How Much is Too Much in a Hypertext Link

Investigating Context and Preview – A Formative Evaluation

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ABSTRACT

A high quality of free movement, or mobility, is key to the accessibility, design, and usability of many 'common-use' hypermedia resources (Web sites) and key to good mobility is context and preview. This is especially the case when a hypertext anchor is inaccurately described or is described out of context as confusion and disorientation can ensue. Mobility is similarly reduced when the link target of the anchor has no relationship to the expected information present on the hypertext node (Web page). Confident movement with purpose, ease, and accuracy can only be achieved when complete contextual information and an accurate description of the proposed destination (preview) are available. We suggest that sighted people can benefit from additional context and preview information included in hyperlinks and disprove the empirical evidence that suggests these users do not benefit from link descriptions which have this enhanced information. We briefly describe a middleware system to automatically expand context and preview in link descriptions thereby 'fixing' terse links, links out of context, and inaccurate or inadequate preview information. Finally, we conduct a formative evaluation which shows us that a system to expand context and preview would be useful in different ways depending on the type of link.

Categories and Subject Descriptors

H.1.2 [**Models and Principles**]: User/Machine Systems—*Human factors / Human information processing*;
H.5.1 [**Information Interfaces and Presentation**]: Multimedia Information Systems—*Evaluation/methodology*;
I.7.2 [**Computing Methodologies**]: Document Preparation—*Hypertext / hypermedia*;
K.4.0 [**Computers and Society**]: General

General Terms

Human Factors, Design, Measurement

HT'04, August 9–13, 2004, Santa Cruz, California, USA.

Keywords

Document Engineering, Evaluation, Web Mobility, Hypertext

1. INTRODUCTION

Confident movement through and around complex hypermedia environments, of which the Web is the most obvious example, has long been considered an important and major issue in the Web[1] design and usability field [9, 15]. The commonly used slang phrase 'surfing the Web' implies rapid and free movement, pointing to its importance among designers and users alike. We now establish that this potentially complex and difficult movement is further complicated, and becomes neither rapid nor free, if the user does not have context or preview information on which to base movement decisions. Previous work has suggested that both the context of a link and a preview of the link destination should be considered when creating hypertexts [24, 12, 19, 13]. It has also been recognized in the hypermedia and ergonomics design communities that design patters including context and preview may also be important [31, 20, 34]. Supporting anecdotal evidence does exists in the form of patterns such as link destination announcement or similar variants [17, 35, 30, 4], however, conflicting empirical evidence also exists. This empirical evidence (the prevalence of one or two word generic link descriptions eg 'Click Here', 'More', etc) suggests that because users can easily see the surrounding text, context will be implicitly given to any associated links. This empirical evidence suggests that users do not need, benefit from, or prefer additional context and preview information within the link description itself. When preview is seen as important it often only extends to the title or filename being included near the link description, and these can often be inaccurate or inadequate.
Therefore, we wanted to investigate these two conflicting positions by performing a statistical survey to answer the following two questions:

> 'Do users benefit from link descriptions which include additional context and preview information within the link description as opposed to context information conjoined to the link but not part of it, and no preview information at all?'

> 'If users do benefit from link descriptions which include additional information related to the link destination and surrounding text, how much information should be included? In effect, how much is too much?'

[1] Or hypermedia.

To answer these questions we conducted a formative evaluation in which we were particularly focused on making sure that the experience of sighted users was enhanced [33, 2]. This distinction is important because there is a tendency to address issues relating to one user group while ignoring those of another.

1.1 Synopsis

The rest of the paper can be summarised as follows:

- We investigate the browsing behavior of Web surfers to support our assertion that context and preview are important. And find from related literature that browsing behavior suggests that both context and preview are not only involved in the activity, but are also important for the successful completion of the activity (**Section 2**).

- Next, we investigate the issues surrounding context and preview in hypermedia and we establish why these twin concepts are important for better universal access to Web-pages (**Section 3**).

- We explain how context influences the interpretation of the link destination by the reader (**Section 3.1**). And that users prefer some form of detection and avoidance schema based on accurate and appropriate previews (**Section 3.2**).

- Our research includes both a formative evaluation and the tool creation however in this paper we focus on the evaluation. Therefore, we only briefly describe the concepts, rational, and techniques behind our tool. This is a middleware system to automatically and dynamically annotate Web-pages with additional context information present within the page and preview information present within hypertext link destinations found on the page (**Section 4**).

- Finally, we describe our formative evaluation to investigate if additional context and preview information is an asset or hindrance to users. Indeed we show that the lack of context and preview are a hindrance users (via our evaluation)(**Section 5**). More importantly we show that the link type matters and that in some cases users do not want context information. Overall however, our formative evaluation concludes that enhancing link descriptions with context and preview is both useful and important. However, there is a problem with information overload which may result in a lack of cognition over link destinations.

