Issues of Saliency and Recognition in the Search for Web Page Bookmarks

By Alex Poole

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Contents

Abstract

Bookmarks are a useful way for people to return to web pages they visited previously, but it can be difficult to find a specific link when the bookmark collection grows too large. Graphical aids do exist to make bookmarks “stand out”, such as icons and thumbnails, but these are not universally applied. This study attempts to find the optimum way of writing bookmarks so that they can be recognised more effectively in a visual search of the bookmark menu when no graphical aids are available.

30 post-graduate students were presented with a series of news websites followed each time by a menu of bookmarks. Their task was to find the bookmark they thought corresponded to the website they had just seen. The structure of the bookmark was manipulated (top-down or bottom-up information structures) as well as the number of informational cues (one, two or three). The time taken to find each bookmark was measured and eye movement data was gathered to provide a deeper understanding of the participants’ visual search behaviour and related cognitive processing.

The number of cues on display in a bookmark was a significant factor in recognition time, where two cues were found to be necessary for optimal recognition, one cue was found to be highly sub-optimal and a third cue added no recognition value at all. However, top-down and bottom-up bookmark structures were found to be equally salient.

Keywords

Bookmarks, eye-tracking, information salience, visual search, World Wide Web

1. Introduction

1.1) Keeping found things found

Since its inception 12 years ago, the World Wide Web has experienced a phenomenal growth rate far beyond that of any other comparable media. Accurate estimates on the size of the web are hard to acquire, but the largest search engine, Google, claims to hold 3 billion web pages in its database (“Benefits of Google”), but this can only be a small fraction of the total number of web pages currently in existence (Lawrence & Giles, 1999).

Although the Web serves as the primary information resource for many people, its massively increasing size and complexity has made “information overload” one of the biggest and most obvious drawbacks of the technological age. Thankfully, in recent years finding resources on the web has been made easier with modern search engines such as Google, together with more refined search functions found within websites themselves. But managing to successfully find a web page invites a secondary problem - how do you keep it “found”? (Jones, Bruce & Dumais, 2001).

Users have many different methods of “keeping” resources found on the web. They save whole pages to their hard drives, print them out, send URLs to themselves in an email, write them down on a piece of paper or add them to the "bookmarks" list in their web browser (Jones, Bruce & Dumais, 2001; Cockburn, & McKenzie, 2000; Tauscher & Greenberg, 1997). The last method, “bookmarking”, will be the focus of this study.

1.2) Bookmark basics

Bookmarks have been in existence since the creation of the first World Wide Web browser in 1991 (Cailliau, 2002), and have been adopted by most web browsers as a standard navigation and revisitation tool, but referred to by different names for reasons of marketing. The term “bookmark” is used in the Netscape Navigator browser, the equivalent term being “favorites” in Internet Explorer, as shown in Figure 1 below (The term “bookmark” will be used throughout this paper and is synonymous with “favorites” and “links”).

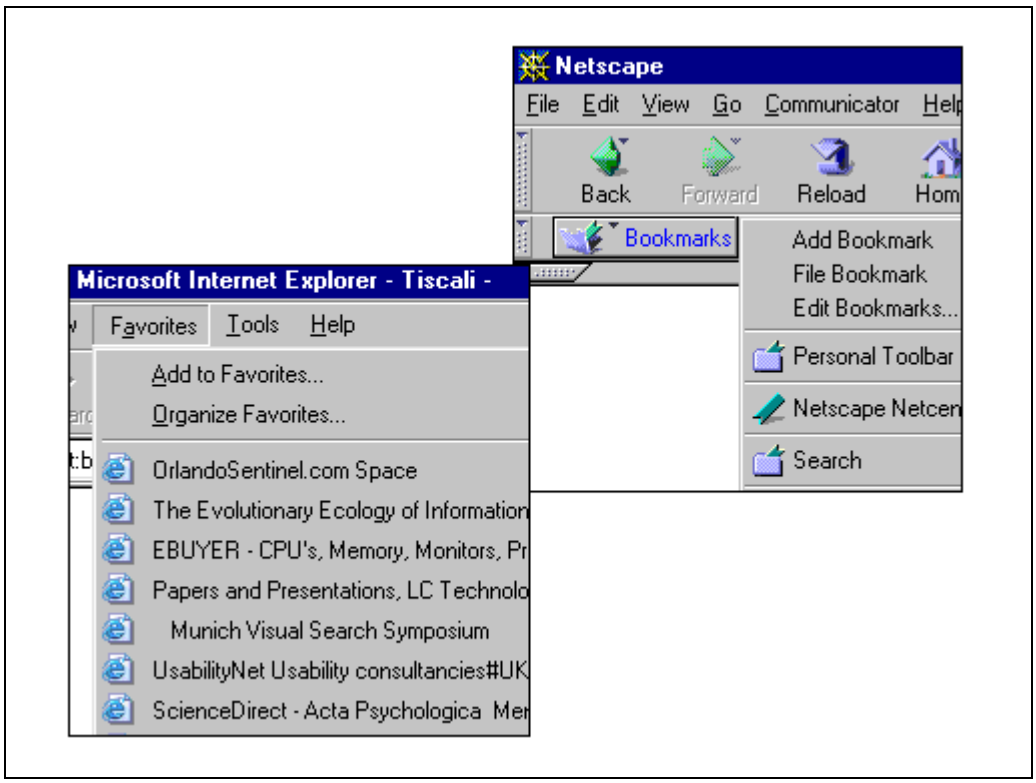


Figure 1
“bookmarks” and “favorites” menus.

The text in a bookmark begins its life as the title of a web page, found in the <title> tag in the html code that is used to build the page (Figure 2).

```
<html>
<head>
        <title>OrlandoSentinel.com: Space</title>

        <meta name="Description" content="A foam st
        <script language="javascript" src="/javascr
        <script language="javascript" src="/javascr
        <script language="javascript" src="/javascr
        <link rel="stylesheet" href="/stylesheets/d
</head>

<body bgcolor="#FFFFFF" link="#00457B" alink="#0045
```

Figure 2
The title text comes from the <title> tag as defined in the HTML code.

The content of this tag is extracted and used for various functions in Microsoft Windows. It is used firstly as the title of the page in the top bar of the web browser and for the icon representing the browser on the Start bar when the browser is minimised (Figure 3). If the user decides to save the web page to their hard drive, the title is used as the filename. The <title> text also appears in the “History” list of the web browser and of course in the bookmark if the user decides to keep the page by that method. Finally, the text also appears in the tool tip that pops up when the mouse pointer is held over the bookmark in Internet Explorer (Figure 3).

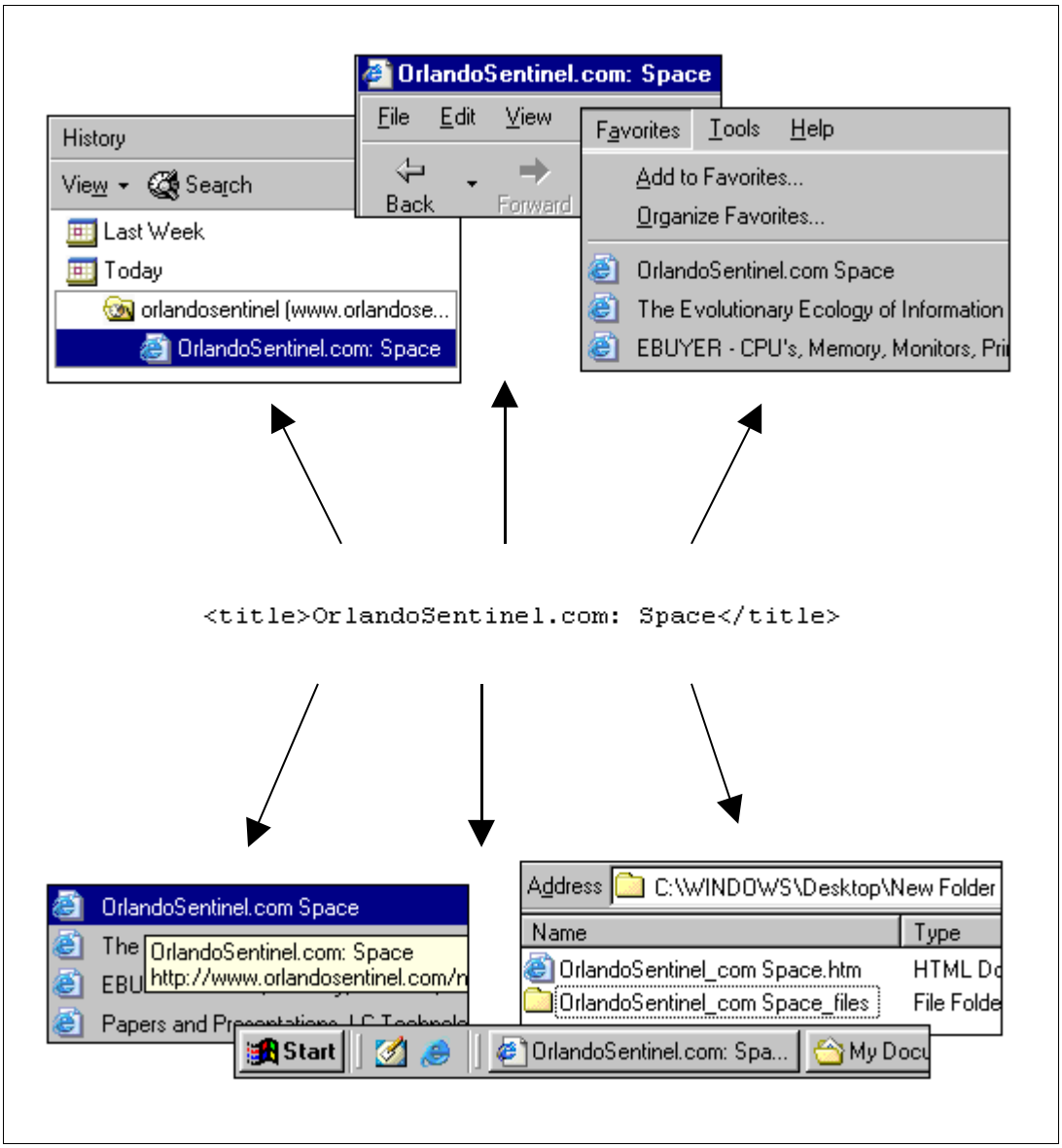


Figure 3
The <title> tag text is extracted and used for various functions in Windows: It appears in the browser's top bar, as the "Start" bar icon and in the history list. It is also used for the bookmark and the corresponding the tool tip, and to name a saved file.

It is important to note that the text in the <title> tag does not actually appear on the web page itself, and is not necessarily the same as the "title" appearing within the web page, which has to be defined separately by the author (Figure 4).

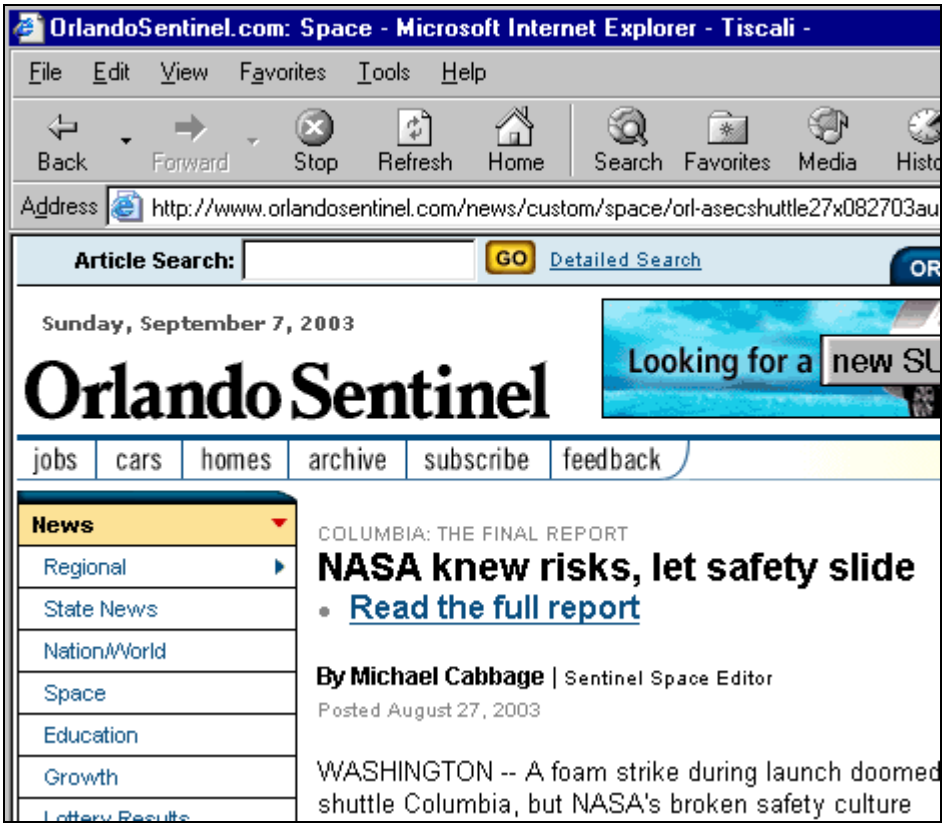


Figure 4
An example of when the <title> text does not match the “real” title of the page.

1.3) Good housekeeping

There are a few basic things a web author should do in order to write an acceptable bookmark, based on the complaints of web users (Kassten, Greenberg, & Edwards, 2002; Cockburn, Greenberg, Jones, McKenzie & Moyle, 2003).

First, they must remember to actually define the <title> tag. If the <title> tag is empty or even missing from the HTML code, the filename and directory path of the page will be shown instead of a meaningful title, for example http://www.hppmusicindex.com/out.asp or http://thezfiles.co.uk/seek_ae5663dc.htm.

If the author is using web publishing software such as Macromedia Dreamweaver, the programme's default text will be displayed if they don't define the <title>. This can be recognised frequently on the Web by pages marked "Untitled".

The author must ensure that the <title> tag and the "title" within the page actually match. Differences between the two have been cited by users as a major annoyance when trying to locate a bookmark (Kassten, et al., 2002). Also, authors should ensure that each page on their website has a unique title to aid multiple bookmarking of pages from the same site.

Lastly, the author has to make the title fit within the bookmark character length limit. In Windows, the maximum length for a bookmark is 255 characters (including spaces), but only the first 65 characters on average will be visible in the "favorites" menu in Internet Explorer, although all 255 characters should appear in the tool tip (see Figure 5 below). Only average capacity can be given as the amount of words visible will depend on the thickness of the letters used (if Windows used a monospaced font for menus, the character limit would be identical each time).

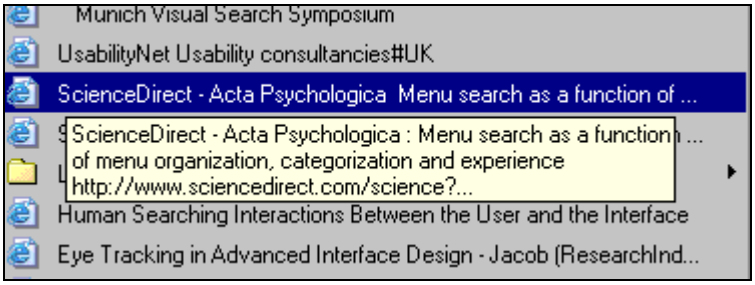


Figure 5
On the "favorites" menu in Internet Explorer, the tool tip displays 255 characters while the bookmark only displays 65 characters on average.

2. Purpose of the Experiment

2.1) Rationale for studying text-only bookmarks

Bookmarks are a convenient way to revisit web pages, until your bookmark list grows so large you can no longer find the bookmark you need. This task becomes even more difficult when returning to the list after a long time, most likely with a fragmented memory of what the bookmark text actually was.

To address these problems, there has been a lot of productive research in making bookmarks easier to find and organise (Cockburn & Greenberg, 1999; Cockburn et al., 2003; Kassten, et al., 2002; Abrams, Baecker & Chignell, 1998; Tauscher & Greenberg, 1997). Custom icons can make the bookmark reference stand out, as shown in Figure 6.

