Messages From A Tangled Web

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Abstract

HCI has an established history of criticising system error messages and offering design guidelines for their improvement. This paper continues this tradition by exploring users' attitudes and recovery strategies to web error messages, examining the variety of messages produced by popular web-sites and presenting design guidelines for error messages. We believe this is the first academic work on web error messages. We first investigated users' conceptions of error messages and recovery strategies for a broad section of users (novice to expert). This revealed that standard error messages have a poor construction, which goes against most (if not all) of the guidelines for writing effective error messages. We then examined a range of popular information and ecommerce sites from the US, Europe and Australia and we offer a critique of the different styles of dealing with errors. Finally we provide a checklist of design considerations for use by web designers and site managers that pay close attention to good customer service and experience.

Keywords: Error messages, customer experience, Web, eCommerce, 404, design guidelines.

1. Introduction

HCI research has shown that poorly designed error messages result in reduced task efficiency, user frustration, and often ambiguous content. Error messages are initially designed by programmers to help them in debugging their applications and are therefore providing content couched in programmers' terms and not in those typically used by users. Despite the exhortations of the HCI literature, the error messages often remain in the domain of the programmers and become a neglected part of the interface.

For single machine applications, poor design of the error messages may not be a problem since the program will hopefully be robust in normal operation. But the Internet and the World Wide Web are not single machine applications – they are large heterogeneous distributed systems, in which some of the components will be failing at any given time. For instance, servers will sometimes be out of action, or there may be routing flaps in which some parts of the network are inaccessible, or the sheer volume of traffic may deny service due to congestion [12]. In the Web, pages may be moved, renamed or deleted leaving dangling links. An article on TechWeb [18] reports that more than 84,000 link errors and some 3.6 million coding errors were found in 300,000 web pages on the Fortune 100 corporate web-sites. Thus, breakdowns are inevitable.

In a perfect world, breakdowns would always be resolved without the need for user interaction, but the underlying technology is not yet that advanced. Therefore users are currently doomed to confront error messages and to be involved in resolving the breakdown.

Our research was primarily motivated by a desire to understand the conceptual models that users hold about networked applications in order to improve interface design to aid in breakdown recovery. We designed a study to see how users would resolve breakdown situations on the Web, hoping that this would reveal the mental models users hold of the workings of the Internet. During this study, the participants reported that Web error pages are commonplace and are generally unhelpful, and that they have generic recovery strategies regardless of the specific errors reported. We were intrigued by the irrelevance of the error messages, and so analysed the design of web error messages further.

This paper proceeds by first providing a short survey of the HCI literature on error messages. We then describe our initial user study, followed by our findings from an examination of a number of popular consumer web-sites. We conclude by providing a summary of considerations for web-site design in dealing with errors.

2. Background

For users to aid in resolving the breakdown, the users must be motivated and have enough information to formulate a recovery strategy. It is the role of the error message to motivate and provide the information

Despite the potential usefulness of error messages, they can often interfere with or abruptly halt the user's task. They are intrusive on the user's task, waste time and cause frustration, with a message that can be rude, non-meaningful and often incorrect. Some errors may simply be a result of user exploration which forms part of the learning process, but if errors are interfering with the task then we need to improve the system. Many instances of poor errors are exampled at the Interface Hall of Shame [17].

The term 'error' can have different meanings attached to it, but is often seen as a deviation from the right way, a blunder, mistake or wrongdoing. An error message is designed to inform the user that something unexpected has happened.

> "Errors are the main thieves of time (and satisfaction)." [6].

Coats and Vlaeminke [1] stress that error messages are not intended for the designer or the programmer of the system, and should be informative to the user. Thus the message should be couched in terms and refer to concepts which reflect the user's model of the task.

If a user enters something that is unacceptable, the dialogue should provide a message which accurately diagnoses the cause of the error highlighting what was unacceptable, explaining how to recover and what the effect of this will be. If the error messages are to be informative, they must be complete, and not a code which must be looked up in a manual. The system should tell you this information directly without the need to refer to documentation away from the task at hand.

George [5] points out that users are typically are uninterested in the information presented in the error message. Something has interrupted them in their work, it is irritating and they want to fix it and move on as easily as possible. They are looking for a direct positive statement of what they should do. Cox and Walker [2] echo this feeling, stating that one of the most frustrating things about many systems is not knowing what to do. The user must know how to get out, and there should always be a clearly marked recovery. When a message is given, it needs to be well phrased telling the user what to do.