2. WHAT IS BROWSING?

It is recognised that, whilst browsing, users do not read web pages, they scan them [28] and links are important elements of web pages that facilitate scanning and browsing. As a consequence we research browsing and scanning behavior to investigate our assertion that context and preview are important dimensions of these activities. The literature on scanning and browsing activities [6, 27, 11] suggest that both context and preview are not only involved in the activities, but are also necessary for its successful completion. If web surfers did not use context and preview while browsing hypertext then it would be difficult to suggest that enhanced context and preview would be useful in link descriptions.

Browsing is an activity that is difficult to define [6], but there is general agreement that "we all browse in various context to make sense of the world around us" [7]. Some researchers also describe it as a process of "picking out bits and pieces$\cdots$selecting worthwhile information need or interest" [11]. Different disciplines look at browsing from different perspectives [7]. Various reviews suggest that browsing is a kind of searching, in which initial search criteria or goals are only partly defined or known in advance. Browsing involves scanning, which has been described as looking, examining, or sampling, during which the person's body or eyes move smoothly at will [28]. Browsing also involves distinct [7] consumer shopping behavior that is related but not equated with buying behavior. Methodologically, eye movement can be a useful indicator of browsing and has been used to test the effect of different page layout or catalogues on browsers' attention [7]. Browsing is fundamentally scanning and has been related to environmental perception and cognition. For example, sightseeing is environmental browsing as perceptual experience [7].

Although all of these views of browsing have various approaches and provide different definitions, there seems to be an agreement on the essential characteristic of browsing which is movement. Browsing can be thought of as travel in information space, and in fact many users refer to real world metaphors to describe browsing [26]. Indeed research suggests [27, 23] that browsing is made up of *Searching*, the task of looking for a known target. *Inquiry*, the task of looking to see what is available in the world. *Querying*, using a search engine to submit a description of the object being sought and receiving relevant content of information. And *Navigation*, moving oneself sequentially around an environment, deciding at which step where to go.

In investigating the nature of browsing, several researchers have attempted to establish different types of browsing [23]. Fundamentally, these types have been established by considering the goal, purpose or the information need. Search strategies have been defined as "a set of ordered tactics or behavioral moves that are consciously selected, applied and monitored to solve the problem" [27]. Analytical search strategies are formal, discrete and deterministic, in contrast, browsing search strategies are informal, continuous and heuristic. Indeed the four distinguishable browsing strategies of scanning, observing, monitoring, and navigating have been identified [27]. Finally, five dimensions that can be used to distinguish browsing from other information seeking behaviors and to characterize types of browsing [7] have been suggested.

Context: Organisation (how resources are organised and presented), Interface (the display perceived by the user), Feedback (relevance or content related, and orientation feedback), Economics (access costs, resources available such as time).

Behavioral: Scanning (orientation or exploratory scanning) and movement [32].

Motivation: Purpose (why people engage in browsing) and goal (what they intend to accomplish).

Cognitive: Plan (accomplishing a goal can be planned or unplanned) and knowledge/experience (content or structure knowledge) [32].

Resource: Form (object or representation) and focus (content or path) of resource.

These five views are important to our research because motivation influences context and link description supports context. Preview influences link description composition supports behavior, and good information preview supports cognition and resource destination.

In summary, browsing is movement in the information space and the user is in control of what to read or examine. While chance or synchronicity may have some part to play in browsing behavior the user is still in control of the filtering the information presented. Many studies have addressed different browsing types and strategies [26] however movement is the essential characteristic of browsing [3]. We all browse in various contexts picking out bits and pieces of information and selecting worthwhile information [25]; and we accomplish this by using a searching and scanning behavior over organisations of the material [33, 28], interfaces to that material [2], and feedback about the material [27].

3. CONTEXT AND PREVIEW

3.1 Context

Specifically, context means the part or parts of something written or printed which precede or follow a text or quoted sentence, and are so intimately associated with it as to throw light upon its meaning.

In general, information contextualisation is important for mobility within the docuverse[2] because users presume they will be staying within the context of the current information space. This means that movement becomes difficult if context changes when the user does not want to. Obviously there may be times when a user wishes to change context but without more information than a hyperlinked keyword the decision to move along that link is more difficult. For instance creating an anchor point described as 'Georgia' will enable linking to an associated resource, however if the context of the discussion is not known then the user cannot tell if they will move to another resource describing Georgia the former eastern bloc country, Georgia the US state, or Georgia our dog.

Put simply, in terms of our research, context influences the interpretation of the link destination by the reader.

3.2 Preview and Probing

In Web-mobility, the lack of previews of upcoming hyperlink destinations and information relating to movement across those destinations suggests that some degree of 'probing' must be implemented so that a limited preview can be obtained [18]. Indeed a user observed traversing the Web, can be seen to select a hyperlink, preview the contents (by clicking or placing the caret over the link to see the destination) and return if the contents are not applicable. This probing is continued until each hyperlink is previewed, and interesting contents are found which suggests that to avoid unrequired information encountered 'on-the-fly' a user needs some form of detection and avoidance schema based on accurate and appropriate previews.