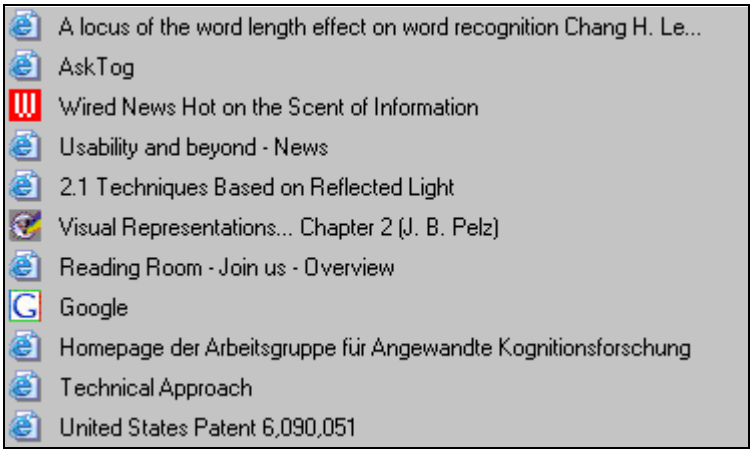


Figure 6
Custom icons can make bookmarks easier to spot.

An extension of this idea is the use of thumbnail images of the websites themselves next to the text bookmark, as in Figure 7. This has been shown to be a successful approach (Cockburn, et al., 2003), but is yet to adopted by Internet Explorer as a standard revisitation mechanism.

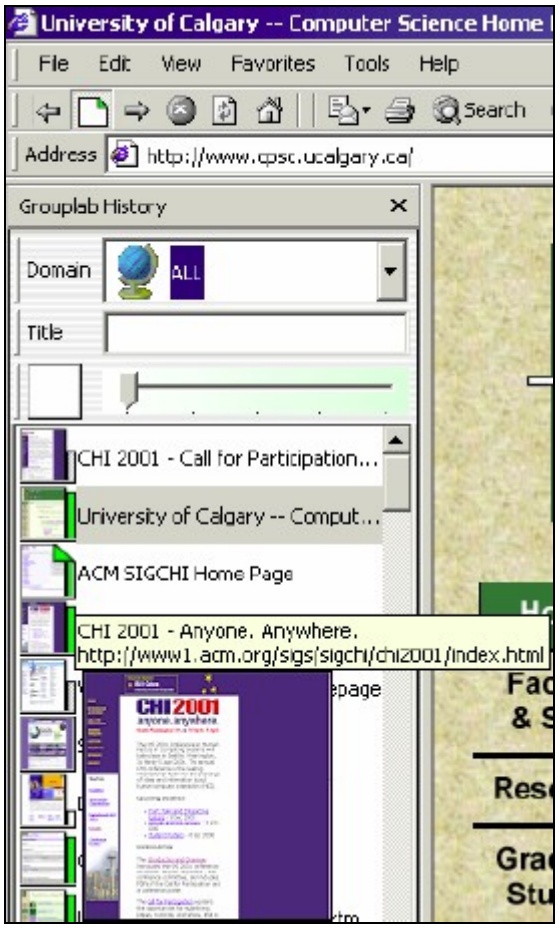


Figure 7
Thumbnail images of web sites next to their text bookmarks can aid recognition (Figure © Cockburn & Greenberg, 1999).

The research states that there are severe limitations to using the <title> tag text for bookmarks, as mentioned in the previous section (Kassten, et al., 2002; Cockburn, et al. 2003). However, these 'limitations' are not inherent in the <title> tag system, but stem from Web producers' own habits. Icons are subject to the same limitations, since they are also created by Web producers. Some of these icons can be rather obscure and may not in fact aid recognition of the bookmark.

Furthermore, the advantages of icons may be short lived. If the use of custom icons becomes widespread, and every bookmark has one attached, their ‘pop out’ value will be greatly reduced and recognition time is likely to be just as slow as it can be for text.

Thumbnails also have their own recognisability problems. Text-based pages are hard to recognise at any resolution and pages from web sites that are consistently designed are hard to differentiate (Cockburn & Greenberg, 1999). Thumbnails also consume a high proportion of screen real-estate. Each bookmark on the favorites menu in Internet Explorer occupies 20 pixels of vertical space, however, to achieve just a 60% chance of recognising a particular web page, a thumbnail 144 pixels high is required (Kassten, et al., 2002).

Accessibility and usability may also be problematic for visual recognition aids. Icons and thumbnails are of little to no benefit for visually impaired users, but plain text can always be interpreted by voice web browsers. Similarly, other systems such as file organisers, search engines and databases may not be able to interpret graphical representations. For example, it may be difficult to implement automatic and meaningful bookmark sorting based on graphical properties.

In terms of usability, it is not clear if icons and thumbnails will transpose well to PDAs and mobile phones. These devices have extremely limited screen real-estate, and thumbnails in particular may have to fill most of the screen in order to be recognised.

The research has shown that these visual aids can make bookmarks stand out, but this same research does not propose how to make web pages easier to recognise when they are represented by standard text-only bookmarks.

It is clear that text-based referencing is still a major force on the Web and warrants continued research and improvement. This study is intended as an initial step towards this aim by finding the factors that most affect the recognition of text bookmarks.

2.2) Types of bookmark: Top-down & Bottom-up structures

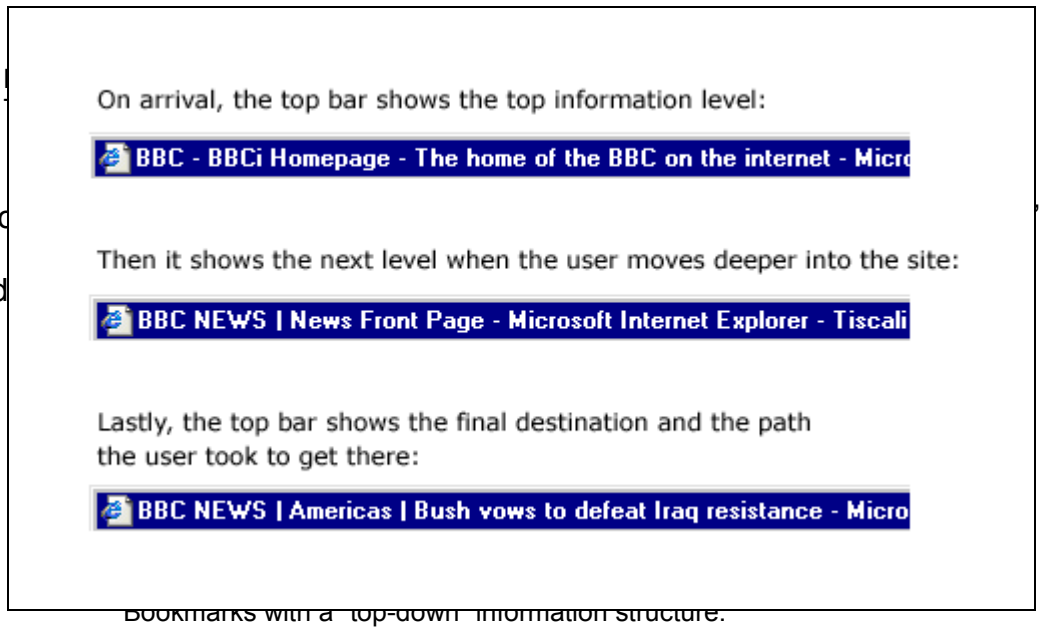
Most web producers use their common sense when writing bookmark text. They ensure that the text satisfies some basic criteria, then choose some appropriate information to identify the page, such as the name of the website or the subject of the page, etc. (Table 1).

Table 1
Potential appropriate contents for a bookmark.

• The content or subject of the page • The name of the website that hosts the page • A description of the host website • The name of the author • The date • The name of the section of the website that the page comes from (could be useful in very large websites where the same page title appears in more than one context) • Reference numbers

They then have to choose how they will put this information together. Many web producers who manage large websites with several levels of information choose to model the <title> tag text on how this information is organised on the site. This can help users while they navigate, because their

navigation trail is built up in a logical way, giving them feedback on where they are, and how they got there, as shown in Figure 8 (Preece, Rogers & Sharp, 2002).



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Bookmarks with a "top-down" information structure.

Model:
site name - section name - page title
Examples:
BBC NEWS - Middle East - Top Saddam official surrenders Lancaster University - Postgraduate students - Alex Poole

Conversely, a bottom-up structure starts with the title of the page, and ends with the name of the site (Table 3).

Table 3
Bookmarks with a "bottom-up" information structure.

Model:
page title - section name - site name
Examples:
Top Saddam official surrenders - Middle East - BBC NEWS Alex Poole - Postgraduate students - Lancaster University

Both structures could reasonably identify a page, but how do we know which one will be most recognisable to users when they are searching in a large list, with imperfect memory?

2.3) Saliency and recognition

The assumption for the present study is that the information at the start of the bookmark is somewhat dominant. The leading information defines the structure of the bookmark - if it starts with the title of page, it must be bottom-up, and if it leads with the name of the site, it must be top-down.

Also, the leading information has a higher “profile” as users tend to “scan” down the left-hand side of a menu (Altonen, Hyrskykari & Räihä, 1998), sometimes only reading the first word or two of each list item.

Bearing this in mind, if there is a difference in saliency between the title of the page and the name of the site, this should affect the salience of the bookmark as a whole.

The second assumption for the present study is that the page title is likely to be more salient than the site name, meaning that bottom-up structures may be more salient than top-down structures. There are several reasons why this might be so.

Firstly, users actions are driven by goals and tasks (Preece, et al., 2002). Visually searching the bookmark menu is an example of goal-driven behaviour - the user is searching the menu to find a particular bookmark, for a particular reason. Anything that is tailored to the user’s task will improve the

usability of the system (Nielsen, 1992). Since the title of the page describes what the user was specifically reading, while the site name may be completely unconnected to the subject matter, it is likely that the page title may fit the user's task more than the name of the site, improving relevance and potentially improving recognition.

Secondly, the fuller descriptions afforded by page titles may be more likely to evoke stronger mental imagery, which is known to aid memory and recognition (Clark & Paivio, 1987). Likewise, they may fit better into our existing knowledge structures, aiding subsequent recognition (Alba & Hasher, 1983; Bartlett, 1932).

The final assumption is that the number of components in the bookmark is likely to affect recognition. The more pieces of information that are displayed, the more we will able to infer the meaning or identity of the whole bookmark. The possible interpretations are constrained by the context brought by the extra information (Rumelhart & Norman, 1985).

Measurement

In the present study, recognition will be measured by the time taken to find a target bookmark embedded within a set of distractor bookmarks. Faster times will be taken as indicating superior recognition.

Eye movements will also be used as a measure of information salience: In particular, the number of fixations on a bookmark component, together with fixation duration, will be taken as an index of relative salience. A detailed justification for using eye movements is provided in section 3. Suffice it to say that the use of eye movements in the present study is based on the

assumption that they provide an on-line measure of the processing demands associated with items of information, such that more processing would reflect decreased salience and less processing would reflect improved salience.

3. Eye Movements

3.1) Eye movement basics

When reading, it feels as though our eyes are moving smoothly along the page in one smooth sweep, but this is an illusion. Our eyes actually move along a line of text in a series of quick jerks called “saccades”, each lasting typically for 20 to 35 milliseconds (ms). After each saccade, the eyes stay relatively still while taking in, or “encoding” information. These moments are called “fixations”, and they last for 218ms on average, although the range is 66 to 416ms. Sometimes the eyes move back in the direction of text that has already been read - these regressive saccades are known as “regressions” (Rayner & Pollatsek, 1989). Scan paths are recurring patterns of saccades and fixations - in this study, it is assumed that people adopt a scan path which runs over the far left of the bookmark menu (Altonen, Hyrskykari & Räihä, 1998).

The information available in a fixation is defined by the total perceptual span - it is the region in which letters can be recognised as well as the spaces between words (Figure 9). Due to the anatomy of the eye, visual acuity drops off towards the edges of the perceptual span, providing only lower grade information at the extremes. (Rayner & Pollatsek, 1989; Lansdale & Ormerod, 1994)

Information on word length can be picked up from up to 12-15 characters to the right of the fixation centre and 3-4 characters to the left, although specific letter information can only be detected up to 10 characters to the right of centre. The area in which reliable and accurate word

identification takes place is actually 7-8 characters to the right and 3-4 characters to the left of the centre of the fixation. This is known as the “word identification span” (Ojanpää, Näsänen & Kojo, 2002).

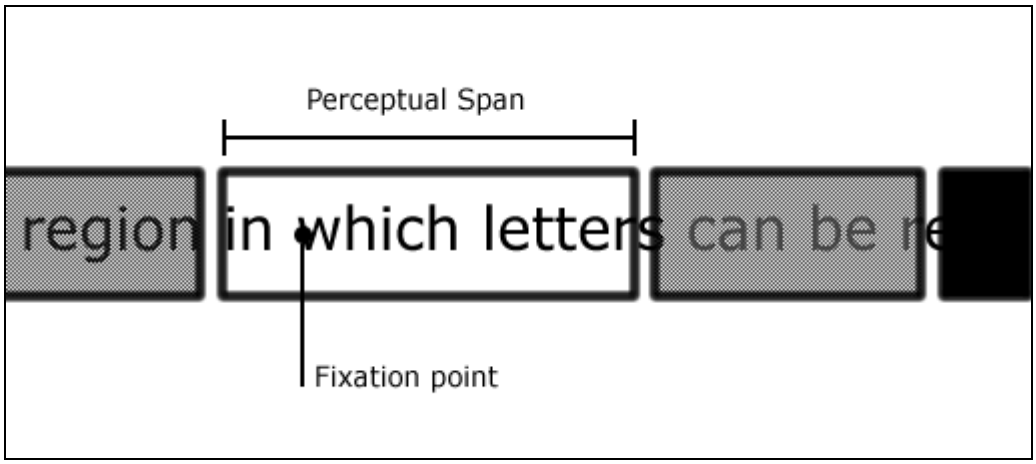


Figure 9
Perceptual span with decreasing acuity at the extremes.

The form of the perceptual span is not set at birth, but learnt according to which language system the person grows up with. For readers of languages that are written from right to left such as Arabic and Hebrew, the perceptual span is reversed, with 3-4 characters to the right and 12-15 characters to the left of the fixation centre (Rayner & Pollatsek, 1989).

3.2) Interpreting eye movements

Eye movements are in many ways a purer measure of recognition (and therefore saliency) than simple response time. Measuring the eye movements on one particular bookmark eliminates the time spent searching for it, as well as the time spent selecting it (Zelinsky & Sheinberg, 1995).

Although some researchers argue that fixations and saccades are programmed automatically regardless of the words being processed

(O'Regan, 1992), the assumption for this paper is that these eye movements, especially fixation durations, are an index of the amount of cognitive processing being applied to the item being fixated (Goldberg & Kotval, 1999; Just & Carpenter, 1976).

Fixations

Fixation frequency and duration are the main measures of cognitive activity in the present study. Fixations can be interpreted quite differently depending on the situation. In an encoding task (browsing a web page for example), higher fixation frequency on a particular area can be indicative of greater interest in the target, such as a photograph in a news report, or it can be a sign that the target is complex in some way and more is difficult to encode. (Just & Carpenter, 1976; Jacob & Karn, 2003)

However, these same interpretations are reversed in a search task - a higher number of single fixations or clusters of fixations are an index of greater uncertainty in recognising the target. (Jacob & Karn, 2003).

The duration of a fixation is also linked to the processing time applied to the object being fixated (Just & Carpenter, 1976). It is widely accepted that "representations that require long fixations are not as meaningful to the user as those with shorter fixation durations" (Goldberg & Kotval, 1999).

Saccades

No encoding takes place during saccades, so they cannot tell us anything about the complexity or saliency of the target phrase. However, regressions *can* act as a measure of processing difficulty during encoding (Rayner & Pollatsek, 1989). Although most regressions are very small, only skipping

back two or three letters, much larger phrase-length regressions can represent confusion in higher-level processing of the text (Rayner & Pollatsek, 1989). Regressions could equally be used as a measure of recognition value - There should be an inverse relationship between the number of regressions and the saliency of the phrase. However, access was unavailable to software that could identify regressions so this type of saccade was left out of the analysis.