Shneiderman [15] advises system developers to avoid threatening language and points to examples of vague and unnecessarily hostile messages that often use violent terminology. An input is very seldom 'illegal' and even fewer cases are in fact 'fatal', and yet these adjectives are commonly used in error messages. Such negative words such as 'error', 'invalid', 'abort', 'kill' or 'bad' should be eliminated or used infrequently as they can disturb non technical users. To avoid user frustration and intimidation, messages should be non-threatening, active, positive, problem solving, short, and have a context- sensitive link to help.

Shneiderman [15] summarises that since error messages occur because of lack of knowledge, incorrect understanding, or inadvertent slips, users are likely to be confused, to feel inadequate, and to be anxious. Error messages with an imperious tone that condemns users can heighten anxiety, making it more difficult to correct the error and increasing the chances of further errors. Messages that are too generic or too obscure offer little assistance to most users. These concerns are especially important with respect to novices, whose lack of knowledge and confidence amplify the stress that can lead to a sequence of failures.

Lansdale and Ormerod [7] explain that users have perceptions of their own ability to execute tasks and have some estimations of the risks and costs of mistakes, which in turn affects their self esteem and confidence. The sense of being out of control may or may not be accompanied by errors or poor performance, but is certainly associated with the inclination to avoid such stressful situations. The possible link between errors and potential psychological harm was also noted by Cox and Walker [2] who suggested that exposure to some of the aggressive system beeps and noises associated with errors and the violent terminology within their content may be detrimental to the user experience.

George [5] notes that addressing the issue of error messages is important as they can make the difference between users deciding that they can solve the problem themselves, or deciding the whole application is unmanageable and reaching for the telephone to call support.

Research carried out by Lewis and Norman [8] criticised error messages for being too jargonistic, uninformative, hostile in tone, and unhelpful in terms of what the user can do. Norman [11] and Reason [14] later argued that designers should work under a principle of designing for error, that is, they should develop systems in the realisation that human errors will always be likely to occur, regardless of the training or commitment of uses. By forcing actions that prevent the user from making an error in the first place, providing good error messages, using reversible actions that allow users to correct their own errors and providing a large number of explicit diagnostics should ensure better error handling by the user [13].

3. User Behaviour in the Face of Breakdowns

This study was designed to replicate the context in which users encountered network breakdown situations. The users were then asked to describe what the error message meant and how they would recover from the breakdown. The replicated context was intended to work as a cognitive prop in their reported recollections.

3.1. Participants

There were 35 participants (18 men and 17 women), 25 postgraduate students or academic staff and 10 were

from variety of jobs including office workers and managers and medical practitioners.

Only 3 had used the Web for less than one year, 10 had used it for 2-3 years and 22 for more than 3 years. 17 used the Web more than 3 hours a week, 14 2-3 hours and 4 less than 1 hour. 24 classified themselves as intermediate users, 7 as experts, and 4 as beginners. The participants had a wide variety of Web experience, but nearly all (28) had used the Web for ordering a product or service by filling out a form on the Web, with 14 making a purchase of $75 or more.

3.2. Design

The study was conducted concurrently at two UK academic sites with identical set-ups. This paper concentrates on the Error 404, missing images and delayed response times due to links to non-existent ports or servers. Instructions formed part of the web trail, forming part of some of the web pages that would be visited along the way.

A scan converter was used to grab the screen of the computer and a microphone recorded the participants' think alouds, both of which were fed onto a video cassette. The audio was transcribed and annotated for analysis.

3.3. Procedure

A series of Web pages were created that were designed to take the user through the task of finding a given cooking recipe. The route was sabotaged with obstacles and situations that occur to most of us while using the Web. Participants were shown a one minute video example on the art of thinking aloud whilst carrying out a task, and instructed to do the same whilst taking part in this study. The participants also filled out a brief questionnaire, taken from [19], in order to ascertain demographic data and background Web experience. Each participant used either Netscape 4.6 or Internet Explorer (IE) 4, depending on their normal choice of Web browser. The web server software was CERN httpd 3.0. The study took approximately 30 minutes to complete. As well as thinking aloud, the participant was asked to pause after each error message was encountered and was asked questions in the form of a brief semi-structured interview.