4. EXPANDING CONTEXT AND PREVIEW

Our task was to augment context to links with little or inaccurate context and to place preview information into links which accurately describe the destination of the link. We do this by using transcoding techniques[3] (the algorithms for altering documents as opposed to the physical method of alteration - proxies and the like) which involve extending the document on-the-fly. By re-engineering the document a user can have access to information in a form that is viewable on all browsers, is generated quickly as it is part of the server engine, and is on a fast connection. Speed and time advantages can also be gained by periodically processing all files on the site using this method as opposed to generating them on-the-fly if this kind of processing is deemed too slow. However, at this point we are not concerned with the type of link in the system (Structural, Associative, or Referential [24]) although process time and server load could be reduced if a differentiation process could be formulated as the preview of a referential link could in effect be derived from the context of the refereing page. Problems do exist with this solution as the original document is altered and the look may deviate from the designers original concept due to the document modifications. We decided to create our system as an external application / utility to a Web Server and link to it by using a Content Handler. In this way it would run on most Web Servers – although we used Apache (`http://www.apache.org/`). This solution also has the benefit of making the system code-base updateable on-the-fly without effecting the server itself. And, it allows designers and Web site administrators to specify which directories or file types they would like to be processed in this way so that the 'look and feel' of design critical material can be maintained. The system needs to be installed to process targeted content explicitly. This avoids the issue of third-party transcoding breaking author copyright restrictions, in effect the author says it's 'OK' to transcode. We also decided to code the system in 'Perl' so that it would run on most operating systems and could be translated to 'c/c++' if required. Perl also has the advantage of being a very good middleware bridge and file parsing language, both useful traits in our experiment.

4.1 How do we Expand Context?

Users often have problems deciding on a link's context when that link is not descriptive. Many current Websites only link one or two words when trying to associate pieces of information on their page with associated information on a destination page. Problems also exist when content management systems generate summary pages and clusters of summary links – to referential information – but only provide phrases like 'More' or 'Click Here' to link these pages. Some content management systems just use the title of the referenced material as the link anchor however this does not work for associative links.

Expanding context is a non-trivial task and our solution provides only a partial answer. Our system uses the text surrounding the link to give the link itself a better context when the original text ('Read Me...') is expanded based on the content of the summary above it. Our basic algorithm is simple but effective and moves through the page in a systematic way thus:

1. Search the document for anchors – `<a...> </a>`.
2. Make sure the hypertext link uses the hypertext transfer protocol – `<a href="http://...">` – we don't give context to mail and ftp protocols etc.
3. We now move forwards and backwards expanding the anchor text until we meet either:
   - '.', '.', ',', ';', '(', ')', or ':'

[2]A named set of documents, in this case, joined by hyperlinks which provide a pathway through the discourse. For text, a docuverse is the analog of a database.

[3]Simply, transcoding is technology used to adapt Web content so that they can be viewed on any of the increasingly diverse devices. Systems are often based along similar lines and address set problems, some are annotation based [22], others generate text only versions [29, 10], some filter the content [1], and others are specifically used for small scale device interaction [5].

- <start tag> or <end tag>
- However, if the tag is a line break (
 or </br>) it is ignored. This is because we have found that badly designed sites often use the line break as a means of aligning textual content and in some cases breaking sentences into multiple lines.
- All tags and whitespace are ignored that occur directly before the anchor tag.

However, our system does not always provide links that are fully descriptive. In fact our second experiment processes an anchor from 'Read More...' into 'Instead, they cite conduct and emotional problems as more likely causes. Read More... '. We are intending to investigate this further by looking at ways to modify the anchor based on the sentence structure by deciding if it is a noun phrase built on a pronoun or if words within that phrase are personal pronouns (like 'they'). In which case we could iterate once more to try to find the subject of the pronoun. We are aware that the anaphoric reference is a notorious problem in natural language processing. However, deciding on the amount of information to place in a link is often difficult and intractable. In fact anchor size is usually decided on in an ad-hoc fashion by the developer. In our case we don't have this problem as our anchor size is arbitrary but we do realise that the need to generate expanded context must be balanced with information overload – if the anchor size becomes too large. Trying to achieve this balance means that we limit size to sentence structures or word combinations with some contextual semantics.

4.2 How do we Expand Preview?

Expanding preview is our most computationally intensive activity, because it requires each link destination to be fetched and processed before the complete document is returned to the user. Some systems attempt to cull only the title of the link destination in an attempt to avoid this processing overhead. However, from experiments performed with visually impaired users this method often does not produce effective link descriptions because titles often do not fully represent the content or context of the page. In our system we process each link target looking for a set of key description information.