A further reason for not analysing saccade data in fine detail is that the eye tracker used in this study was not in fact optimised for measuring saccades - the method it uses to record eye movements defines it as a "fixation picker" (Karn, Goldberg, McConkie, Rojna, Salvucci, Senders, Vertegaal & Wooding, 2000). If the study is replicated using a different type of eye tracker optimised for measuring saccades, (a "saccade picker"), very different data may be produced.

Other eye movements

Pupil dilation is a potentially interesting measurement of cognitive workload (Marshall, 2000; Steinhauer & Hakerem, 1992). A lower cognitive workload *may* be used as an indication of increased saliency due to lower processing demands (Marshall, 2000). Unfortunately the eye tracking system that was used did not have sufficient resolution or the necessary software to make accurate measurements of pupil dilation.

4. The Experiment

4.1) Participants

30 mainly post-graduate students took part in the experiment, with an average age of 30-35, and an age range of 15 - 65. 12 were female and 18 were male. All participants had normal or corrected-to-normal vision and were regular users of World Wide Web, with an average of 7 years experience. All but one reported that Internet Explorer was their main web browser. Some had taken part in other eye tracking experiments but none were aware of the research hypotheses in the present study. All were paid £3 for the 30-minute duration of the experiment.

Prior to the 30 participants who completed the experiment, six could not be calibrated with the eye tracker, data from two participants were excluded as the participants did not follow the instructions and a further four were eliminated to ensure that the remaining sample of 30 contained only native English speakers.

Most of the participants reported that they had never seen the websites used in the test, although six participants stated that they were familiar with one or two of the websites, but didn’t use them regularly.

4.2) Materials and Design

A 2x3 within subjects design was used, the first factor being the bookmark structure (either top-down or bottom-up), the second factor being the number of information components, or "cues" available in the bookmark (One, two or three cues) (Table 4).

Table 4
Experimental conditions in a 2x3 within subjects design (conditions are labelled a - f).

Bookmark Structure	**Number of cues**		
	1	2	3
Top-down	a) Site name	c) Site name - Article title	e) Site name - Section name - Article title
Bottom-up	b) Article title	d) Article title - Site name	f) Article title - Section name - Site name

The format of the experiment was straightforward - participants were asked to view a series of websites then find its corresponding bookmark in the menu that followed each time.

A set of 24 web pages containing articles on international news and current affairs were collected from news websites and saved as screenshots (Figure 10) (See Appendix A & B for a full listing). The chosen web pages all had a clear site name, article title and section name, ensuring equal opportunity of encoding for later recognition.

As they were static screenshots, the body text of the article was often not fully in view, and participants were not able to "scroll down" to read the rest of the news story. The original title bar text was deleted from each website screenshot to allow the full manipulation of the bookmark text (this is necessary as the title bar and bookmark text is the same, as mentioned in section 1.2.

Figure 10
One of the news websites used in the test: Note that the <title> tag text has been removed from the browser's top bar to prevent it from clashing with the manipulated bookmark text in the search task.

For each website, a corresponding set of screenshots were created of Internet Explorer 6 with the "favorites" menu displayed, The bookmark corresponding to the web page was located somewhere on the menu (Figure 11).

Lastly, a questionnaire was prepared to collect demographic data (Appendix D).

The experimental conditions were distributed so that websites 1-4 were followed by bookmarks of condition type "a" (site name alone), websites 5-8 were followed by bookmarks of condition type "b" (article title alone), websites 9-12 were followed by bookmarks of condition type "c" (site name and article title), and so on (see first row, Table 5).

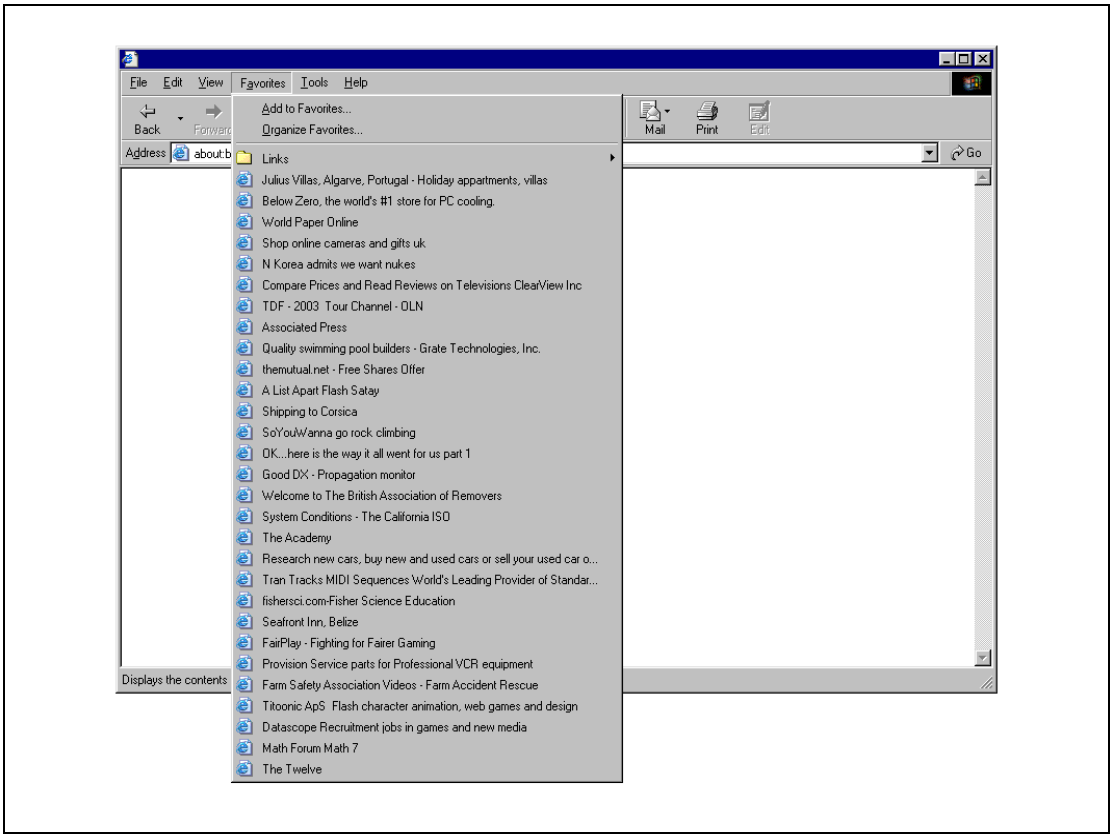


Figure 11
A bookmark menu screenshot used in the test.

The presentation order of the websites was counterbalanced so that all conditions occurred equally, and further randomised to eliminate fatigue and practice effects. Lastly, participants were randomly assigned to one of six groups (Table 5), and completed 24 trials, one for each website/bookmark menu combination.

Table 5
Counterbalancing of experimental conditions a - f.

Group	Website 1 - 4	Website 5 - 8	Website 9 - 12	Website 13 - 16	Website 17 - 20	Website 21 - 24
1	a	b	c	d	e	f
2	b	a	d	c	f	e
3	c	d	e	f	a	b
4	d	c	f	e	b	a
5	e	f	a	b	c	d
6	f	e	b	a	d	c

The bookmark conditions for each trial were manipulated by taking six screenshots (one for each condition) of the bookmark menu in Internet Explorer. Across all six menu screenshots, the distractor bookmarks were identical, the target bookmark was in the same location but the format was different, depending on the experimental condition (Table 4).

The order of the distractor bookmarks in each menu were changed haphazardly for each trial as well as one or two bookmarks being substituted for new ones each time (See Appendix C for typical set of distractor bookmarks). The target bookmarks appeared once in each position in the menu from number 4 to 27, with 29 bookmarks in the menu each time.

4.3) Apparatus

The website screen shots were presented on a 15" flat screen monitor, with a screen resolution of 1024 x 768 pixels.

Eye movements were recorded with an LC Technologies Eyegaze development system. The Eyegaze eye tracker consists of a standard desktop computer running Windows NT/2000, an infrared camera mounted beneath the monitor (Figure 12) and software to process the eye movement data ("Eyegaze development system").

An additional smaller monitor was used to ensure that the eye was in the centre of the camera's field of view. The Eyegaze system determines the eye's gaze direction by the pupil-center/corneal-reflection method. A small LED at the center of the camera lens directs infrared light into the eye, causing a reflection in the cornea and increasing the brightness of the pupil to make it more easily identifiable (Figure 13).

Figure 12
The eye tracker used in the present study: a desktop computer with an infrared camera mounted beneath the monitor.

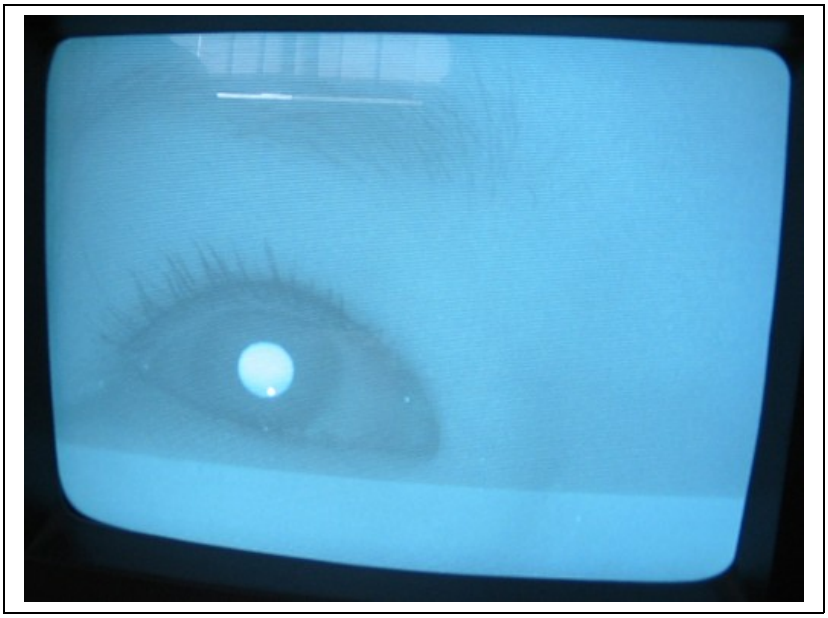


Figure 13
The “bright pupil” effect shown in the eye shown in the infrared camera monitor.

Image processing software is then used to identify and locate the centres of the pupil and corneal reflections. Finally, the gaze point (the coordinates of where the person is looking on the monitor) is found by computing the angle between the corneal reflection and the centre of the pupil.

The eye tracker is accurate to within 0.45 degrees of visual angle, which at 51cm from the screen covers approximately 3.8cm. This corresponds to 12.8 pixels on the monitor used in the test, which had a dot pitch of 0.297mm. Eye movements were sampled 60 times a second, with tracking errors not exceeding 6.3mm.

Although the eye tracker can tolerate head motion of around 3cm in all directions, participants were asked to use a chin rest (Figure 14) to minimise loss of eye movement data. A small wad of tissue is placed in the chin rest to improve comfort, certainly necessary for sessions lasting longer than a few minutes.

Figure 14
A chinrest is essential in keeping head movements to a minimum in order to maintain tracking of eye movements.

Fixations were detected at 100ms or above, an appropriate cut-off point for tracking the movement of the eyes in reading tasks (Hyönä, Niemi & Underwood, 1989; Inhoff & Radach, 1998).

Finally, a monitoring console similar to those used in lab-based usability evaluations was used to observe the participants during the main part of the experiment (Figure 15).

Figure 15
Monitoring console equipped with three CCTV cameras, used to observe participants

4.5) Procedure

On arrival, participants were shown the monitoring console and told that it would be used by the experimenter to monitor the progress of the test while keeping a distance from the participant, so as not to distract them or make them feel self-conscious during the test. It was further explained that none of the video feedback would be recorded (none of the participants objected to this arrangement).

Next, the participants were shown the eye tracker and given a brief explanation of how it worked and why it was necessary to use the chin rest. Participants were then helped to get comfortable for the duration of the test by making appropriate adjustments to the chinrest and the monitor to accommodate individual variations in seated head position. At all times, approximately the same viewing angle between the face and the screen was maintained. Participants were seated on average 51cm from the screen.

Once the participants were comfortable in the chin rest, the camera was adjusted vertically and the participant was asked to move slightly to the left or right so that one of their eyes was in the centre of the camera's field of vision. Lastly, once the camera's focus and aperture was set, the participant was calibrated with the eye-tracker.

The calibration procedure lasts 15 seconds and consists of the participant following a series of 9 dots around the screen with their eyes, starting in various locations. Through this, the system can accurately plot the person's gaze point. Once this profile of the person's eye has been captured, there is no need for them to be calibrated again, even across different test sessions.

In the present study, six participants could not be calibrated due to low contrast between the eye and pupil, large pupils being partially obscured by the upper eyelids, eye reflections being distorted by super-compressed lenses, and partially obscured pupils caused by "lazy eye".

Next, custom software was launched which presented participants with on-screen instructions and the experiment itself. After reading the instructions,

(Figure 16) the participants completed 4 practice trials while the experimenter sat beside them to answer any queries.

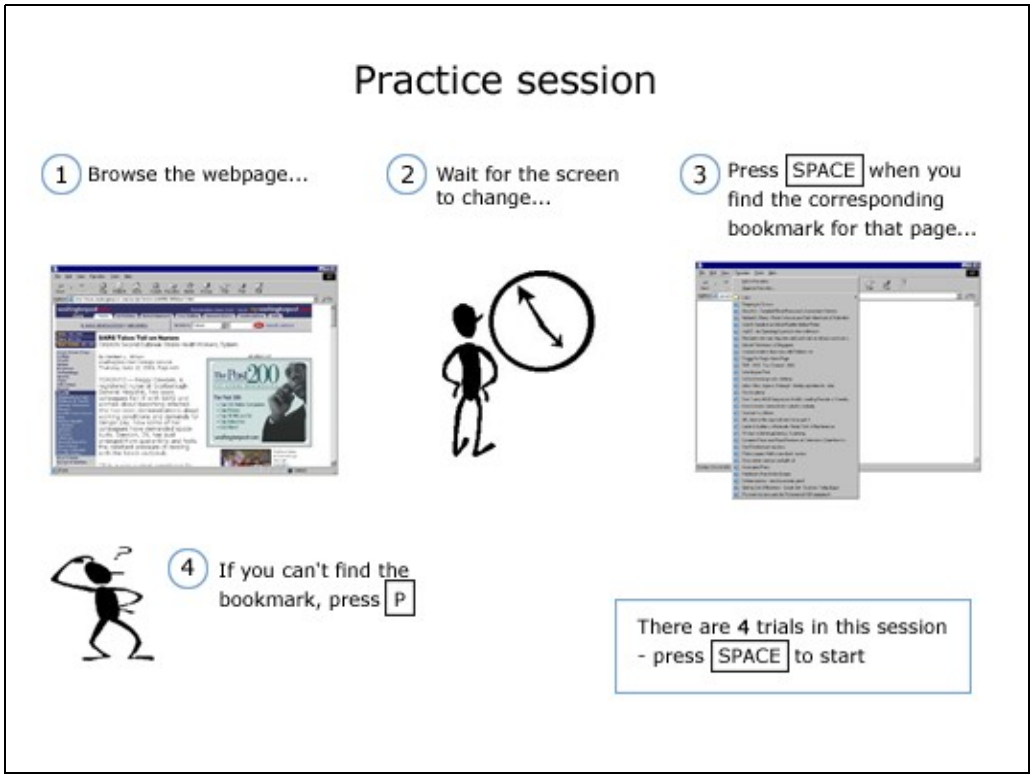


Figure 16
The main instruction screen.

Extra care was taken to check that the participants understood what they had to do before proceeding to the main session. The experimenter went to the far side of the room behind the monitoring console and left the participant to complete the main session without distraction.

Each website appeared on screen for 18 seconds, with each bookmark screen appearing for a maximum of 30 seconds. Participants pressed the space bar on the keyboard to indicate that they had found the target bookmark. If they could not find the target within 30 seconds, the trial ended and the next trial began. Once the participant had reached the end of the

main session (lasting around 15 minutes) they were given the questionnaire to complete (Appendix D).