The scenarios each participant encountered were as follows:

- Error 404 (due to a spelling mistake in the link)
- 3 failed images on a page due to a non existent image, wrong format, and read protected.
- Link to page on same server but different port number specified
- Link to a page on a non existent server
- Automatic redirect (without courtesy page)
- Using a search engine
- Encountering a password protected page

- Filling in form and seeing the security alert dialogue box
- Being prompted to use the reload/refresh browser button.

3.4. Focus of the study

Error 404

Participants followed a link containing a spelling mistake of the filename on an existing server and CERN's standard Error 404 page was displayed;

> Error 404
> Not found – file doesn't exist or is read protected [even tried multi]

Note that if the file was indeed read protected as in the broken images scenario below, a Fatal Error message would be displayed, making this particular error message incorrect.

Broken Images

Participants were directed to a page that contained three separate broken images. If the path name was altered to specify the image filename, the non-existent image would produce a separate page showing a broken link (in the case of Netscape) and an Error 404 (with Internet Explorer). The image with the wrong format displayed an Error 404 and the read protected file displayed the following message on both browsers;

> Fatal Error
>
> System call 'fopen' failed: Permission denied.

Delay

By inserting a wrong port number into a link we force the message that the Web browser displays during a delay or server non-response;

Netscape;
> There was no response. The server could be down or is not responding.
> If you are unable to connect again later, contact the server's administrator.

IE;
> Internet Explorer cannot open the Internet site http://www-mice.cs.ucl.ac.uk:100/cookery-school/recipes/mains-vegetarian/aubergine/recipe2.html
>
> A connection with the server could not be established.

This situation produces the same symptoms as attempting to connect to a server which is down or is busy. The cause is unusual, so we were not necessarily expecting a successful diagnosis of this particular problem, but hoping to elicit a response of normal recovery behaviour in situations of this type.

3.5. Analysis

The participants' think aloud and answers to the questions were transcribed for detailed analysis. Originally it was thought an in depth examination of the transcripts might be required using discourse analytic techniques. As it transpired the participants had quite short and often abrupt comments that were similar across the participant sample. Therefore we considered that a broad grained discourse analysis could be used to demonstrate such feelings as frustration, lack of confidence, confusion and apathy supported by anecdotal evidence.

3.6. Results from the transcripts

> You've seen an Error 404 before?
> Yes lots of times.

All but one of the participants recognised the error 404 message immediately; the other participant who was a novice was uncertain if he had seen this particular message before, but had seen error messages. All expert users were able to offer possible explanations of what might have gone wrong, as did the majority of intermediate users, but none of the novices did.

> Doesn't give you any information so you can't tell what went wrong. P7

> I don't know I just see it and think something has gone wrong…it's just one of those things, I don't really know the technicalities. P12

> Not particularly specific these error messages. P15

The immediate reaction offered by novice and most intermediate participants was to complain that the presented error message was not particularly helpful to them, as it did not diagnose the problem or offer a simple solution in a way that had any meaning. Some participants had difficulty explaining the terms of 'file' and 'read protected', and no participants (including the experts) were able to offer a meaning to the term 'Even tried multi.'

> Error, sorry I just ignore these things, I see them so often, it just comes up error and I don't even, does it say why there's an error. I don't even read them now, they come up so often I just think something has gone wrong…P13

The most striking finding was the general apathy displayed by all users when confronted by these types of error messages. When asked to describe their normal behaviour when dealing with these types of errors, the most common response was to go back, try one more time and then forget it and move on to something else. The more experienced users said they might check the spelling or remove the end of the pathname in order to move up the directory within the site in an attempt to locate the problem, or even go back to the main page and look for a search facility.

> Maybe the site has changed its name or something. So the filename doesn't exist, at this point I would be stuck

not knowing what to do…normally I treat it as a dead end and I will go back and try a different search type or different location. P 3

> I check the URL here for mistakes, see if there's something like HTM or HTL or something, something simple like that, if that doesn't work then I go back to the original page and try and re-do a search or something. Or perhaps sometimes I will just take off the end file and try to get at the directory below and see if there's another link to it. P 4

All participants said that they would usually forget it and try somewhere else, even the expert users who had enough knowledge to investigate the problem further. The general attitude would appear to be that it is easier to find something similar than waste time investigating a problem that may be completely out of their control.