1. We look for the text in the first paragraph ... . In this way we try and skip banners and menu information.
2. If this is not present we look for text inside the <body> element but outside other elements – in the document object model (DOM).
3. If this is not present we look at <meta ..> tags within the document header and process these to provide a keyword set.
4. Finally, we look for our richest meta data named element 'DC.Description.Abstract'. This element is the Dublin Core Description element and can be found in newer XHTML type pages. This element normally gives and abstract description of the page that has been reached.
5. We then process the information from one of the previous steps (in the cascade) by removing all tags within the paragraph and process to the first '.', '.', ',', ';', '(', or ')'.

The page would obviously become overly complex if we wrote the preview information as part of the anchor text (as we will see with our evaluation) along with the context text. Therefore, we add this preview information to the title attribute of the anchor so that accessibility systems can read it and the information is also displayed when the cursor is rolled over the link text.

5. FORMATIVE EVALUATION

5.1 Objective

Our objective was to see if users benefit from link descriptions which include additional context information within the link description as opposed to context information conjoined to the link but not part of it. If they also benefit from link descriptions which include additional preview information related to the link destination. And if so how much information should be included? It is already understood that visually impaired users benefit from more descriptive link names giving context and preview [21]. This is due to the use-method which entails tabbing from hyperlink to hyperlink looking for the most appropriate point to jump to another resource. However, if we make links very descriptive will this reduce the cognition of users? Or will surfers also use the now descriptive links as glance points which help them summarise the page.

5.2 Methodology

We used a questionnaire approach [8] since it was a subjective evaluation. Respondents were asked to comment on a set a five questions using a variant of the NASA Bi-Polar method and a bivariate scale (Figure 2) [16]. Respondents placed a mark on the scale corresponding to their perceptions when comparing two differing views of the same page but with links varied to analyse context and preview (Figure 1).

We compared the original view against one with enhanced context; the original against enhanced preview; the original against both enhanced context and preview together; and finally, context against preview. These views were investigated against referential links in titles, referential links with repeating text ('click here' links), and single word or small phrase associative links within the narrative (see Section 3). A set of five questions were applied to each comparison set and link type set thus:

1, Which side do you find more descriptive? [4] We wanted to see if users used the link text more than the contextual but unlinked surrounding information.

2, On which side is the link destination more obvious? Does additional information make the destination more obvious and therefore assist any navigation?

3, Which side do you find more helpful? Do users find one side or the other more helpful? This question enabled users to 'contradict' themselves incase they actually preferred less information.

4, On Balance, which side do you prefer? Does the user prefer a different side to the first three answers?

5, Which side has too much information? If a side has too much information then we also want to know.

The evaluation was conducted over an appropriate respondent set [8] with differing characteristics. To achieve this, five disjoint physical locations (an Internet Cafe, A Supermarket, the University Precinct, a Hall of Residence, and a Plaza / Square) were targeted at varying times of the day and we applied our questions over different social and economic groups with varying Web proficiency. The only requirements were that they had experience in using the World Wide Web, that they each surfed different kinds of websites (not

[4]Remember, participants were shown images like Figure 1 while answering the question and choose between the left or right image.

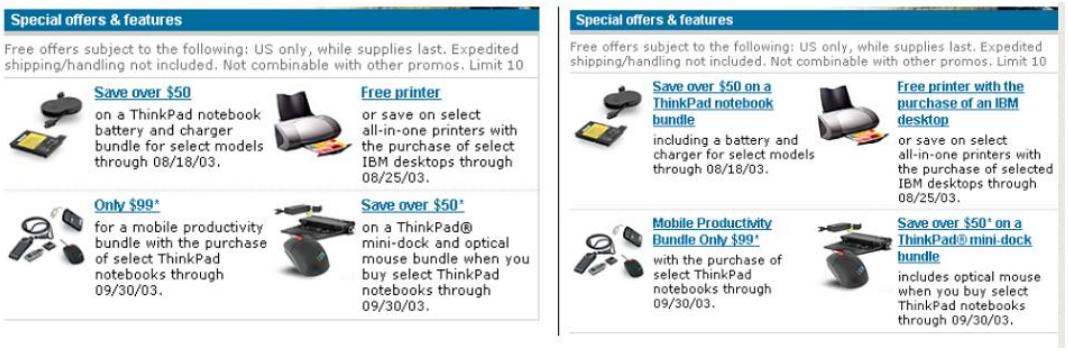


Figure 1: Test image based on a fragment of IBM's Homepage.

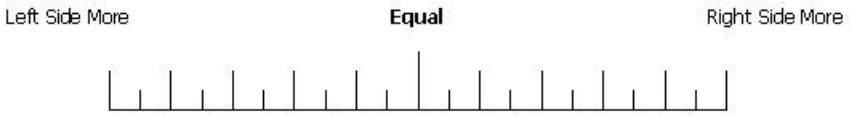


Figure 2: Bivariate Scale - A scale of 10 unnumbered divisions was presented both left and right of a central point. The central point was titled 'equal' and the boundary of the left and right sides were titled 'Left Side More' or 'Right Side More'.

just news, say) and their first language was English or they were fluent in reading English (although their fluency was not formally tested and we relied on their honesty). All testers followed a set script and the whole process was initially tested on four respondents as a way of eliciting comments on the procedure. In this way the questioning system was tested before the real evaluation (these test scripts were not taken into account in the overall survey of 42).