Many significant experimental design issues were solved through a thorough multi-iteration piloting phase.

5. Data processing

5.1) Essential tools for processing eye movement data

Recording eye movements generates huge amounts of data which have to go through several levels of processing before they can be understood and analysed (Jacob & Karn, 2003).

The raw data are quite dense (see Appendix F) and is best reviewed using a graphical gaze point viewer, which should be supplied with most eye trackers. This type of software can “play back” eye movements, superimposed over the image that the person was originally viewing, as shown in Figure 17.

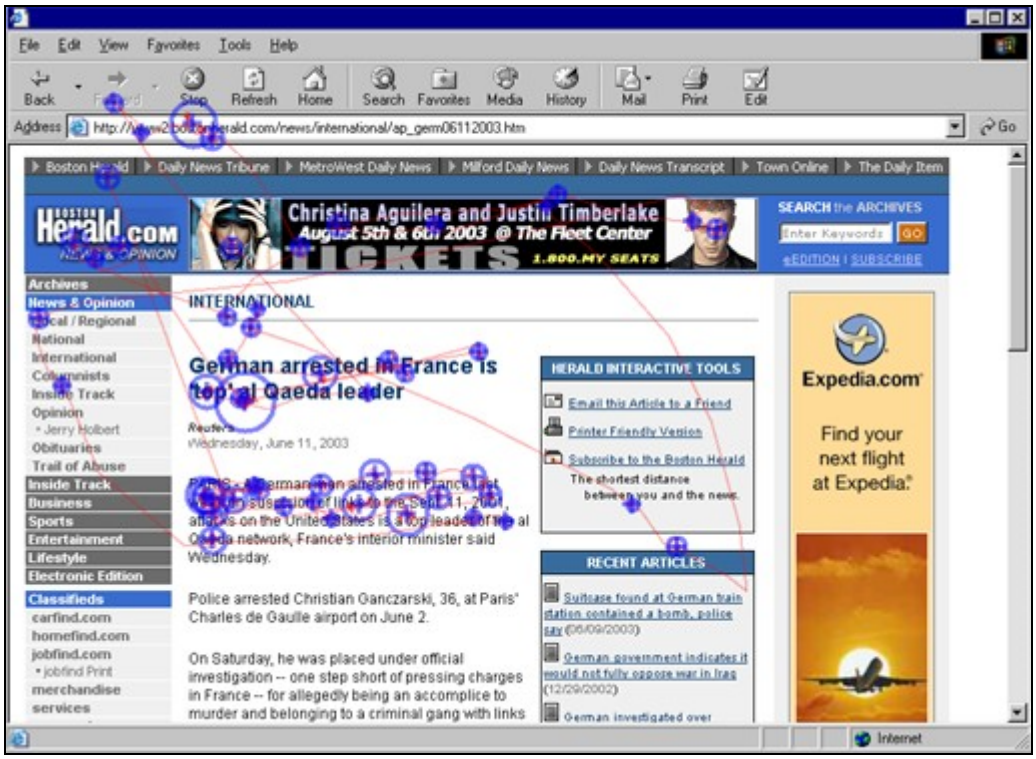


Figure 17
Eye movements can be “played back” using custom software.

Here, fixations are identified by blue crosses at their centre with blue circles indicating the duration of the fixation. Saccades are represented by the red

lines connecting the fixations. The complete superimposed eye movement data is called a “trace”.

5.2) Error correction

Eye trackers can be notoriously sensitive and subject to error, so it is prudent to check the accuracy of all data. In the present study, a reliable pattern of error was detected in the x,y coordinates of the gaze point location.

Firstly, a “drift” was found in the **absolute** gaze point of many of the participants. This was most likely due to errors in re-acquiring the image of the eye after it moved in and out of camera range. Absolute drift is easy to spot since **all** gaze points on the screen are shifted in the same direction by the same amount, with fixation patterns obviously not matching the objects on screen, as shown in Figure 18.

Absolute drift was corrected in the present study by “dragging” the eye trace back so that the pattern of fixations and saccades matched the layout of the objects on screen, as shown in Figure 19.

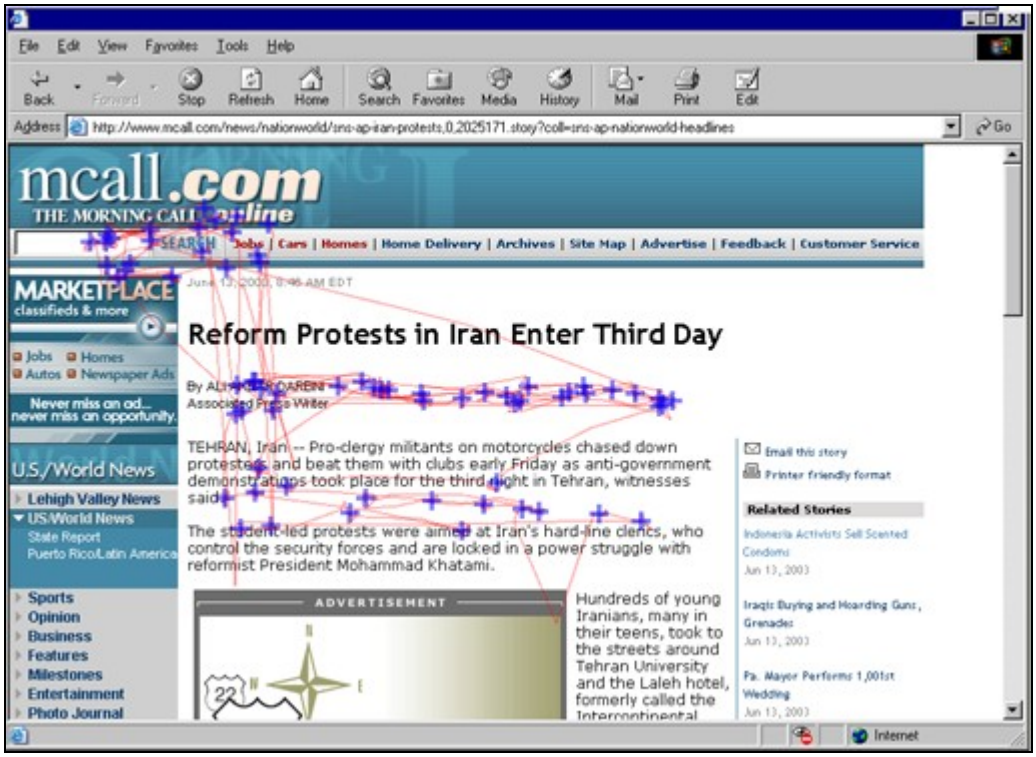


Figure 18
An example of “absolute drift” in the eye movement record: every gaze point has drifted in the same direction by the same amount.

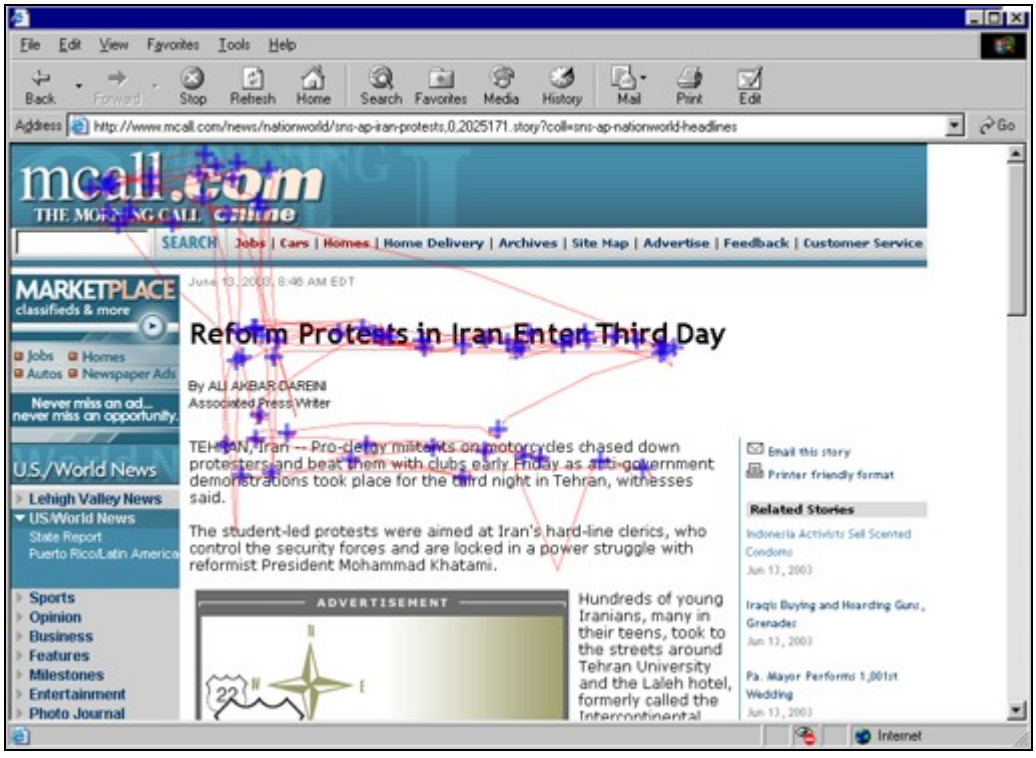


Figure 19
The same eye movement data from Figure 18, after the “absolute drift” has been corrected. Note how the pattern of fixations and saccades now matches the layout of the objects on screen.

Errors in **relative** gaze point location, however, are more difficult to correct. With relative drift, the eye trace is “warped” so that some fixation clusters appear to be on target, while others “fall short” of their apparent target or “over shoot” them. Figure 20 shows an example of relative warp: Here, we can see a cluster of fixations which matches the address bar, but doesn’t quite “reach” it despite the fact that the fixations on the article title are perfectly centered.

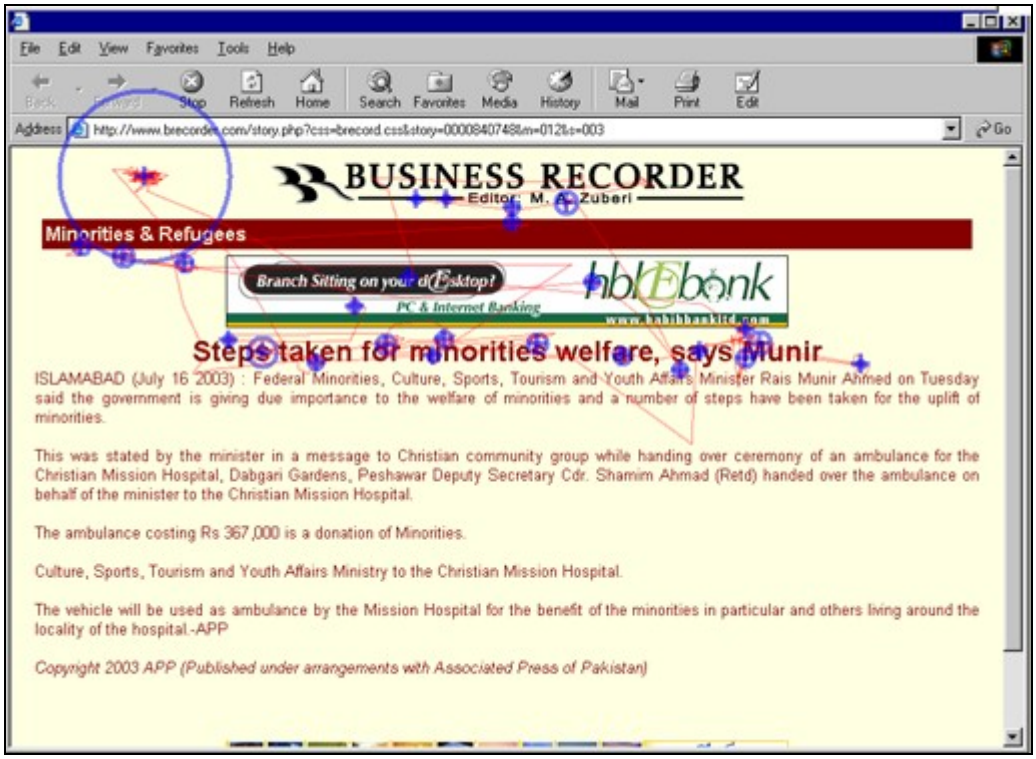


Figure 20
An example of “relative warp” in the eye movement record: most gaze points match the objects on screen, while others miss their apparent target.

When attempting to correct for relative drift, not all the fixation clusters can be re-aligned with their apparent intended targets. In this study, the elements of interest were the name of the site, the title of the article and the section name, so priority was given to adjusting fixation clusters over these regions to maximise data accuracy where it mattered most. Each time the eye trace was

corrected, the raw data file was re-written with the new gaze points, ready for the next stage of processing.

In principle the absolute offset should be consistent for each person, meaning that the offset can be corrected once and applied to the rest of the trials for that participant. However, the relative warp was fairly unpredictable, therefore the offsets were corrected manually trial by trial to achieve the best possible accuracy of raw data for the subsequent stages of analysis.

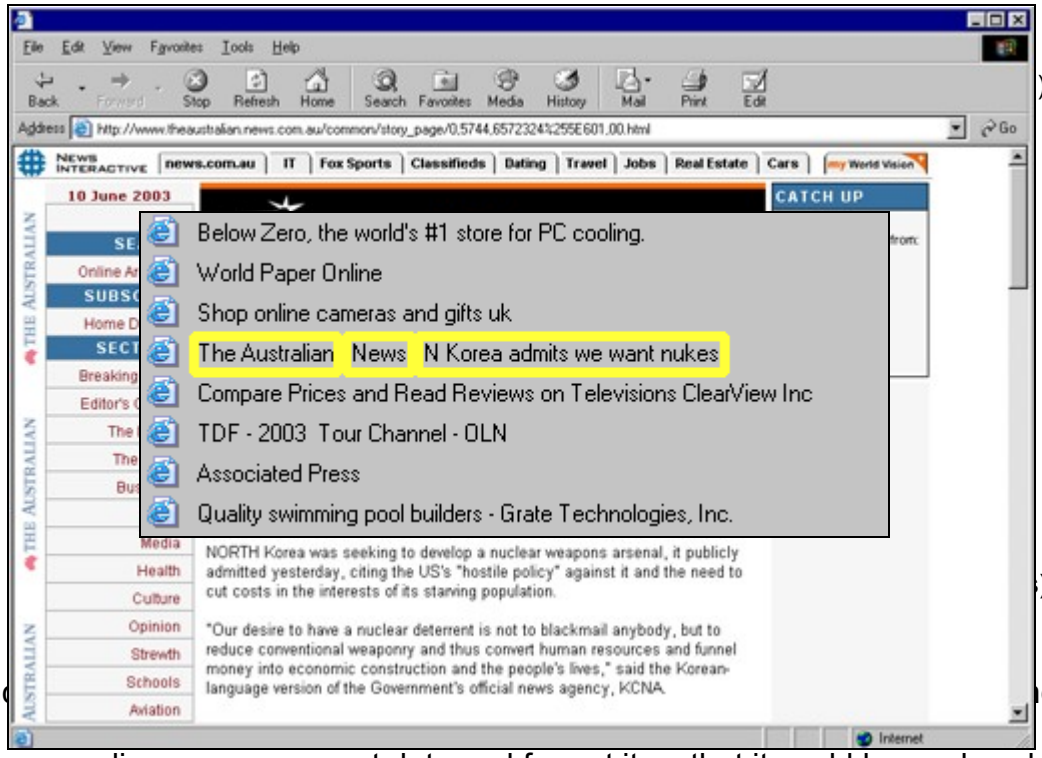
At all times, the eye trace was re-aligned with textual elements so that the first fixation in a phrase fell 3-4 characters to the right of the start of the first word, in accordance with the structure of the perceptual span. In total, 1440 trials were corrected by hand.

5.3) Filtering and analysis

Once the eye movements have been measured, logged and error corrected, the data have to be filtered to enable examination of participants' processing of specific regions of the screen, such as control elements, navigation links and images etc. In the present study the main areas of interest were the site name, section name and article title on both the website and bookmark screens.

