a; see Figure 5). We used the heuristics in the book for our analysis.

Information covered The Alexander and Tate heuristics (1999b) contain a mix of general and specific items. The authors do not claim to cover all aspects of Web sites but support assessing the quality of the information on the page. Five checklists help users and designers to assess information quality using "traditional" criteria, such as reliability and accuracy. The set of checklists is complemented with three checklists on navigation, interaction/transaction, and non-text features. For the latter checklists, the items are certainly not exhaustive for the features covered, and the relation to information quality is unclear. In Alexander and Tate's Appendix A, the checklists are adapted to a number of main genres of Web sites; the checklists in their Appendix B are not genre-specific but primarily feature-specific, focusing on information quality.

Validity The issue at stake in the Alexander and Tate heuristics is not the information quality of the site but rather the degree to which information quality can be assessed through content and page features such as author information, update frequency, or contact information. The questions in the Alexander and Tate heuristics often have a yes/no answer format, which makes them seem mechanistic—for example, "Are the qualifications of the organization, company or person responsible for the content of the site indicated?" Some questions leave more room for interpretation by the user of the heuristics: "Is the point of view of the individual or organization responsible for providing the information evident?" Different reviewers might well answer that question differently. Since the heuristics present information from a field that is not typically associated with Web design, the heuristics might well contain novel information for evaluators and designers.

Presentation format The checklists consist of long lists of yes/no questions. Explanations are found throughout the book preceding the checklists. The questions are organized under headings such as "The business checklist" (in Alexander and Tate's Appendix A) or "Objectivity" (in their Appendix B). The formulation mostly refers to specific product characteristics, such as the presence of a logo or a site map. Hence, the issues are low-level issues, rather than high-level ones.

Use Alexander and Tate indicate that their heuristics are



Checklist for an Informational Web Page

How to Recognize an Informational Web Page

An **Informational Web Page** is one whose purpose is to present factual information. The URL Address frequently ends in **.edu** or **.gov**, as many of these pages are sponsored by educational institutions or government agencies.
Examples: Dictionaries, thesauri, directories, transportation schedules, calendars of events, statistical data, and other factual information such as reports, presentations of research, or information about a topic.

Questions to Ask About the Web Page

Note: The greater number of questions listed below answered ***"yes"***, the more likely it is you can determine whether the source is of high information quality.

Criterion #1: AUTHORITY

1. **Is it clear who is responsible for the contents of the page?**
2. Is there a link to a page describing the purpose of the sponsoring organization?
3. **Is there a way of verifying the legitimacy of the page's sponsor? That is, is there a phone number or postal address to contact for more information? (Simply an email address is not enough).**
4. Is it clear who wrote the material and are the author's qualifications for writing on this topic clearly stated?
5. If the material is protected by copyright, is the name of the copyright holder given?

Criterion #2: ACCURACY

1. Are the sources for any factual information clearly listed so they can be verified in another source?

Figure 5. Sample screen of the Alexander and Tate heuristics (1999a).

primarily meant for evaluation purposes: "Answering the following questions will help a user determine whether the information on a Web page is coming from an authoritative, accurate and reliable source." They can also be used for planning purposes: ". . . as a guide to creating pages that can be recognized as originating from a reliable trustworthy source." Given the number of items and the formulation in detailed product characteristics, the heuristics support the evaluation stage better than the planning stage. The structure of the heuristics and the subdivision along lines of genres helps designers internalize the long lists of questions. Alexander and Tate suggest using the checklist for verification: "The greater the number of 'yes' answers, the greater the likelihood that the quality of the information on the page can be determined." They are not clear about the number of "yes" answers required to benchmark a page as containing "high quality" information.

Our evaluation The five Alexander and Tate checklists on information quality criteria will be useful aids for Web designers and evaluators. They focus on an issue that might well be very new to Web designers who do not have an Information Science background. They draw attention to product and content characteristics that can serve as a signal for information quality on Web pages. The focus on the signals rather than on the content is at the same time a limitation. The issue of information quality from the point of view of users (for example, comprehensibility, applicability) is underdeveloped. The adaptation of the checklists to various types of Web pages makes sense: the purpose and functions of the site indeed influence the kinds of signals to be expected on the page.

We are less convinced of the value of Alexander and Tate's checklists on interaction and transaction features, navigation, and non-text features. If the goal is to evaluate those features, better heuristics are available. Probably the authors have included checklists on those features because they assume that they have a special influence on information quality. However, they have not succeeded in formulating checklist questions on these features that help to identify signals of that influence.

The term *checklist* and the use of the yes/no answer format suggests use in an evaluation stage rather than in a planning stage. Using the checklist for evaluation can become very complicated since evaluators have to move through the entire site and through the entire checklist at the same time. However, the clear structure of the checklists enables evaluators to "read between the lines."

Many relevant sources on evaluating the quality of Web-distributed information can be found through Alexander and Tate's Web site (1999a). Heuristics on assessing the quality of Web information often come from university libraries that support students who want to use information for research papers—for example, Grassian (1998) of the University of California Los Angeles and Ormondroyd, Engle, and Cosgrave (1999) of Cornell University. Those

heuristics have a less broad and thorough view of information quality than the Alexander and Tate heuristics.