The order of presentation becomes important when presenting a battery of instruments to participants. This is because if all respondents are given tasks in the same order then it cannot be guaranteed that the effects are due to the phenomenon under investigation or the order they are presented in (i.e. low ratings, lack of variability in ratings towards the end maybe because respondents are tired or getting bored). We therefore varied the order of the tasks to reduce the risk of these effects.

Finally, we wanted to add weight to our findings and give credit to our respondents to encourage them to participate. We decided to do this by acknowledging them.

5.3 Data Analysis

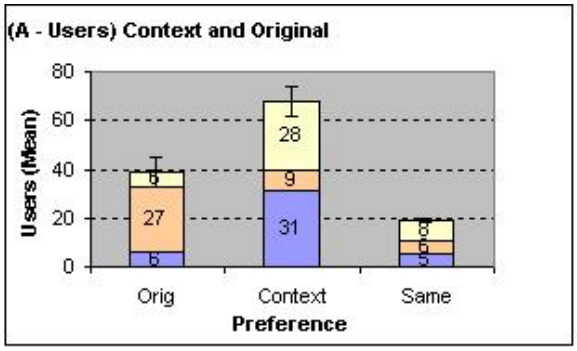
Forty two sighted individuals participated in our evaluation; 21 male and 21 female; with 7 male and 7 female for each age range category of: 16-30, 31-45, and 46-60. A spread of occupations were targeted so that we did not just interview students, and the browsing behavior of each respondent was not just confined to one type of site.

Using our base set of 42 respondents we get an 80% Confidence Interval with a Sampling Error Rate of (+/-)10% for a population of 150,000 [8].

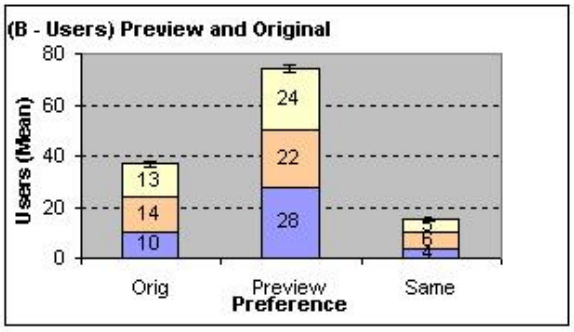
We use a 10 point scale both left and right as opposed to a linear transform. We can therefore compute percentages and averages more easily for each question which enables us to clearly see the distribution of response values when graphed. We are aware of the work in this field which suggests that there is little value including divisions beyond a certain number of points on a scale [16]. After 7 or 8 intervals people fail to make the discrimination (i.e. on a 5 point scale from excellent to very poor, there is a distinction from one category to the next - excellent to good maybe). On a ten point scale there is little meaningful difference in a category 8 score from a category 9 score [14]. However, we continued with our 10 point scale as we did not mark numbers or categories (excellent etc) on the scale. We could also apply a linear transform later, if required. However, we did decide to augment our study by implementing a boolean analysis of the data (by assigning a simple yes or no, one or zero, to the side the respondent preferred most). We considered other options like the 'Summated Rating Scale Construction' but decided that our initial construction was appropriate for our evaluation.

5.4 Results

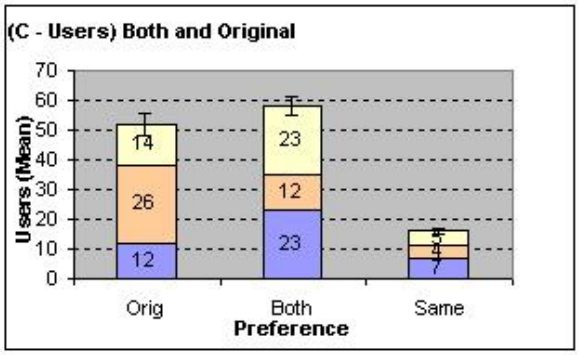
Figures 3 and 4, show the results from our evaluation as both graphs and in tabular formats. Each graph / table pair is labelled from 'A' to 'D' listing the mean values for each of the link categories (associative and referential links, and referential titles) along with the harmonic mean and standard deviation. The sets of data in Figure 3 show the number of users who expressed a preference to original and modified link descriptions. We can see that compared to the original, users preferred enhanced context (Figure 3–A), enhanced preview (Figure 3–B), and both enhanced context and preview (Figure 3–C). We can also see that users preferred additional preview information as opposed to expanded context descriptions (Figure 3–D). Figure 4 shows the mean ratings (or weight of feeling) as to just how much they supported their decisions. This based on how far to each side of the bivariare scale a user rated their preference. We can see from the standard deviations in data-set A and D that ratings were variable. Our second analysis was to determine user preference across each link type as opposed to augmentation type (Context or Preview). To accurately justify our conclusions we decided to use the 'Analysis of Variance Between Groups' (ANOVA) rating which also produces p-values. In terms of the de-