The first step in defining the areas of interest was to load the stimuli screenshots into a graphics editing program, then draw to a rectangle around the target element and log the screen coordinates of this rectangle in a data file. The coordinates in this data file were then used by parsing software to count eye movements occurring only in these areas. The x,y screen coordinates in pixels of the top left corner and bottom right corner of the rectangle were recorded as well as it's width and height. Examples of the

areas of interest are shown in Figures 21 and 22 below (The yellow borders serve to highlight the location of the areas of interest, and did not appear on the original screenshots).



On corresponding eye movement data and format it so that it could be analysed with standard statistical software such as Excel or SPSS.

6. Results

6.1) Response times

Mean response times per condition were derived for each participant and reflected the time taken between the appearance of a bookmark menu and the participant registering that the target bookmark had been detected. Faster response times were taken as indicating superior recognition (Table 6).

To retain as much data as possible, response times were scored even if participants failed to find the target bookmark. This does not invalidate the results as the response times were not a measure of failure or success in recognising the bookmarks, but rather a measure of relative differences in recognition. If a bookmark was not found, a maximum response time of 30 seconds was scored.

Table 6
Mean times taken to locate target bookmark (seconds)

Bookmark Structure	**Number of cues**			
	1	2	3	*Mean*
Site name	13.698 (6.37)	9.901 (5.06)	10.578 (4.29)	11.392
Article title	12.801 (6.05)	11.103 (4.99)	11.487 (5.19)	11.797
Mean	13.250	10.502	11.033	

Note. Values enclosed in parentheses represent standard deviation.

Correlations

No significant correlations were found between response time on any condition and the years using the Web or years using computers, as reported by participants in the questionnaire. Also, no significant correlations were

detected between the size of the site name logo and the response times for the three conditions of bookmarks with a top-down structure.

ANOVA

A two-way repeated measures ANOVA was used to analyse these data and revealed that there was no main effect of Bookmark structure (top-down vs. bottom-up) ($F_{(1, 29)}$ = 0.155, p = 0.697) but there was a main effect of number of cues (one, two or three) ($F_{(2, 58)}$ = 8.443, p = 0.001).

Employing the Bonferroni post-hoc test, significant differences were found between the one cue and two cue conditions (p = 0.004) and the one and three cue conditions (p = 0.011). However, no significant differences were found between the two and three cue conditions.

6.2) Adjusting eye movement data for phrase length

As the eye movement data was analysed per area of interest, a raw count of fixations would show misleading results as they do not take into account the length of the text phrases contained within the areas. To adjust for this, the mean number of fixations on each element was divided by the mean number of words in the phrase. (2.79 for site name, 6.83 for article title and 1.79 for the section name). In this way, we are able to separate higher fixation frequency due to the simple fact that there were more words to read, and higher fixation frequency because an item is actually harder to recognise. Mean fixation duration is not contingent on the number words in the phrase, so this measure was not adjusted. It remains a measure of mean fixation duration on the whole area of interest. Finally, eye movements were analysed for 24 of the 30 participants.

6.2) Eye movements during the encoding task

A one-way repeated measures ANOVA was used to analyse mean number of fixations per element (Table 7) and revealed that there was a main effect of the type of element being viewed (adjusted for phrase length) ($\boldsymbol{F}_{(2, 46)} = 68.962$, $\boldsymbol{p} < 0.001$).

Table 7
Mean number of fixations per element (adjusted) while browsing the websites

Area of interest	Mean number of fixations (adj.)	Standard Deviation
Site name	2.41	0.88
Article title	2.09	0.63
Section name	1.08	0.39

Bonferroni post-hoc tests revealed that the element most frequently fixated was the name of the site. It was fixated on average 2.41 times, slightly but significantly ($p = 0.12$) more often than the 2.09 fixations that fell on the title of the article, and more than double the number fixations than on the section name ($p < 0.001$) which received 1.08 fixations. The title of the article was also fixated almost twice as frequently as the section name ($p < 0.001$).

A one-way repeated measures ANOVA was also used to analyse mean fixation duration (Table 8), and a main effect was found according to type of element being viewed ($\boldsymbol{F}_{(2, 46)} = 8.948$, $\boldsymbol{p} = 0.001$).

Table 8
Mean fixation duration per element while browsing the websites

Area of interest	Mean fixation duration (ms)	Standard Deviation
Site name	241	.024
Article title	225	.020
Section name	227	.022

Bonferroni post-hoc tests revealed that the mean fixation duration on the name of the site was slightly longer at 241ms than on the title of the article at 225ms (p = 0.001) and longer than on the name of the section at 227ms (p = 0.021). The mean fixation durations on the article title and the section name were not significantly different.

6.3) Eye movements during the visual search task

In the search task, participants consistently scanned down the left had side of the bookmark menu, as has been found in similar studies of menu search (Altonen, Hyrskykari & Räihä, 1998). Fixations were largely concentrated in the second 8th of the bookmark menu, which corresponds to the first four letters of the first word of each entry (Table 9a). Saccades were also concentrated towards the left of the menu (Table 9b).

Table 9a
Fixations on the bookmark menu per area of interest

Area of interest	No. of Fixations	Total Fixation Time	Mean fixation time (ms)
1st	1530	492.4	322
2nd	13368	4180.0	313
3rd	5191	1199.1	231
4th	2906	648.7	223
5th	1820	404.1	222
6th	1136	248.5	219
7th	611	134.7	221
8th	117	23.6	202

Table 9b
Saccades occurring in the bookmark menu per area of interest

Area of interest	No. of Saccades	Total Saccade Time	Mean Saccade time (ms)
1st	297	7.8	26
2nd	8823	147.2	17
3rd	7040	155.8	22
4th	4089	101.5	25
5th	2638	74.7	28
6th	1702	50.5	30
7th	1021	29.8	29
8th	0	0	0

This result provides confirmation that the lead cue in the bookmark does in fact lie in a dominant position. For the purpose of analysis in the present study, we measure eye movements only on the lead cue, and assume that it is a fair proxy for the bookmark structure as a whole.

Number of fixations

A two-way repeated measures ANOVA was used to analyse the mean number of fixations on the leading cues in the bookmark (Table 10). In the present study, a higher number of fixations are an index of greater uncertainty in recognising the target. The analysis revealed that there was a main effect of the bookmark structure (top-down vs. bottom-up) ($F_{(1, 23)}$ = 73.962, p < 0.001).

Table 10
Mean number of fixations (adjusted) on the leading cues of the bookmark

Bookmark Structure	Number of cues			
	1	2	3	*Mean*
Top-down	1.34 (.44)	0.87 (.35)	1.00 (.46)	1.07
Bottom-up	0.75 (.22)	0.61 (.19)	0.67 (.27)	0.67
Mean	1.05	0.74	0.84	

Note. Values enclosed in parentheses represent standard deviation.

There was also a main effect of the number of fixations (adjusted for phrase length) on the leading cues when extra cues were added ($F_{(2, 46)} = 12.259$, $p < 0.001$).

Lastly, there was a significant interaction ($F_{(2, 46)} = 4.620$, $p = 0.015$) between the bookmark structure and the number of cues. The number of cues affected fixations differently depending on whether site name or article title was the leading cue.

Post-hoc tests were used to explore the interaction effect further. A stringent alpha level of $p < .005$ was set to accommodate the fact that multiple comparisons were being made.

When the name of the site was presented alone, it received 1.34 fixations, much higher than the 0.75 fixations that fell on article title when it was presented alone ($F_{(1, 23)} = 44.362$, $p < 0.001$). Adding another cue after site name reduced the number of fixations to 0.87 ($F_{(1, 23)} = 20.828$, $p < 0.001$), a much larger reduction than adding a cue to article title, which reduced slightly to 0.61 fixations ($F_{(1, 23)} = 20.828$, $p < 0.001$). Increasing the number of cues to 3 actually increased the number of fixations on both leading cues, though not significantly.

As indicated previously, bookmarks with a top-down structure received a significantly higher number of fixations at all levels than bookmarks with a bottom-up structure.

Mean fixation duration

In the present study, information which requires longer fixations is less meaningful to the person than information with shorter fixations. A two-way repeated measures ANOVA was used to analyse the mean fixation duration on the leading cues in the bookmark (Table 11). A main effect of the bookmark structure (top-down vs. bottom-up) was revealed ($F_{(1, 23)}$ = 10.437, p = 0.004), as well as a main effect of the number of cues ($F_{(2, 46)}$ = 5.742, p = 0.006).

Table 11
Mean fixation duration (ms) on the leading cues of the bookmark

Bookmark Structure	**Number of cues**			
	1	2	3	*Mean*
Top-down	335 (74)	272 (75)	292 (50)	300
Bottom-up	274 (30)	277 (34)	266 (54)	272
Mean	305	275	279	

Note. Values enclosed in parentheses represent standard deviation.

Lastly, there was significant interaction between the bookmark structure and the number of cues ($F_{(2, 46)}$ = 5.948, p = 0.005). The number of cues affected fixation duration differently depending on whether site name or article title was the leading cue.

Post-hoc tests were used to explore the interaction effect further. As before, a stringent alpha level of $p < .005$ was set to accommodate the fact that multiple comparisons were being made.

When the name of the site was presented alone, it received an average fixation duration of 335ms, 61ms higher than the 274ms that were spent fixating the article title when it was presented alone ($F_{(1, 23)} = 44.362$, $p < 0.001$). However, adding an extra cue brought fixation duration on site name down by 43ms to around the same level as for article title, but adding the 2nd and final cue increased the gap again, so that fixation duration on site name was 20ms longer than on the article title alone, although not significantly ($F_{(1, 23)} = 8.150$, $p < 0.01$). While fixation duration on the site name continued to be affected by the addition of extra cues, fixation duration on article title was not significantly affected at all.

6.3) Questionnaire results

Basic demographic information was collected through a questionnaire (Appendix D). Responses are described in section 4.1.

7. Discussion

7.1) Was there a difference in saliency?

Response times

Faster response times were taken as indicating superior recognition when participants were searching for a target bookmark within a set of distractor bookmarks. There was no significant difference in the time it took to find either type of bookmark (top down or bottom-up), meaning that in a broad sense, they were both equally salient.

However, the number of cues on display was a significant factor in recognition. Two cues were found to be the optimal length for a bookmark, while one cue was clearly inadequate. Adding a third cue did not bring any significant benefit in terms of recognition. This is most likely to due to the 65 character limit on the bookmark menu - only some or none of the third cue may actually have been visible, negating its usefulness.

This said, there are subtle hints in the response times that top-down bookmarks were much more sensitive to the existence of extra cues than were bottom-up bookmarks. The bottom-up bookmark with one cue had the slowest response time out of all the conditions, but decreased sharply to the fastest response time overall when a second cue was added. This does indicate that the site name may be relatively less salient than the article title - The site name appears to “need” extra information to spark the same level of recognition that the title of the article can attract on its own. Fortunately, the eye movement data permit us to explore this subtle effect in more detail.

Number of fixations

The assumption in the present study was that higher fixation frequency in a visual search task indicates uncertainty in recognising targets (Jacob & Karn, 2003). This certainly appears to be case for bookmarks with bottom-up structures, which were fixated more frequently than top-down bookmarks, regardless of the number of cues. This clearly shows that bottom-up is more salient than top-down as a bookmark structure.

As was hinted at by the recognition times, the site name was far more sensitive to the existence of extra cues than was the article title, and as before, these extra cues had a diminishing marginal benefit.

Fixation duration

Longer fixation times on particular cues indicate that they are less meaningful (Goldberg & Kotval, 1999). The pattern of fixation durations on the leading cues strongly suggest, as with fixation frequency, that the name of the site is less salient than the name of the article, and by extension, that top-down is less salient than bottom-up as a bookmark structure.

When viewed in isolation, the name of the site was less salient in absolute terms, as it was fixated for far longer than was the article title.

Fixation durations on the title of the article were unaffected by extra information, indicating that it was “salient enough” with or without extra information. The addition of a second cue to site name reduced the fixation time by quite a large margin, indicating that the site name was much more meaningful when processed in the context of the extra information.

Encoding

When we consider the encoding phase of the test, when participants read through the website in order to identify its bookmark, we saw that site name actually received slightly greater attention than the article title. It was fixated more frequently and for longer on average, serving as further evidence that site name is less salient. Despite being subject to more potentially more encoding, the name of the site was still not as salient as the article title.

7.2) What factors lead to greater saliency and recognition?

Semantic value

Information that can be characterised in terms of existing knowledge structures, or "schemata" are easier to remember (Alba & Hasher, 1983; Bartlett, 1932). Article titles tell stories of international events, which should have greater potential for being remembered in terms of what people already know about the world (eg, a terrorist attack may always be linked to certain countries in a schema), rather more than an abstract site name. By extension, this should be true of most well-formed page titles that refer to rich content.

Meaning is essential if we are to remember something effectively (Rumelhart & Norman, 1985). The article title tells a story, a scenario – it has a strong intrinsic meaning. Site names however, at least for news websites, probably have a lower capacity for rich meaning as they are simple, yet abstract names unconnected to the news stories they provide,.

Imagery evoking potential

Imaginable and concrete items can be easier to remember as they are represented more richly in memory (Paivio, Yuille & Madigan, 1968). Article titles tend to have more imaginable, concrete words that the site name, which can often be rather abstract, so an advantage in recognition value may arise from this difference. Highly imaginable words are encoded in both verbal and visual channels, and can be recognised more effectively due to the inferential connections that are established between them. Words that are less imaginable may only be encoded verbally, so unable to take advantage of this inferential power in recognition (Clark & Paivio, 1987).

At a broader level, the whole article title tells a story, so for this simple reason it may evoke more imagery than the name of a mundane news website, committing it to memory more effectively as in a mnemonic process. (Clark & Paivio, 1987).

7.3) A critique of the experimental method

Errors

The “absolute drift” and “relative warp” that existed in the eye movement data was a great concern and does raise the question of whether the results are valid. However, exhaustive measures were taken to ensure the accuracy of the data. The error factors were well known and every piece of data was checked by hand, potentially ensuring a greater level of accuracy than would have been achievable with a fully automatic analysis.

One solution to reduce the error rate would have been to recalibrate the participants at several times during the test, as some researchers advise

(Stampe, 1993). This is indeed an excellent way to ensure data accuracy but it is likely to introduce more artificiality into the test situation. Participants would have been made even more aware of their eye movements, potentially exaggerating trends in the data.

Word-level effects

Readers fixate longer on low frequency words than on high frequency words (Hyönä & Olson, 1995; Inhoff, 1984; Rayner, Fischer & Pollatsek, 1998), and this may have accounted for some of the longer fixation duration on the site name than the article title.

As the websites in the test were all authentic examples, it is of course true that the bookmark elements were not balanced for word frequency (nor for syntactic difficulty or word length). An informal analysis of the wording used in the target bookmarks (Appendix A) showed no particular extremes in vocabulary.

Furthermore, since the average length of the article title was approximately 7 words and the site name approximately 3 words, there was by definition a greater probability of lower frequency words appearing in the article title.

Two site names longer than one word were presented in the bookmarks as domain names (“startribune.com” and “bostonherald.com”). Since these forms lack spaces between the words, they may have been harder to read, thus affecting fixation frequency and duration (Rayner, Fischer & Pollatsek, 1998). However, this effect was only reported in the context of at least sentence-length pieces of text, not simple two-word combinations.

Furthermore, people are very much used to reading domain names without spaces on the web, so we would expect very little interference in word identification.

Lastly, one site name ("THE PRESS") was presented in upper case on its bookmark, while the distractor bookmarks were presented in a mixture of lower case and title case. This may have artificially decreased recognition time, as this difference in appearance is sufficient for parallel processing of the target bookmark, while the distractor bookmarks are still processed serially (Nakayama & Silverman 1986). This is the same principle that allows for superior recognition of custom icons on the bookmark menu.

Miscellaneous critiques

The fact that a participant could not find a bookmark does not necessarily mean that they couldn't recognise it - people sometimes do "skip" menu items (Byrne, Anderson, Douglas & Matessa, 1999). An informal review of the results during the manual error correction found that this did sometimes happen on random search and even with systematic search, but as this happened on only 11 out of a total of 1376 trials, occurrences were too low to affect the overall means.

A fixation on the far right of an element in the bookmark may include parafoveal processing time for the next element (Inhoff & Radach, 1998), thus wrongly attributing some fixation time. However there is some evidence that this may not be the case (Henderson & Ferreira, 1993).