> I usually try it one more time and see if it works, and it didn't, so now I'll probably look someplace else to find out about cookery. P1

> I'd just ignore it completely or try one more time…I never look at these things as long as it gets me to where I want to get P14

> Try another home page maybe on the same sort of subject. P30

Broken Picture Images

> Likely to be an error in the HTML code…but obviously it's someone else's site, I guess you just have to go without the picture. P 4

Some participants felt that a broken image was something they could not do anything about. Others said they would be unlikely to investigate the broken image unless they felt that it was something they thought they really had to see, and others expressed frustration at this type of occurrence.

> I'd check if the info is crucial to me or I'd leave it. P20

> Wouldn't bother checking…Not unless it was something I was really really interested in. P25

> Go back and try another site…Depends how interested I was. P29

> How long will it take?
> Bloody ages knowing the web, sorry I don't usually wait for pictures to come up, I know there's a way in which you can have pictures not come up and that's what I'd like to do but I've never had time or bothered to work out what it is you have to fiddle about to have to do so they just don't come up.
> …No I've never been that interested in the pictures and to be perfectly honest when they don't come on I just get frustrated, when I get really frustrated is if there's a picture but you *have* to look at the picture, if something there is twiddly it's something you have to look at to understand, I get frustrated with the whole thing and won't deal with it. P13

When prompted to investigate the broken images by finding out the image filename and directing the browser

to display it, one of the images presented a 'Fatal Error' message as it was read protected. When asked to explain the meaning of the error, participants talked of its seriousness and irretrievability;

> I don't have a clue, but, it must be something quite serious for it to have, to say that permission has been denied and it's a fatal error I think. P0.

> Fatal error – the machine's fallen over. P26

Server Delay Response

This time delay in system response was a common experience to all participants, and excuses offered were that it was typically the volume of users on the Internet was large or the amount of data making up the Web page requested was high. Frustration was commonly described, as was moving on to somewhere else.

> Yeah (I've seen his before) I usually wait or I will stop and reload. Stop and click it again. Permanently agitated I will click it a few times, but I don't know if that actually helps, I think it just makes me feel better. P1

> It's taking quite a long time which means there's lots of pictures or something…I wait a fair amount of time, but if I get frustrated I, like now…I press stop and try something else, but it depends on how much I wanted to see that site. P 3

Slow response time was equated to quality of service and poor corporate image, highlighted by this participant;

> I am just trying to think of an example where this has happened, it's usually a cheap site where they have not got the resources to cope with demand for that particular web page. P24.

4. Provider Behaviour in the Expectation of Breakdown

We examined the error messages of a number of popular sites in the UK, US and Australia. These messages were compared against the design guidelines in the HCI literature discussed above and the lessons drawn from the transcript data responses and good and bad ecommerce site messages. 50 sites were viewed, as a convenience sample of ecommerce sites listed in the Ernst and Young report [4], and from the top 25 Web properties listed on the Cyberatlas [16]. The intention of the exercise was to iteratively develop and refine the guidelines. The polished guidelines are presented below.

The options open to site developers for error messages are constrained by HTTP [3] and the developers' chosen server software. In HTTP, an exceptional condition is indicated by an error code such as 404, along with a small piece of explanation as plain text – the reason-phrase. The server can be configured to supply an HTML page along with the error, which would be displayed instead of the plain text error message. Alternatively, the server can redirect on a specific error to some other page. Browsers would display any associated HTML entity in preference to the reason-phrase. Internet Explorer 5 (IE5) goes one step further and displays a built-in page for each message in the absence of server supplied HTML. IE5 was not available for this study.

It should be noted that because the Web is ever evolving, many of the examples examined below may well have changed by the time this paper is being read. Hopefully, this will be a positive thing and will embrace many of the usability issues that are highlighted later on.

4.1 Illustrative Examples

The following set of pages do not provide satisfactory messages, choosing their server's default settings. These messages do not follow any of the design principles listed above. Various sites, including Amazon.com&uk, davidjones.com.au, goshopping.com.au, yellowpages.com.au, grannymays.com.au, Sainsburystoyou.co.uk, bol.com, bras-online.co.uk, Railtrack.co.uk produced the following message.