TOWARDS A RESEARCH AGENDA

While we were writing this article, participants in an online discussion list on usability testing were discussing the value of heuristic evaluation as opposed to testing with users. One practitioner recommended including heuristic evaluation in all usability testing projects prior to involving representatives of the target groups. In reply, another participant suggested that designers skip heuristic evaluation altogether when user-focused testing is planned, since ". . . the first five users uncover 70% of the major usability problems and it's rarely necessary to test more than eight . . . . it's proven true in hundreds of tests we've conducted." The argument between the list participants simply cannot be resolved, since at the moment, we lack a sound foundation for discussing the value of heuristic evaluation. The framework we present in this article may contribute in various ways to discovering the answer to this question of the value of heuristic evaluation.

Framework as an aid for reflection

Our framework can be used as an aid to reflect on the pros and cons of existing heuristics, both in general and in specific Web design processes. It is not clear what techniques or guidelines are meant exactly when the term *heuristic evaluation* or *heuristics* is used. Given the diversity of heuristics we found and the inconsistency in names, we should first distinguish a number of approaches and characterize them. We have presented our framework for characterizing heuristics as a first step in this direction. The categories in the framework we present—coverage, validity, presentation format, and use—reflect the characteristics that we think are important. Using the framework is not merely an academic inventory exercise: Practitioners need to reflect on the tools they are using and the kind of contribution they expect their tools to make in their design practice. If they do not carefully consider the nature and affordances of their tools, they will end up trying to drive screws in the wall with a hammer.

Framework revealing success factors

The framework has given us some ideas (albeit speculative ones) about critical success factors for heuristics. With regard to the categories of coverage and validity, our main conclusion is a rather obvious one. Heuristics should not consist of arbitrary items, and the users of heuristics should be adequately informed about the rationale behind the heuristics. As obvious as these requirements may be, none of the existing heuristics fully meets them.

With regard to the presentation and use of heuristics, three requirements seem to be very important.

- Heuristics should enable Web designers to "read between the lines"—that is, to fill in the gaps between heuristic items and to see the intentions behind them. A meaningful structure and an adequate mix of high-level and low-level items may be very important in this respect.
- Heuristics should inform users about the background and rationale of the items contained, making it possible for users to evaluate the applicability of the heuristics for a specific site or design process, and, again, to see the intentions behind them. The link between heuristic items and supporting evidence must therefore be emphasized.
- The nature and formulation of heuristics should be tailored to the ways heuristics are to be used in the Web design process.

In all three respects, serious flaws are apparent in many of the existing heuristics.

Framework to point out research issues

Finally, the use of the framework has made clear how little we know as yet about the use and the benefits of heuristics. In research into the effectiveness of heuristics, two main issues need to be addressed.

1. We need to know more about the ways heuristics are actually used in design and evaluation practices in relation to their presentation format. That knowledge is indispensable for developing sound heuristics, as much as observing people who are reading and using manuals has been and still is important for technical communicators, or thinking-aloud studies of people using software have been and still are important for interface designers.

2. But practitioners' reports about their use of heuristics or about the results of using heuristics (like Levi and Conrad 1996) is not enough of a basis to determine what makes heuristics effective. The second issue on our research agenda is that we need to know more about what the heuristics actually *did* for the Web designers. At the moment we have lots of practitioners advocating heuristic evaluation, but very few solid reports on the yield of heuristics and heuristic evaluation. The few studies we have (for example, Nielsen 1994; Desurvire 1994) compare heuristic evaluation to user-focused testing, but there is a place for both evaluation approaches in the design process. It is no use to create an artificial opposition between methods and to study them as if we need to declare one better than the other.

There are many more relevant questions to be answered. The studies of Nielsen and Desurvire indicate that the various reviewers using the heuristics did not agree much about the problems they saw, and did see problems that were not detected by the users. What kinds of problems can be predicted or detected by users of heuristics,

and how do they compare (in a qualitative, not in a quantitative sense) to the results of unguided evaluation or other methods of testing? What is the relation between the actual heuristics used and their characteristics on one hand, and their yield on the other hand? What is the role of prior knowledge and experience or task perception of the user of the heuristics? And (here we come to what we think is the ultimate question about the effectiveness of heuristics) does using heuristics or using the findings of heuristic evaluation indeed result in better Web sites or better pages?

A starting point for practitioners and researchers

Our Web search located 384 heuristics, and by the time this article appears in print, this number will undoubtedly have grown. Web designers and producers find it important to develop heuristics and to present them; their colleagues appreciate the sharing of experiences and find heuristics valuable tools for their design practice. Despite the large number of heuristics, however, the number of studies of what heuristics do is very small. We don't know what makes heuristics work as tools in the design process. There is still much practical and research work to do before we can use those tools to their full extent, but we are fascinated by their potential. We hope this article and the special issue it is part of will work as a starting point for both practitioners and researchers to further develop the promising set of instruments that heuristics can be for Web designers. T**C**

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APPENDIX 1: A FRAMEWORK FOR CHARACTERIZATING HEURISTICS

Information covered by the heuristics	
Specificity	General Genre-specific Feature-specific
Exhaustiveness	Exhaustive ↔ Arbitrary
Validity of the heuristics	
Foundations	Standards Theory Research Practitioners
Novelty value	High ↔ Low
Room for interpretation	Mechanistic ↔ Expert-mediated
Validation research	Available ↔ Unavailable
Presentation format of the heuristics	
Structure	Randomly ordered ↔ Meaningfully structured
Formulation of items	Instructions Questions Requirements
Type of answers	Open ↔ Closed
Level of items	High-level Low-level
Use of the heuristics	
Phase in the design process	Planning-oriented Evaluation-oriented
Focus of support	Process-oriented Product-oriented
Function in the design process	Troubleshooting Verifying Idea-generating
Assumptions about actual use	Internal representation External representation

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