Websites were not balanced for the size of the site name logo - most were smallish and in the top left corner but some were very large and in the

middle of screen (see Appendix B), thus potentially being much more salient. However, correlation results confirm that logo size was not a factor in recognition.

Participants were mot requested to reset their gaze point before each search task, as some researchers advise (Zelinsky & Sheinberg, 1995). This meant that participants were looking somewhere other than the top of the bookmark menu as they would if they had activated the menu in a real task. Participants' gaze often fell directly on the menu, potentially leading to more chance bookmark finds.

The encoding task in the experiment was slightly different compared to a real life web browsing situation. Here they had to pick up elements that would identify the website, but when browsing the web, you are likely to look at things that interest you and you may not consciously try to remember elements to identify later on. The encoding of the website is not motivated by a desire to return to the site, but only by the demands of the experiment. This is where a longer-term ethnographic study may be more appropriate, as it would reduce much of the artificiality inherent in lab-based studies.

Similarly, encoding and recognition must be affected by interest and engagement - many participants reported that they were interested in some stories but not others**,** but this effect should be eliminated by the randomisation that was applied to the trial set.

Some of the difference in saliency between the site name and the article title could be attributed to shift in context from coloured logos to plain text. There may have been interference in the recognition of site name partially to fact that the encoding took in visual elements of colour and shape

(as they were logos) as well as verbal elements, but recognition was solely on verbal elements. (Clark & Paivio, 1987; Zelinsky, 2000). However, there is empirical evidence that claims that colour is not a strong contextual cue in recognition (Pointer & Bond, 1998).

It may have been beneficial to interview participants to find out what they consciously found more salient. When some participants were asked this in informal chats, all reported that they were looking for the article title while searching the bookmark menu. These are interesting responses, but people can be notoriously inaccurate when attempting to report on their inner cognitive processes (Nisbett & Wilson, 1977).

7.4) Limits and generalisability of the results

The study could be criticised on the grounds that any real life situation would include location memory for menu entries (Hornof & Kieras, 1999). Apart from memory for location, the other recognition cues in this case is approximate memory for the length of the bookmark text. In this way people can find the entries quicker by looking for low spatial frequency features that can be exploited in a parallel search (Lansdale & Ormerod, 1994).

The main counter-argument is that bookmark lists can be left for a long time or re-arranged, and menu positions can be forgotten. Another justification is that pages saved on the hard drive are often left in archives a long time and can be re-ordered in many ways thus destroying any memories for entry location. In these cases the users would have to rely on the text content of the bookmark, hence the purpose of this study.

Lastly, these results should generalise most appropriately to sites that share a similar information hierarchy.

7.5) Future work

There may be more factors affecting the salience of bookmarks than could be revealed in the present study, which tests for short-term recognition. For example, further studies could explore longer cut-off times on the visual search task, or introduce longer delays between the viewing of the website and the appearance of the bookmark menu. The effects of familiarity could also be investigated: Are people more likely to recognise pages that come from websites that they use regularly? Lastly, it would certainly be worthwhile to perform a longer-term ethnographic study to explore the full depth of recognition and salience issues.

Eye movement data on the websites themselves could be analyzed to make recommendations for the bookmark text based on the pattern of eye movements while encoding. For example, the URL was looked at quite often in the present study, which indicates that it may be a significant navigational cue. Similarly, the previous research in graphical bookmarks (Cockburn et al., 2003) could be replicated using eye tracking measures for a more detailed analysis of recognition value.

Finally, further studies could be performed to refine the test protocol so that companies can use the technique to find out how to organise information structures in large scale information retrieval tasks. Application areas include Information Architecture, Knowledge Management, database engineering and Web design.

8. Conclusion

The number of cues on display in a bookmark was a significant factor in recognition, where two cues were found to be necessary for optimal recognition in a visual search of the bookmark menu. However, top-down and bottom-up bookmark structures were found to be equally salient. This is good news for web producers, as there is essentially no trade-off between bookmark recognition and the navigational scheme that they may choose to portray on the web browser's top bar.

Although there was no significant difference between bookmark formats, eye movements did indicate that recognition of the site name is highly context sensitive. It may be likely that in larger scale systems, this factor could be amplified and have an appreciable effect on information recognition. Web producers would do well to assess the salience of their data structures using the techniques described in this report.

Acknowledgements

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Linden - for absolutely everything, including his lucid thinking, his great quotes, and especially for enduring so many meetings with me!

Peter - for making all this possible with his data crunching machines and technical expertise, not to mention for being so generous with his time.

Minnie, **Kate**, **James**, **Sean** and **Ian** - for essential support when times were tough (thanks guys!).

Karine - for acting as my sounding board and helping me to spark off so many brainwaves

…and of course thanks to everyone who participated in the experiment!

The dissertation in numbers

Working with eye movement data is very labour intensive - here are some stats to mull over if you are thinking of doing working with eye trackers:

- 40,000 data points manipulated to extremes in Excel and SPSS
- 1,440 eye movement errors corrected (painstakingly) by hand
- 360 areas of interest defined (painstakingly) by hand
- 144 bookmark screens captured as screenshots and processed in Photoshop
- 150 websites reviewed for possible inclusion in the study
- 30 websites processed in PhotoShop for inclusion in the study
- 40 participants who took part
- 7 pairs of eyes that could not be tracked

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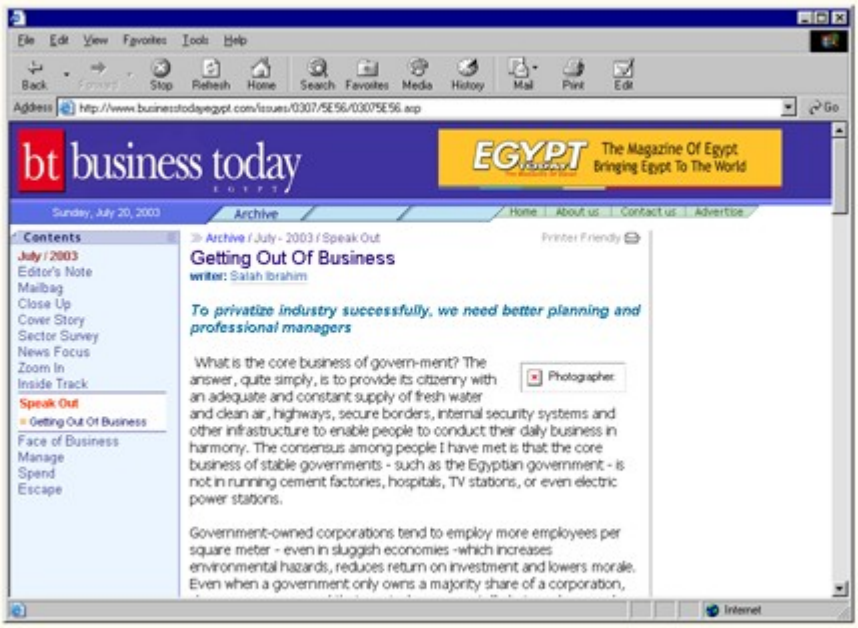
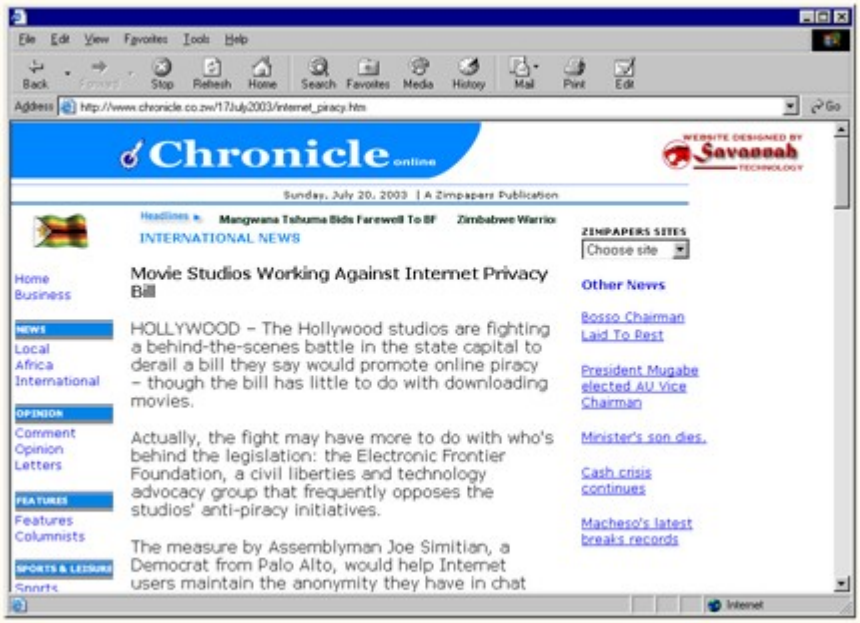
Appendices

Appendix A - Test websites and their corresponding bookmark text

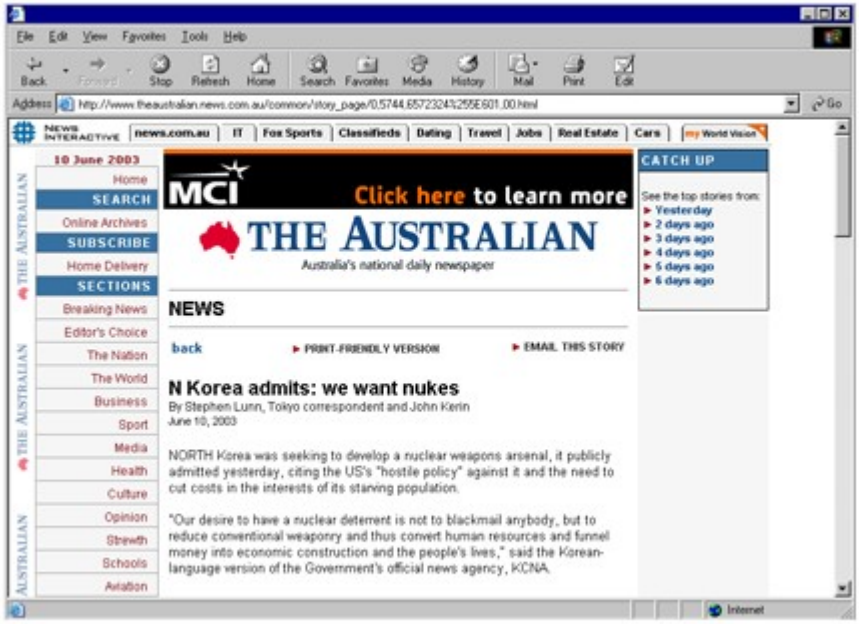
No.	Site name	Section Name	Article Title
1	Business Today Egypt	Speak Out	Getting Out Of Business
2	The Canberra Times	News - International	Brothers testify against each other
3	Cronicle Online	International News	Movie Studios Working Against Internet Privacy Bill
4	startribune.com	nation world	5 Palestinians killed in Israeli retaliation airstrikes
5	The Australian	News	N Korea admits we want nukes
6	The Daily Citizen	Headlines	OPEC to Maintain Current Oil Production
7	The Globe and Mail	National - Breaking News	Ontario will register same-sex marriages
8	Canada.com	National	Iraqi exile says Saddam is alive, rich and paying people to kill Americans
9	bostonherald.com	International	German arrested in France is 'top' al Qaeda leader
10	THE PRESS	World News Story	Five killed in German train crash
11	The Times of India	World - Africa	Liberians agree truce, pave way for talks
12	The Pioneer	World	More sanctions on Myanmar may have scant impact
13	Sunday Business Post	News	Blair takes a pounding. Bush takes a sidestep
14	The Santiago Times	Current Events	Chile is top spot for British tourists
15	The Business Times	Style	Just what the doctor ordered
16	Daily Nation on the Web	Comment	Britain has sabotaged Europe again
17	Orlando Sentinal	Business	Many feel burned by consolidation rule for student loans
18	The Botswana Gazette	Today's Headlines	Vaccine trials start officially
19	The Morning Call Online	US¦World News	Reform Protests in Iran Enter Third Day
20	The News International	World News	Un inspectors find enriched uranium in Iran
21	Business Recorder	Minoritees & Refugees	Steps taken for minorities welfare, says Munir
22	The Star Online	News - Latest	Accidents cause massive jams in Kuala Lumpur
23	Expatica	French News	Citroen hit by fake order for 5,700 cars
24	The New Zealand Herald	World News	Nasa's second Mars rover launched

Appendix B - Test websites (screen shots)




Chronicle online
Sunday, July 20, 2003 | A Zimpapers Publication
INTERNATIONAL NEWS
Movie Studios Working Against Internet Privacy Bill
HOLLYWOOD – The Hollywood studios are fighting a behind-the-scenes battle in the state capital to derail a bill they say would promote online piracy – though the bill has little to do with downloading movies.
Actually, the fight may have more to do with who's behind the legislation: the Electronic Frontier Foundation, a civil liberties and technology advocacy group that frequently opposes the studios' anti-piracy initiatives.
The measure by Assemblyman Joe Simitian, a Democrat from Palo Alto, would help Internet users maintain the anonymity they have in chat
Other News
Bosso Chairman Laid To Rest
President Mugabe elected AU Vice Chairman
Minister's son dies.
Cash crisis continues
Macheso's latest breaks records


5 Palestinians killed in Israeli retaliation airstrikes
Greg Myre, New York Times
GAZA CITY, GAZA STRIP -- In two airstrikes that further damaged an already fragile Mideast peace plan, Israeli helicopters on Tuesday rained missiles on cars carrying Hamas militants.
Five Palestinians were killed, but the prominent Hamas leader who was the main target survived and vowed revenge from his hospital bed.
Tell the world how you feel!
Click Here to Rate Your Carrier!
Related content
Bush 'troubled' by Israeli attack on Hamas leader
Peace plan not necessarily derailed, despite Gaza violence


THE AUSTRALIAN
Australia's national daily newspaper
NEWS
N Korea admits: we want nukes
By Stephen Lunn, Tokyo correspondent and John Kerin
June 10, 2003
NORTH Korea was seeking to develop a nuclear weapons arsenal, it publicly admitted yesterday, citing the US's "hostile policy" against it and the need to cut costs in the interests of its starving population.
"Our desire to have a nuclear deterrent is not to blackmail anybody, but to reduce conventional weaponry and thus convert human resources and funnel money into economic construction and the people's lives," said the Korean-language version of the Government's official news agency, KCNA.
Click here to learn more
CATCH UP


The Daily Citizen
Getsmart Named "Best Loan Site"
News Sections
Index
Headlines
Sports
Business
Technology
Entertainment
Return Home
Headlines
OPEC to Maintain Current Oil Production
By ANWAR FARUQI
DOHA, Qatar - OPEC ministers decided Wednesday to maintain current production levels until they meet again in September, with an option to revise them in July, the president of the oil cartel said.
Abdullah bin Hamad al-Attiyah said the 11-nation cartel would hold an extraordinary meeting on July 31 to reassess the situation.


THE GLOBE AND MAIL
globeandmail.com
Ontario will register same-sex marriages
Canadian Press
Toronto — Ontario will register the marriages of gay and lesbian couples following a controversial court ruling that legalizes same-sex unions in the province, the attorney-general said Wednesday.
"I'm charged to follow the laws and will follow the laws with regards to this matter," Norm Sterling said as he headed into a morning cabinet meeting. Asked if Ontario would register the marriages, Sterling said: "Absolutely."
"We said during the appeal process that the province of Ontario would follow the court ruling. We made that clear during the process."


canada.com
Iraqi exile says Saddam is alive, rich, and paying people to kill Americans
Edith M. Lederer and Robert Burns
The Associated Press
NEW YORK -- Saddam Hussein has been seen north of Baghdad and is paying a bounty for every American soldier killed, the leader of an Iraqi exile group said yesterday.