Not Found

The requested URL/junk was not found on this server

Novatech.co.uk;

The requested resource 'http://www. Novatech.co.uk/junk' was not found on this server.

Again, offers no support to the customer.

Interflora.com.au;

HTTP/1.1 404 Object Not Found

These large bold letters (as well as forming an unhelpful message) give the impression of shouting at the consumer.

The default server installed 404 messages like those presented in this paper's user study were also noted at other prestigious sites, including; News.bbc.co.uk, ebay.com, e-guide.com.au, ozshopping.com.au, woolworths.com.au, lastminute.com.

HTTP Error 404

404 Not Found

The Web server cannot find the file or script you asked for. Please check the URL to ensure the path is correct.

Please contact the server's administrator if this problem persists.

This type of error message does not express enough information to the user to enable a swift recovery and uses technocentric terms to describe the problem. There is no link or email address provided to aid the user in

contacting the server's administrator if desired, and presents a default server message.

Many sites are beginning to override the server's default error message with their own forms of message page which are much more useful in aiding the user in their task. Some of these go some of the way in presenting better messages but vary in their degree of usefulness and ease of use.

Mp3.com.au, for example, display the following message within their page's usual borders that have their links, advertisements and search fields.

> Oops! There has been an error:
>
> 404 Error
> Page not found
>
> The page you were looking for has not been found.

It does not offer any possible explanation or suggest a recovery strategy that could be taken to help the user find what they may have looking for.

Etoys.co.uk, again present their own message in place of the standard error 404, presenting a message within their regular page's 'look and feel'.

> The page you're looking for is not available, but don't despair…we have plenty of other fun stuff for you to do at eToys. Take a look around and browse through our toys, software, videos, and other wonderful features!

Their tone is jolly, courteous and non threatening and their usual headers and links are carefully laid out to encourage the user not to leave their store. This message is more of an invitation though than a direction, perhaps in line with their audience of children?

Just because the page is written by the site's producers, it does not mean that it will be any better then the default error text. The following example is taken from Pilotwarehouse.co.uk/junk.html:

>   x
>   x
> Either the page does not exist or your browser is not supported. Please use either Internet Explorer 3 (or greater) or Netscape Navigator 2 (or greater).
>   x   x
> x

The above page provides little information as to why there may have been a problem, does not offer a practical solution or direct the customer back to its main page. The picture links ('x') are broken which does not present a good corporate image. It is noted however that the term 'page' is used rather than default terms such as 'file' or 'object'.

Two sites that should be used as examples of good practice during this study were the BBC home page, and that of Web design guru Jacob Nielsen (useit.com).

The BBC page, again looks like a typical page from their site with their usual links down the left hand side, and presents the following message;

> File not found   Help

> Error 404
>
> The page you have requested is: /junk
>
> Sorry, the requested Web page no longer exists, or has been moved to another server with another address. This error message may occur for a number of reasons:
>
> The file may have moved or deleted because it is out of date
> – You may have followed a link from another website which contains an incorrect or out of date URL (Web page address)
>
> – You may have typed an incorrect URL into your browser (see Help for more information about this and other error messages)
>
> – There may be an error on the BBC Online website
>
> If you think there is an error, please let us know by sending an e-mail to the Webmasters at webweaver@bbc.co.uk. Please provide full details of the referring page's URL and the page you were expecting.
>
> If the web page you require is available on the BBC Online website you should be able to find it by either browsing the BBC A-Z Index or using the Search Engine below.
>
> Type words or phrases in the box below. Use title case for names or titles – Tom Jones, rather than tom jones.
>
> -------- Search!

This message addresses all of the suggested guidelines from the literature. Nielsen's page is similar, although does not offer the same level of detail (e.g. simple explanation of URL). This may be due to the expected level(s) of user attracted to these two sites. In addition Nielsen presents a brief list of some of the most popular pages on his site and finally the offer of a search engine which is a link to it rather than a direct search box.

Qxl.co.uk (Europe's largest online auction house), shopsmart.com and others, choose not to present a separate message page. Instead, no matter how far you are into this site, a 404 error will simply redirect you back to the home page with no mention of a problem. This could potentially confuse and disorientate a customer and interrupt the original activity. It would appear to be a good strategy in attempting to keep the customer inside the shop, but is not very helpful or informative.