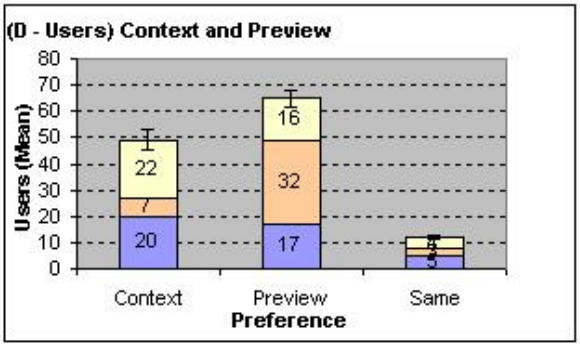
	Original	Context	Same
Associative Links	6.00	28.00	8.00
Referential Links	27.00	9.00	6.00
Referential Titles	6.00	31.00	5.00
Mean	**13.00**	**22.66**	**6.33**
Harmonic Mean	8.10	16.75	6.10
Standard Deviation	12.12	11.93	1.52



	Original	Preview	Same
Associative Links	13.00	24.00	5.00
Referential Links	14.00	22.00	6.00
Referential Titles	10.00	28.00	4.00
Mean	**12.33**	**24.66**	**5.00**
Harmonic Mean	12.07	24.42	4.86
Standard Deviation	2.08	3.05	1.00



	Original	Both	Same
Associative Links	14.00	23.00	5.00
Referential Links	26.00	12.00	4.00
Referential Titles	12.00	23.00	7.00
Mean	**17.33**	**19.33**	**5.33**
Harmonic Mean	15.52	17.61	5.06
Standard Deviation	7.57	6.35	1.52



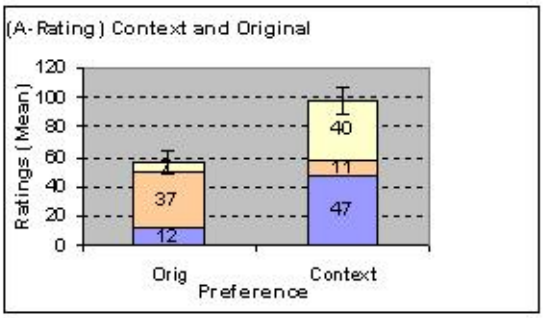
	Context	Preview	Same
Associative Links	22.00	16.00	4.00
Referential Links	7.00	32.00	3.00
Referential Titles	20.00	17.00	5.00
Mean	**16.33**	**21.66**	**4.00**
Harmonic Mean	12.58	19.66	3.82
Standard Deviation	8.14	8.96	1.00

Figure 3: ***User Preferences*** **across Associative, Referential, and Referential Title link Categories**

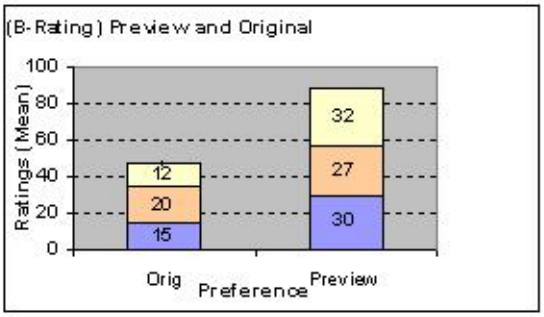
tails of the ANOVA test, note that the number of degrees of freedom ("d.f.") for the numerator is one less than the number of groups. The number of degrees of freedom for the denominator is the total number of responses minus the total number of groups. The F ratio can be computed from the ratio of the mean sum of squared deviations of each group's mean from the overall mean [weighted by the size of the group] and the mean sum of the squared deviations of each item from that item's group mean.

We use hypothesis testing to infer a statistical value from our data sets. We start with a hypothesis about a population parameter called the null hypothesis. Our data can then be analyzed as to the viability of the null hypothesis. We defined our null hypothesis thus:

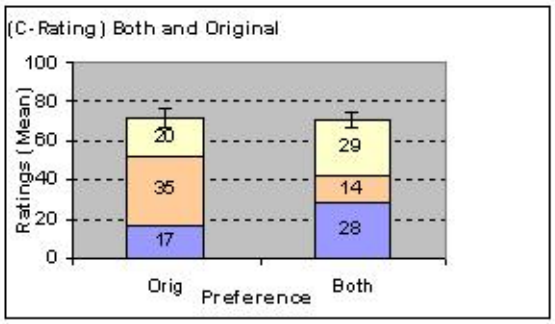
> 'Users prefer an unchanged link without additional information.'