File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites Media History Mail Print Edit
Address http://www2.bostonherald.com/news/international/ap_germ06112003.htm
Boston Herald | Daily News Tribune | MetroWest Daily News | Milford Daily News | Daily News Transcript | Town Online | The Daily Item
Herald.com NEWS & OPINION
Christina Aguilera and Justin Timberlake
August 5th & 6th 2003 @ The Fleet Center
TICKETS 1.800.MY SEATS
SEARCH the ARCHIVES
Archives
News & Opinion
Local / Regional
National
International
Columnists
Inside Track
Opinion
Jerry Holbert
Obituaries
Trail of Abuse
Inside Track
Business
Sports
Entertainment
Lifestyle
Electronic Edition
Classifieds
carfind.com
homefind.com
jobfind.com
jobfind Print
merchandise
services
INTERNATIONAL
German arrested in France is 'top' al Qaeda leader
Reuters
Wednesday, June 11, 2003
PARIS - A German man arrested in France last week on suspicion of links to the Sept. 11, 2001, attacks on the United States is a top leader of the al Qaeda network, France's interior minister said Wednesday.
Police arrested Christian Ganczarski, 36, at Paris' Charles de Gaulle airport on June 2.
On Saturday, he was placed under official investigation -- one step short of pressing charges in France -- for allegedly being an accomplice to murder and belonging to a criminal gang with links
HERALD INTERACTIVE TOOLS
Email this Article to a Friend
Printer Friendly Version
Subscribe to the Boston Herald
The shortest distance between you and the news.
RECENT ARTICLES
Suitcase found at German train station contained a bomb, police say (06/09/2003)
German government indicates it would not fully oppose war in Iraq (12/29/2002)
German investigated over
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Find your next flight at Expedia.
Internet


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Back Forward Stop Refresh Home Search Favorites Media History Mail Print Edit
Address http://www.stuff.co.nz/stuff/thepress/0,2106,2537358a6428,00.html
jobstuff propertystuff stuff on sale personalstuff inl archives
www.stuff.co.nz
Get your fix of footy with Stuff's Rugby section!
THE PRESS >> WORLD NEWS >> STORY
Thursday, 12 June 2003
STUFF
NZ NEWSPAPERS
LOCAL NEWS
NATIONAL NEWS
WORLD NEWS
SPORT
BUSINESS
WEATHER
TECHNOLOGY
FEATURES
OPINION
RURAL
SUBSCRIBE TO THE PRESS
NZ MAGAZINES
SKY TV
CANTERBURY SERVICES
SEARCH STUFF WEB GO
HEADLINES ALERT
THE PRESS
www.thepress.co.nz
WORLD NEWS STORY
Five killed in German train crash
12 June 2003
BERLIN: Five people have been killed and several injured after two trains collided near the southern German town of Schrozberg, police say.
"We have five dead and several seriously injured," a police spokesman said.
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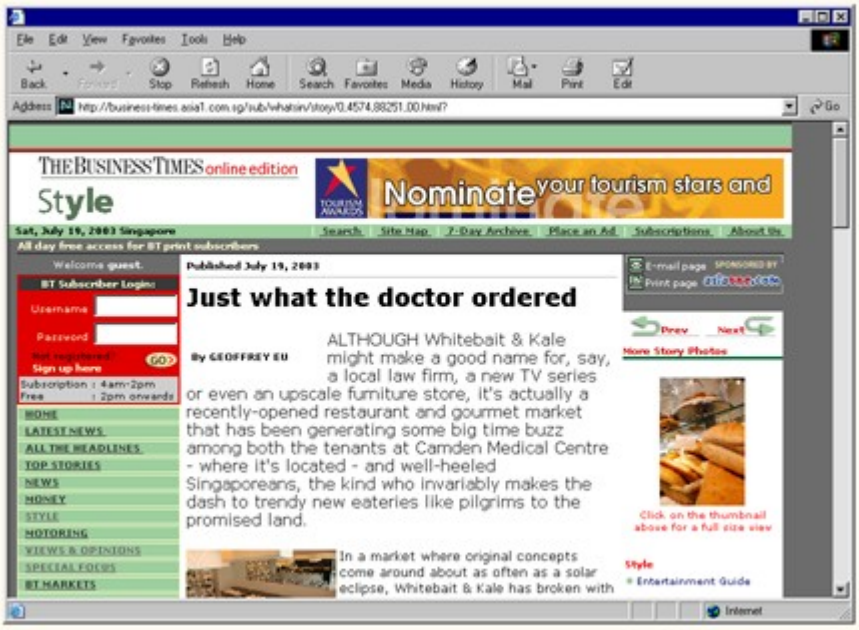
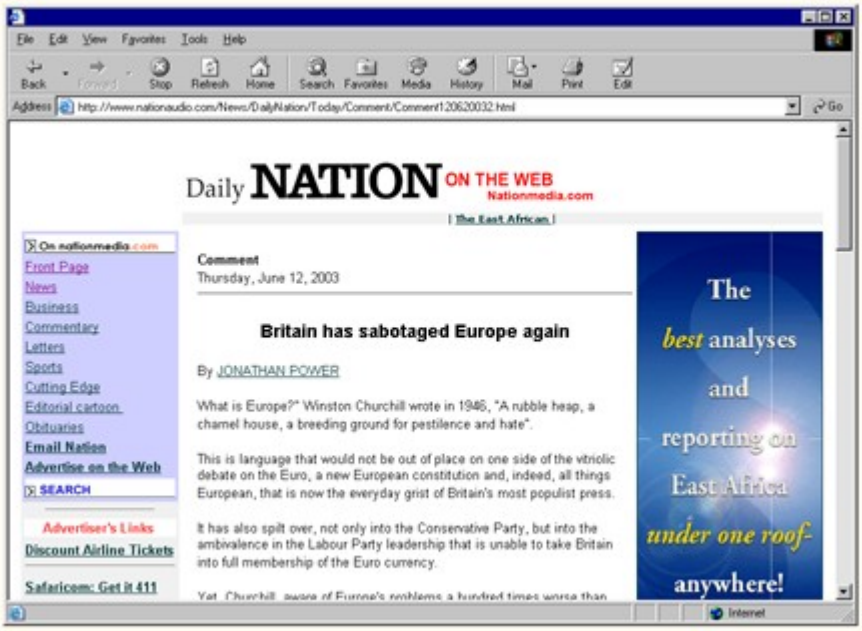
THE TIMES OF INDIA
WORLD: AFRICA
INDIATIMES
Liberians agree truce, pave way for talks
MONROVIA: Liberia's President Charles Taylor agreed on Wednesday to halt hostilities against rebels, paving the way for peace talks to start in earnest and possibly prevent a bloody showdown in the capital.
The truce offers a glimmer of hope to hundreds of thousands of terrified Liberians, who have crammed into rain-drenched Monrovia fleeing fighting on the outskirts. Food and drinking water are scarce, and the risk of disease high.
The rebels have also promised
AFRICA HEADLINES
$4/47 min to India

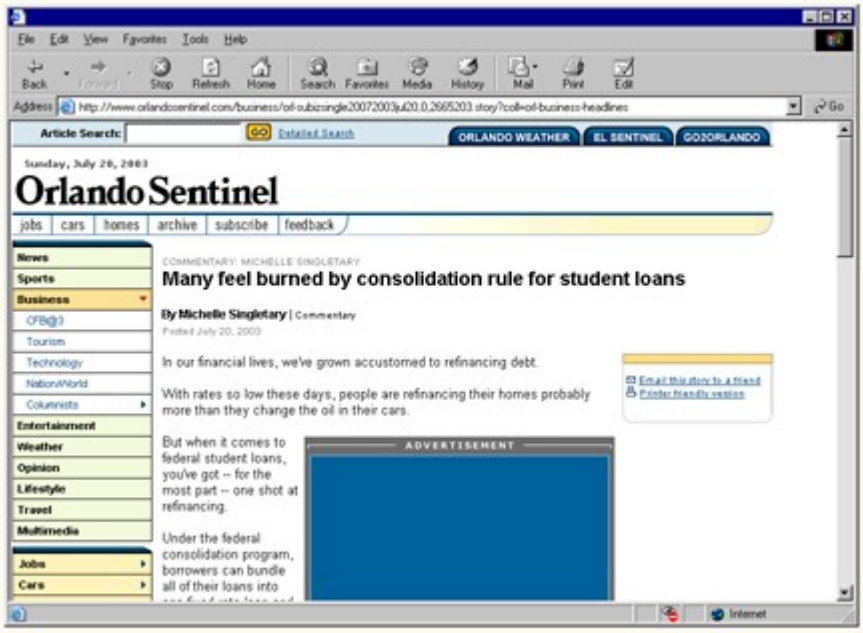

THE PIONEER
Estd. 1864
Thursday, June 12, 2003
Updated: 01:59 am
NEWS
CITY
NATION
STATES
LUCKNOW
BUSINESS
SPORTS
ENTERTAINMENT
WORLD
EDIT PAGE
OP-ED
HOME
EDITOR'S MAIL
SEARCH ARCHIVES
WORLD
More sanctions on Myanmar may have scant impact
Agencies/ Singapore
International pressure is mounting on Myanmar to release, again, pro-democracy leader Aung San Suu Kyi and on its neighbours to back sanctions if the military rulers do not loosen up.
Diplomats say a stiffening of the US sanctions that have been in place for years would scarcely take a bite out of Myanmar's trade because of the interests of regional business partners and ingenious methods to circumvent such punishment. The timing could hardly be worse, however, for the military government. Next week Myanmar joins partners in the Association of South East Asian Nations and the ASEAN Regional Forum (ARF) for meetings in Phnom Penh, when pressure is almost certain to be applied - at least behind closed doors.
"The leaders should talk about the norms of the area," UN envoy Razali Ismail said of ASEAN after he met Suu Kyi in detention in Yangon on Tuesday. "We are all
FREEMAIL!
CLICK HERE!
Members' Email Login
WORTH IT?
dailypioneer.com
ICC WORLD CUP 2003 SPECIAL
Exclusive Press Pics


THE POST.IE
The Sunday Business Post online
Home
NEWS
Thur, July 17, 2003
Navigation
Sunday's Paper
Markets
Comment & Analysis
News Features
Personal Finance
Technology
News
World
Ireland
Lifestyle
Motoring
Property
Travel
Blair takes a pounding. Bush takes a sidestep
13/07/03 00:00
By Ian Kehoe
Maybe , just maybe, the weapons inspectors will unearth something deep in the Iraqi desert or in a Baghdad basement.
A kilo of uranium, a warhead, a litre of anthrax - anything. For Tony Blair, the deliverance of weapons will deliver personal redemption.
The British prime minister's position became more isolated last
THE POST PLUS
Government Services
Human Resources
Training
Supplier Quotes
e-Business
Done Deal
Computers In Business


THE SANTIAGO TIMES
Welcome Wagon
CHIP Travel
Human Rights
Info Center
About Us
Our Mission
Our Staff Members
CHIP Services
Advertising Info
Search
Today's news
8-yr. archives
Member Login
Subscribe Now
Classifieds Section
Welcome Wagon
About Us
Contact Our Staff
Metric Conversions
World Info & Time
Free Acrobat Reader
July 16 2003
CURRENT EVENTS
CHILE IS TOP SPOT FOR BRITISH TOURISTS
British newspaper readers gave Chilean tourism a boost when they voted Chile as their favorite long-haul destination.
Around 24,000 votes were gathered from readers of The Observer, The Guardian, and the affiliated web site, Guardian Unlimited, for the 2003 Travel Awards, the 17th time the media group has run the ballot.
"South America has seen a phenomenal surge in popularity this year, with Chile the favorite," is how the web site blurb announces the award.
In a review of Chile, Guardian's writer Paul MacInnes highlights the "customary friendliness" of the Chilean people. In a reference to the country's geographical diversity, he writes of skiers from the Northern Hemisphere "tearing down the mountains in the morning and lounging in the beaches of the Pacific coast in the afternoon," though he does not mention the long-jacket and scarf that should be worn most July afternoons on beaches nearest to the Andes ski resorts.
The travel writer also describes how the climate "is perfect for vines" and recommends in particular the Concha y Toro vineyard.
On his trip to the Atacama desert to the north of Chile, the Guardian's man in South America was taken back by the silence - "the kind that rings in


THE BUSINESS TIMES online edition
Style
Nominate your tourism stars and
Just what the doctor ordered
By GEOFFREY EU
ALTHOUGH Whitebait & Kale might make a good name for, say, a local law firm, a new TV series or even an upscale furniture store, it's actually a recently-opened restaurant and gourmet market that has been generating some big time buzz among both the tenants at Camden Medical Centre - where it's located - and well-heeled Singaporeans, the kind who invariably makes the dash to trendy new eateries like pilgrims to the promised land.
In a market where original concepts come around about as often as a solar eclipse, Whitebait & Kale has broken with


Daily NATION ON THE WEB
Nationmedia.com
Comment
Thursday, June 12, 2003
Britain has sabotaged Europe again
By JONATHAN POWER
What is Europe?" Winston Churchill wrote in 1946, "A rubble heap, a chamel house, a breeding ground for pestilence and hate".
This is language that would not be out of place on one side of the vitriolic debate on the Euro, a new European constitution and, indeed, all things European, that is now the everyday grist of Britain's most populist press.
It has also spilt over, not only into the Conservative Party, but into the ambivalence in the Labour Party leadership that is unable to take Britain into full membership of the Euro currency.
The best analyses and reporting on East Africa under one roof- anywhere!


Orlando Sentinel
Many feel burned by consolidation rule for student loans
By Michelle Singletary | Commentary
In our financial lives, we've grown accustomed to refinancing debt.
With rates so low these days, people are refinancing their homes probably more than they change the oil in their cars.
But when it comes to federal student loans, you've got -- for the most part -- one shot at refinancing.
Under the federal consolidation program, borrowers can bundle all of their loans into


THE BOTSWANA Gazette
Do you want to advertise in this space?
TODAY'S HEADLINES ON GAZETTE.BW
Vaccine trials start officially
GABORONE - THE first trial of an experimental AIDS vaccine in Southern Africa began this week in Botswana with the enrolment and injection of the first two volunteers at the Princess Marina hospital in Gaborone.
"This study is a significant and hopeful step in Botswana's battle against the scourge of AIDS," said Joy Phumaphi, Botswana's Health Minister. "The volunteers of this trial exemplify the best of the traditional Botswana values of altruism and selflessness. They are true heroes in this fight for our country's future."
The research is a joint initiative by the Ministry of Health and the Botswana-Harvard AIDS Institute Partnership (BHP), established in 1996 by the Botswana Government and the Harvard AIDS Institute. Phase 1 of the trials,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THE MORNING CALL online
Reform Protests in Iran Enter Third Day
By ALI AKBAR DAREINI
Associated Press Writer
TEHRAN, Iran -- Pro-clergy militants on motorcycles chased down protesters and beat them with clubs early Friday as anti-government demonstrations took place for the third night in Tehran, witnesses said.
The student-led protests were aimed at Iran's hard-line clerics, who control the security forces and are locked in a power struggle with reformist President Mohammad Khatami.
Hundreds of young Iranians, many in their teens, took to the streets around Tehran University and the Laleh hotel, formerly called the


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WORLD NEWS
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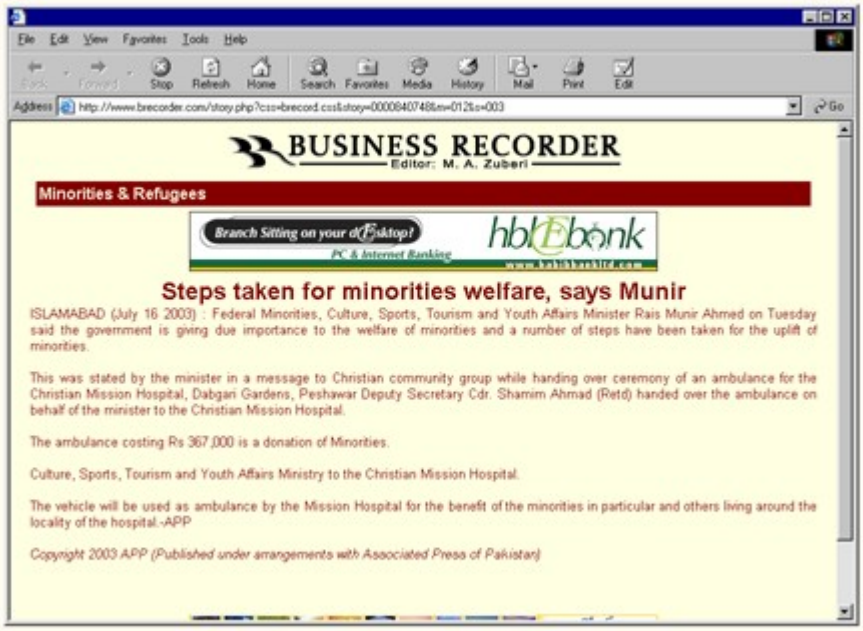
'UN inspectors find enriched uranium in Iran'
WASHINGTON: UN nuclear inspectors have found traces of enriched uranium at an Iranian nuclear facility south of Tehran, The Washington Post reported on Saturday, raising renewed concerns over Iran's suspected nuclear weapons programme.
The uranium was found in samples taken by International Atomic Energy Agency (IAEA) inspectors near the town or Natanz, where Tehran is



BUSINESS RECORDER
Editor: M. A. Zuberi

Minorities & Refugees

Steps taken for minorities welfare, says Munir

ISLAMABAD (July 16 2003) : Federal Minorities, Culture, Sports, Tourism and Youth Affairs Minister Rais Munir Ahmed on Tuesday said the government is giving due importance to the welfare of minorities and a number of steps have been taken for the uplift of minorities.