One other feature of note is a page presented by Amazon.co.uk when their site is down (possibly for maintenance), as it is the electronic equivalent of a note taped to the door of a shop that informs the potential customer that they will be "Back in 10 minutes."

> Amazon.co.uk
> We'll be right back!
>
> We're sorry, but our store is closed temporarily. We expect

to be back soon. If you would like to be notified when we reopen, please leave your e-mail address below and we'll be happy to let you know.

Keep shopping…

Feel free to visit out partner site Amazon.com, which remains open. Again, we apologise for the inconvenience, and thank you for your patience.

Your friends at Amazon.co.uk

Please enter your e-mail address ------- submit

However, one current flaw is that this page can be cached and therefore provide an out of date message if the browser is not reloaded or refreshed.

5. Discussion

This study highlighted the inadequacies of the error messages presented in typical contexts, providing users' reactions to such breakdown situations. All the participants commented on them causing irritation, stating that they seldom make the effort to recover from the situation unless it was something that was important to them. This reveals that users will only persevere with a task after encountering an error if their volition is high. Perhaps by presenting better-informed error messages this task is made easier and likely to result in a more successful interaction.

This study pointed the user to the first error 404 page via a link that contained a spelling error. Four participants noticed the mistake when asked to describe possible recovery strategies. If we had asked the participant to type in a long URL, perhaps more attention would have been placed by the user on checking for possible typing slips. This would suggest that Web authors should attach short and correctly spelt meaningful filenames to their pages using common natural language, so any typing slip would appear more obvious.

Browsers, servers, and proxies currently do not all include spelling checkers, so users are doomed to fail if they don't get every single character exactly right when typing in a URL. [10]. Software is currently being developed that notes and updates any changes to filenames (such as being moved) and has the potential to update all links that point to it. There may also be a way of comparing the requested file path with those on the Web server that would suggest any near matches as part of the message to the user, rather like a spellchecker.

As Nielsen [10] points out; unless everything works perfectly, the novice user will have little chance of recovery. In the long term, we need to build better self-diagnosing systems that can provide more constructive error messages and easier ways of fixing problems. In the short term, developers of web solutions for novice users will need to polish their user interfaces until every fleck of dust is gone.

HCI research has called attention to error messages for over 10 years, and yet the biggest and most widely used system still falls into the trap of often presenting badly designed error messages to the users of today. This study has shown users struggling with the meaning of error messages, treating them as dead ends and eventually deciding to look elsewhere. It also highlights that those more 'expert' users, who are perhaps better equipped to diagnose and investigate an error's cause, seldom do so and eventually suggesting it is easier to try something else.

With the rapid increase of ecommerce, proving just under 40 million online shoppers in the US alone in 1999 [4], companies would be advised to pay attention to the messages displayed from their Web servers. Treating users as potential customers and offering quality of service would seem essential. As seen in many of the popular websites examined, having a customised error page is likely to engage the user on your site for longer than a standard error message page and offers the user a range of recovery possibilities. Standard error messages are recognised quite quickly and are likely to be treated as a dead end. Something that does not look like the default error page has potentially more chance of being read, and is more likely to result in action being taken that is favourable to the page provider. Keeping the potential customer on your site, offering popular links and the ability to search can only be of benefit to a company wishing for a sale. As Nielsen [10] demonstrates, 79 per cent of Web users scan rather than read, possibly due to the hundreds of millions of other pages competing for the users' attention. Users do not know whether the page they are presented with is the one they need or whether some other page would be better. Modern life is hectic and people simply do not want to spend time working hard for their information. We should not expect to see such sterile, redundant, unhelpful and old-fashioned Error 404 messages in future.

Other design considerations would be to advise against the use of technocentric language avoiding reference to such things as 'files' and 'objects', when most users refer to, and expect to see 'pages'. Also designing pages in the knowledge that the network is prone to slow down at the best of times, can be accounted for by limiting the amount of heavy graphics that can increase download times. Slow responses to user actions can often be assumed to be unprofessional, offering poor quality of service. Images can be presented in a smaller form that can be clicked on to view a larger version, or indeed graded to appear gradually rather than at once. Both scenarios offer the user a choice of waiting to see if it is something they wish to view or move on to another page avoiding a wait.