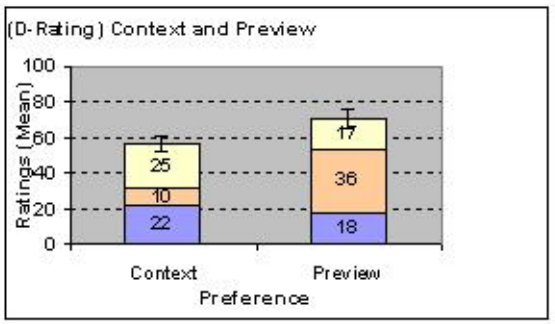
	Original	Context
Associative Links	7.00	40.00
Referential Links	37.00	11.00
Referential Titles	12.00	47.00
Mean	**18.66**	**32.66**
Harmonic Mean	11.84	21.86
Standard Deviation	16.07	19.08



	Original	Preview
Associative Links	12.00	32.00
Referential Links	20.00	27.00
Referential Titles	15.00	30.00
Mean	**15.66**	**29.66**
Harmonic Mean	15.00	29.52
Standard Deviation	4.04	2.51



	Original	Both
Associative Links	17.00	28.00
Referential Links	35.00	14.00
Referential Titles	17.00	29.00
Mean	**24.00**	**23.66**
Harmonic Mean	21.83	21.18
Standard Deviation	9.64	8.38



	Context	Preview
Associative Links	25.00	17.00
Referential Links	10.00	36.00
Referential Titles	22.00	18.00
Mean	**19.00**	**23.66**
Harmonic Mean	16.17	21.10
Standard Deviation	7.93	10.69

Figure 4: *User Ratings* across Associative, Referential, and Referential Title Link Categories

We therefore defined our alternate hypothesis as:

> 'Users prefer the link information to be changed to include additional context and preview information (as per our algorithm).'

The data sets and significance tests for these two hypothesis can be found in figure 5. If the null hypothesis is rejected, then the effect found in a sample is said to be statistically significant. If the null hypothesis is not rejected, then the effect is not significant. We choose the standard significance level of 0.01 (1% level), a more conservative value than the other common 0.05 level.

It is worth noting that we do not use the common t-test because with increased pairings a P=0.05 for one pair cannot be considered significant. ANOVA puts all the data into one number (F) and gives us one P for the null hypothesis. We can see from our results that:

Associative Links Users prefer both context and preview to be present in associative links (light grey on Figures 3 and 4).This can also be seen on the simple graph in figure 5 showing data set C, F, and I as having the highest user rating for each at the 'Alt' position. We can also see that the probability of the null hypothesis (ANOVA Results - Associative Links) is 0.001 as

Link Augmentation		Hypothesis		
		Null	Alternate	Same
A	Adding Context to Referential Titles	6	31	5
B	Adding Context to Referential Links	27	9	6
C	Adding Context to Associative Links	6	28	8
D	Adding Preview to Referential Titles	10	28	4
E	Adding Preview to Referential Links	14	22	6
F	Adding Preview to Associative Links	13	24	5
G	Adding Both to Referential Titles	12	23	7
H	Adding Both to Referential Links	26	12	4
I	Adding Both to Associative Links	14	23	5

ANOVA: Results – Associative Links

Source of Variation	Sum of Squares	d.f.	Mean Squares	F
between	582.00	2	291.0	30.10
error	58.00	6	9.667	
total	640.00	8		

The probability of this result, assuming the null hypothesis, is 0.001

ANOVA: Results – Referential Links

Source of Variation	Sum of Squares	d.f.	Mean Squares	F
between	434.00	2	217.0	6.510
error	200.00	6	33.33	
total	634.00	8		

The probability of this result, assuming the null hypothesis, is 0.031

ANOVA: Results – Referential Titles

Source of Variation	Sum of Squares	d.f.	Mean Squares	F
between	824.00	2	412.0	44.14
error	56.00	6	9.333	
total	880.00	8		

The probability of this result, assuming the null hypothesis, is 0.000

ANOVA: Results – Additional Preview Information is Better?

Source of Variation	Sum of Squares	d.f.	Mean Squares	F
between	492.70	2	246.3	5.005
error	295.30	6	49.22	
total	788.00	8		

The probability of this result, assuming the null hypothesis, is 0.053

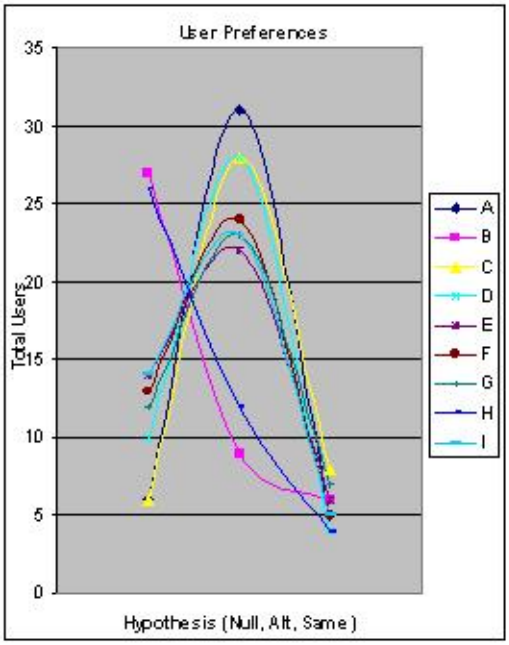


Figure 5: Anova Analysis of User Preference

being true. This means that the null hypothesis is rejected and the alternate must be correct (remember our significance level is 0.01). **Generally, users prefer associative links to be augmented with context and preview information.**

Referential Links Referential Links are a little harder to analyze. Our initial analysis based on context and preview augmentation suggests that users find preview links more beneficial than both context and non-enhanced links when looking at referential links because they find some information repeated and again there is a danger of information overload (medium grey on Figures 3 and 4). However, on analysis across link types we can see from the simple graph in figure 5 the data sets B and H that users drastically prefer the orig-

inal unchanged version. It also seems that from data set E that they prefer preview in referential links but the difference between the null and alternative hypothesis are not as large. We can also see that the probability of the null hypothesis (ANOVA Results - Referential Links) is 0.031 as being true. This means that the null hypothesis is accepted and the alternate must be incorrect (remember our significance level is 0.01). **On the whole users prefer referential links not to be augmented with context or both context and preview together but there is evidence to suggest that preview information in it's own is acceptable.**

Referential Titles Finally, our initial observations suggest most people prefer referential titles to have both context and preview information however, they think there is a possibility of information overload when context and preview are displayed in the same link description (dark grey on Figures 3 and 4). On further analysis (see fig 5) we can see that data sets A, D, and G on the graph support our alternate hypothesis. These findings are confirmed by the ANOVA Results - Referential Titles in same figure. The probability of the null hypothesis being true is 0.000. This means that the null hypothesis is rejected and the alternate must be correct. **We can see that user prefer referential titles to have either context or preview or both present in the anchor description.**

Which is Best, Context or Preview? On investigation of the initial data set analysis (Set D on Figures 3 and 4). It seems preview comes out as being preferable with the score of 32 for referential links increasing the average. Indeed although the mean of preview against context is 21.66:16.33 we can see a greater disparity in the more accurate (in some cases) harmonic mean. With the standard deviation for both being comparable. However, on analysis of the ANOVA Results (Additional Preview Information is Better?) we take the null hypothesis to mean context is preferred and the alternate as preview is preferred. We can see that the probability of the null hypothesis has a chance of 0.053 as being true. This is over our significance limit therefore indicating that the alternate must be incorrect.

5.5 Evaluation Conclusions

Besides our statistical results we also found that most users considered text size important, they tend not to read but glance (as is consistent with our browsing research) and so they naturally pick out information that is most obvious. Therefore, font size which is small (even if highlighted) tends to be overlooked. We did notice that some respondents contradicted themselves when asked 'On Balance, which side do you prefer?'. However, on further questioning they stated that it was because they were more used to the original non-enhanced methods of presentation and that this would not arise once used to enhanced versions. Finally, users also stated that they often used hyperlinks like a bullet list (forming and ad hoc summary of the page) but that sometimes too much preview information can disrupt the narrative flow. It seems that enhancing link descriptions with context and preview is both useful and important. However, there is a problem with information overload which may result a lack of cognition over link destinations. The target then is to modify links usefully while not overloading the user with too much information. We decided this could be best achieved by placing the preview information into a link anchor title attribute while extending link description to included more context information. In this way additional context and preview can be added in line with our formative evaluation.

6. CONCLUSION AND FURTHER WORK

We have described the design and implementation of a formative evaluation to assess the context and preview needs of web users. Through this study we have confirmed that both context and preview are important for browsing by all web users. Our formative evaluation:

- Supports the anecdotal design pattern view that uses benefit from enhanced preview within link descriptions.
- Disproves the empirical evidence that Web surfers do not need context or preview to be built into their link descriptions.
- Suggests that enhanced context information is important to web surfers.

We propose that further work needs to be undertaken along 2 paths: extend the system such that the problems of incorrect preview, information overload, and clutter in the docuverse are overcome; and create a summative evaluation to confirm our implementation.

7. ACKNOWLEDGEMENTS

We would like to thank: Aragao M., Aragao V., Buckley K., Coultard P., Creighton S., Hart I., Inggs C., Jin B., Kirk E., Li L., Mee K., Morehead C., Omon A., Sambells G., Sonmez Y., Stebbing A., Walsh T., Zhao H., and the remaining anonymous respondents for their participation in our evaluation.

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