6. Summary of design principles for customer messages

Informative Diagnosis
The customer needs to be briefly informed of the problem, with an accurate and specific diagnosis of what was unexpected.

Non technocentric language
The message needs to be couched in terms that reflect the task of the customer, avoiding technical jargon.

Non threatening terms
Violent terminology (fatal, illegal etc.) as well as an imperious tone should be avoided.

Allow easy recoverability
The customer wants to know what can easily be done to recover from the situation or they may choose to leave and take their custom elsewhere.

Designing for error
People are prone to error and this needs to be accounted for as far as possible. Easier page filenames and spell checking tools are possible solutions.

Customised message page
A separate message page has the potential to keep customers within the provider's site, and presents a better corporate image.

Lastly, it should be remembered that improving error messages will not turn a bad system into a good one, but it can play a significant role in improving the user's performance and attitude (and experience). Shneiderman [15].

6. Conclusions

Millions of novice and intermediate users are using the Web on a regular basis with more and more joining daily. Competition for their audience and custom is strong, and it is proposed that customer-centred sites who aid the user in navigating and recovering from breakdowns will fare better than those offering poor error messages. We believe that these guidelines offer steps in this direction.

7. Future work

The Apache server code runs on approximately 70% of Web servers worldwide [9]. We are currently trying to encourage the developers of Apache to present better default error messages.

Other Web errors are becoming more prevalent too, with increased use of proxy servers and firewalls. Scripting errors and timeouts are occurring, all of which contribute to poor corporate images. These are to be explored at a later date.

With Web technology moving into new areas such as mobile 'phones and digital televisions, presentation of errors will be an important usability factor. Users are unlikely to expect error message codes on their television screens or mobile displays. Web developers moving onto these new platforms will have new constraints placed upon them, such as reduced screen displays in the case of mobile 'phones. Ernst and Young [4] predict that ecommerce will be boosted by these technologies as the Web reaches a wider audience. As many of these new users will be novices the problem of error messages will have to be addressed.

8. Acknowledgements

9. References

[1] Coats, R.B. and Vlaeminke, I. *Man-Computer Interfaces.* Blackwell Scientific Publication, London, 1987.

[2] Cox, K. and Walker, D. *User Interface Design.* Second edition. Prentice Hall, New York, 1993.

[3] Fielding, R. et. al., Hypertext Transfer Protocol – HTTP/1.1, RFC2616, The Internet Society, 1999.

[4] Ernst and Young Special Report, Global Online Retailing, *Stores*, Vol. 82, No1, Section 2, January 2000.

[5] Geroge, H. *The Good Usability Handbook.* McGraw-Hill Book Co., London, 1996.

[6] Landauer, T.K. *The Trouble with Computers.* MIT Press, Cambridge, Mass. 1995.

[7] Lansdale, M.W. and Ormerod, T.C. *Understanding Interfaces: A Handbook of Human-Computer Dialogue.* Academic Press, London,1994.

[8] Lewis, C. and Norman, D.A. Designing for error. In D.A. Norman and S.W. Draper (Eds.) *User centred systems design: New perspectives on human-computer interaction design.* Erlbaum Associates, NJ. 1986.

[9] Niederst, J. *Web design in a nutshell: A Desktop Quick Reference.* O'Reilly, Sebastopol. 1999.

[10] Nielsen, J. *Designing Web Usability.* New Riders Publishing, Indiana. 2000.

[11] Norman, D.A. *The Psychology of everyday things.* Basic Books, NY. 1988.

[12] Paxson, V.E., *Measurement and analysis of end to end Internet Dynamics*, PhD Thesis, University of California at Berkeley, 1997.

[13] Preece, J., Rogers, Y., Sharp, H., Benyon, D., Holland, S. and Carey. T. *Human-Computer Interaction.* Addison Wesley, Wokingham, 1994.

[14] Reason, J. *Human Error.* Cambridge University Press 1990.

[15] Shneiderman, B. *Designing the User Interface: Strategies for Effective Human-Computer Interaction, third edition.* Addison-Wesley, Reading, MA. 1998.

[16] cyberatlas.internet.com

[17] www.iarchitect.com/errormsg.htm

[18] www.techweb.com

[19] www.nua.ie/surveys/