This was stated by the minister in a message to Christian community group while handing over ceremony of an ambulance for the Christian Mission Hospital, Dabgari Gardens, Peshawar Deputy Secretary Cdr. Shamim Ahmad (Retd) handed over the ambulance on behalf of the minister to the Christian Mission Hospital.

The ambulance costing Rs 367,000 is a donation of Minorities.

Culture, Sports, Tourism and Youth Affairs Ministry to the Christian Mission Hospital.

The vehicle will be used as ambulance by the Mission Hospital for the benefit of the minorities in particular and others living around the locality of the hospital.-APP

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The Star Online > News > Latest

Thursday, June 12, 2003

Accidents cause massive jams in Kuala Lumpur

Updates from The Star Newsdesk

KUALA LUMPUR: Three separate accidents, involving heavy vehicles brought Thursday's early morning city traffic to a standstill.

Thousands of motorist reached their offices late after they were forced to endure hours in traffic jams which


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Citroen hit by fake order for 5,700 cars
VIENNA, July 7 (AFP) - French automaker Citroen confirmed Monday that it was the victim of an attempted scam in Austria involving false orders for nearly 5,700 vehicles worth an estimated EUR 43 million (USD 48 million).
Two Austrians have been placed in custody on suspicion of pocketing commissions on the sale of the vehicles, Vienna court spokesman Frederick Lendl told AFP.
The two allegedly placed an order for 3,977 cars on behalf of the Austrian interior ministry and for 1,700 vehicles for the Catholic relief and development organization Caritas.
Lendl said that investigators had not ruled out the possibility the suspects had help inside the company.
The French automaker confirmed Monday it
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The New Zealand Herald
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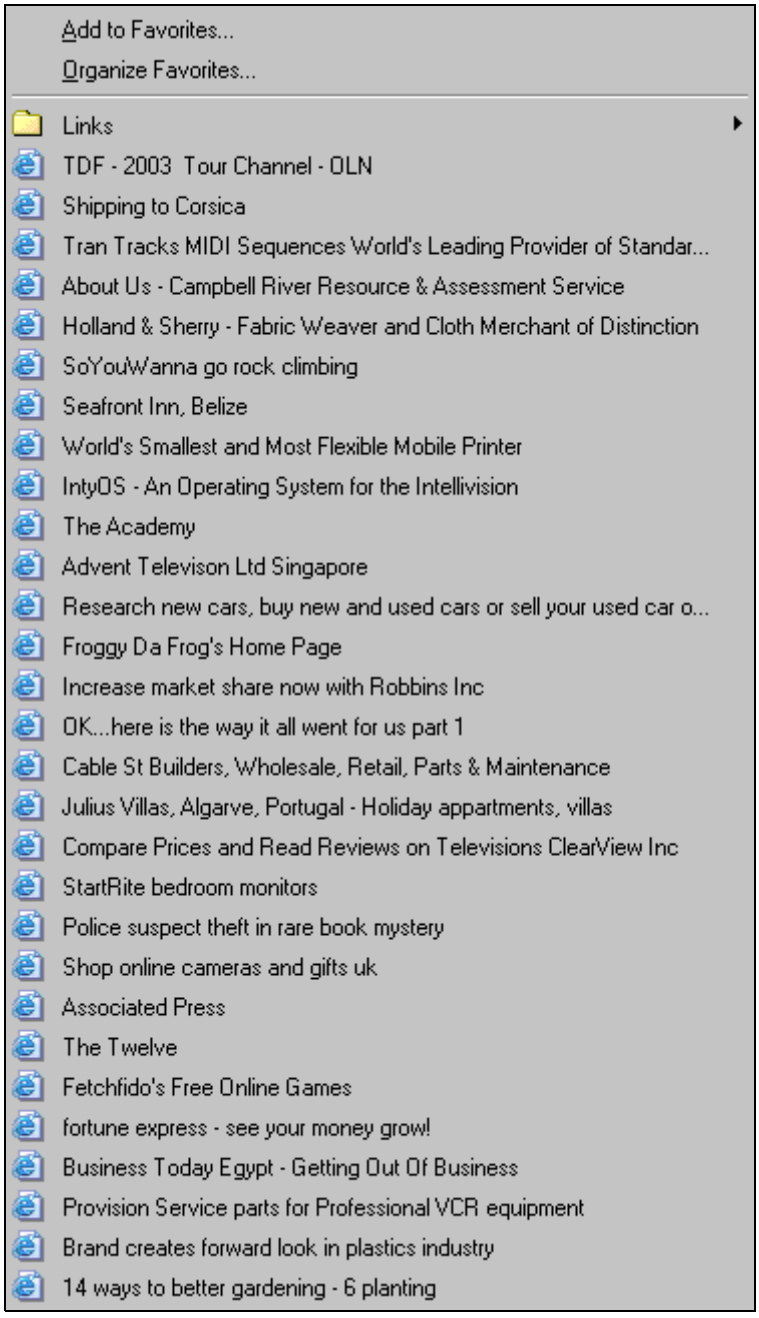
>> Home >> World News
Nasa's second Mars rover launched
09.07.2003
After nearly two weeks of delays, a rocket holding Nasa's second Mars rover was launched yesterday on a mission to study whether the red planet ever had enough water to sustain life.
Nasa had until Tuesday to launch Opportunity before Earth and Mars became too far apart. The next chance would be in four years.
A failed battery cell was replaced over the weekend and workers last week reglued in place cork believed to have peeled off the Delta II Heavy rocket during fuelling.
World News
115 die in crash but 1st lives
Four seriously injured as bulls charge
Pistols add edge to embassy squabble
People power shakes wall of China
Nasa answers Columbia crash riddle
Australia tightens clamp on weapons traffic
Latest World News
Updated 7.26 am NZT
US comic book to unveil Princess Di superhero
Iranian twins die after separation op fails
Outback nuclear dump fight goes on
Western Australia resort plans rejected
Wizard location for sale
One Iranian twin dies after separation surgery
Plane crashes in Sudan, about 115 reported dead

Appendix C - A set of typical distractor bookmarks



Appendix D - Questionnaire

Questionnaire

Participant No:

Section A

Q1	Age (circle one)	<15 15-19 20-24 25-29 30-34 35-39 40-44 45-49 50-54 55-59 >59
Q2	Sex (circle one)	Male Female
Q3	Nationality	
Q4	Occupation	

Section B

Q5	Do you need to wear glasses or contact lenses to see the computer screen properly? (circle one)	Yes No
Q6	Did you wear your glasses or contact lenses for this experiment? (circle one)	Yes No N/A

Section C

Q7	How many years have you been using computers?	
Q8	How many years have you been using the World Wide Web?	
Q9	How often do you use the World Wide Web? (circle one)	Every day 4-6 days week 2-3 days week About once a week About once a month Less than once a month
Q10	Do you usually use “Internet Explorer” to browse the Web? (circle one)	Yes No

Appendix E - Specimen file of raw eye movement data

Gazepoint Trace Data File, 10:16:24 08/04/2003
Scene Type: bitmap 1024 768 Images\website_7f.bmp
Raw Gazepoint Data (60 Hz Sampling Rate):

samp indx	Eye Found (t/f)	Gazepoint X (pix)	Y (pix)	Pupil Diam (mm)	Eyeball-Position X (mm)	Y (mm)	Z (mm)	Focus Range (mm)	Fix Indx
0	1	275	202	3.05	-6.0	-0.1	1.4	585.0	0
1	1	275	202	3.05	-6.0	-0.1	1.4	585.0	0
2	1	278	199	3.08	-8.0	-0.1	2.0	585.0	0
3	1	282	198	3.08	-9.4	-0.1	2.2	585.0	0
4	1	282	204	3.05	-10.4	-0.0	2.1	585.0	0
5	1	282	205	3.07	-11.2	-0.0	2.3	585.0	0
6	1	281	201	3.09	-11.8	0.0	2.5	585.0	0
7	1	269	209	3.07	-12.2	0.1	2.3	585.0	0
8	1	257	222	3.08	-12.5	0.1	1.8	585.0	1
9	1	255	225	3.06	-12.7	0.2	2.0	585.0	1
10	1	258	228	3.07	-12.8	0.2	1.4	585.0	1
11	1	263	229	3.07	-12.9	0.2	1.4	585.0	1
12	1	254	224	3.06	-13.0	0.3	1.6	585.0	1
13	1	256	226	3.08	-13.0	0.3	1.2	585.0	1
14	1	266	226	3.06	-13.0	0.3	1.3	585.0	1
15	1	260	226	3.06	-12.9	0.4	1.0	585.0	1
16	1	256	225	3.09	-12.9	0.4	1.5	585.0	1
17	1	258	226	3.08	-12.9	0.4	1.3	585.0	1
18	1	259	231	3.05	-12.8	0.4	1.3	585.0	1
19	1	261	229	3.08	-12.8	0.4	1.6	585.0	1
20	1	265	228	3.07	-12.8	0.4	1.3	585.0	1
21	1	285	226	3.09	-12.8	0.4	1.8	585.0	-1
22	1	310	221	3.09	-12.7	0.4	2.1	585.0	2
23	1	310	223	3.07	-12.7	0.4	1.9	585.0	2
24	1	304	222	3.06	-12.7	0.4	2.0	585.0	2
25	1	306	222	3.08	-12.7	0.4	2.1	585.0	2
26	1	308	222	3.09	-12.8	0.4	2.3	585.0	2
27	1	312	225	3.08	-12.8	0.4	2.0	585.0	2
28	1	306	225	3.08	-12.8	0.4	2.1	585.0	2
29	1	305	226	3.07	-12.9	0.4	2.0	585.0	2
30	1	310	226	3.07	-12.9	0.4	2.2	585.0	2
31	1	312	223	3.08	-13.0	0.4	2.1	585.0	2
32	1	305	224	3.07	-13.1	0.4	2.2	585.0	2
33	1	305	223	3.07	-13.2	0.4	2.1	585.0	2
34	1	296	227	3.08	-13.3	0.4	2.1	585.0	2
35	1	299	225	3.07	-13.4	0.5	2.3	585.0	2
36	1	295	217	3.09	-13.4	0.5	2.8	585.0	2
37	1	292	217	3.07	-13.5	0.5	2.8	585.0	2
38	1	292	224	3.04	-13.6	0.6	2.4	585.0	2
39	1	293	226	3.06	-13.6	0.6	2.2	585.0	2
40	1	324	220	3.06	-13.7	0.7	2.1	585.0	-1
41	1	371	216	3.06	-13.7	0.7	2.1	585.0	3
42	1	378	221	3.04	-13.7	0.7	1.8	585.0	3
43	1	378	222	3.04	-13.7	0.8	1.8	585.0	3
44	1	375	218	3.05	-13.7	0.8	2.2	585.0	3
45	1	376	219	3.05	-13.7	0.9	2.0	585.0	3
46	1	382	223	3.06	-13.7	0.9	1.9	585.0	3
47	1	379	221	3.04	-13.7	1.0	1.9	585.0	3

48	1	371	214	3.07	-13.7	1.0	2.4	585.0	3
49	1	371	212	3.04	-13.7	1.1	2.6	585.0	3
50	1	373	216	3.06	-13.7	1.1	2.4	585.0	3
51	1	375	220	3.04	-13.7	1.2	2.2	585.0	3
52	1	377	220	3.06	-13.7	1.3	2.0	585.0	3
53	1	379	214	3.06	-13.7	1.3	2.0	585.0	3
54	1	377	213	3.04	-13.7	1.4	2.4	585.0	3
55	1	375	215	3.05	-13.7	1.4	2.4	585.0	3
56	1	374	218	3.05	-13.7	1.5	2.0	585.0	3
57	1	373	226	3.04	-13.7	1.6	1.5	585.0	3
58	1	385	225	3.07	-13.7	1.7	1.4	585.0	3
59	1	440	222	3.05	-13.6	1.7	0.8	585.0	-1
60	1	474	224	3.04	-13.6	1.8	0.7	585.0	4
61	1	469	220	3.06	-13.6	1.9	0.6	585.0	4
62	1	471	216	3.08	-13.6	2.0	1.2	585.0	4
63	1	472	212	3.06	-13.6	2.1	1.9	585.0	4
64	1	471	209	3.07	-13.6	2.3	2.2	585.0	4
65	1	470	211	3.08	-13.6	2.4	2.5	585.0	4
66	1	466	212	3.09	-13.6	2.5	2.8	585.0	4
67	1	467	214	3.07	-13.6	2.6	2.7	585.0	4
68	1	464	219	3.05	-13.6	2.7	2.4	585.0	4
69	1	456	223	3.05	-13.7	2.8	1.7	585.0	5
70	1	454	223	3.07	-13.7	2.8	1.6	585.0	5
71	1	454	220	3.08	-13.7	2.9	1.9	585.0	5
72	1	451	218	3.06	-13.8	3.0	1.8	585.0	5
73	1	451	221	3.05	-13.8	3.0	1.6	585.0	5
74	1	452	219	3.07	-13.8	3.1	1.9	585.0	5
75	1	450	221	3.05	-13.8	3.1	1.5	585.0	5
76	1	449	219	3.05	-13.9	3.1	1.9	585.0	5
77	1	451	216	3.04	-13.9	3.1	1.7	585.0	5
78	1	454	220	3.02	-13.9	3.2	1.7	585.0	5
79	1	445	220	3.02	-13.9	3.2	1.9	585.0	5
80	1	445	220	3.00	-13.9	3.2	1.3	585.0	5
81	1	447	217	3.02	-13.8	3.2	1.7	585.0	5
82	1	472	217	3.01	-13.8	3.3	1.3	585.0	-1
83	1	500	213	3.01	-13.7	3.3	1.7	585.0	6
84	1	500	214	3.01	-13.7	3.3	1.4	585.0	6
85	1	501	217	3.02	-13.6	3.3	1.5	585.0	6
86	1	502	216	3.01	-13.6	3.3	1.7	585.0	6
87	1	502	218	3.01	-13.5	3.3	1.1	585.0	6
88	1	504	216	2.99	-13.4	3.4	1.1	585.0	6
89	1	505	213	3.01	-13.3	3.4	1.5	585.0	6
90	1	518	213	2.99	-13.3	3.4	1.7	585.0	-1
91	1	531	220	2.94	-13.2	3.5	1.0	585.0	7
92	1	530	219	2.99	-13.2	3.5	1.5	585.0	7
93	1	533	212	2.99	-13.1	3.5	1.6	585.0	7
94	1	535	214	2.99	-13.1	3.6	1.4	585.0	7
95	1	534	216	2.97	-13.1	3.6	1.7	585.0	7
96	1	532	210	3.01	-13.1	3.6	2.0	585.0	7
97	1	535	209	2.99	-13.1	3.7	1.9	585.0	7
98	1	538	214	2.99	-13.1	3.8	1.8	585.0	7
99	1	534	215	2.98	-13.2	3.8	1.5	585.0	7
100	1	533	212	2.98	-13.2	3.8	1.7	585.0	7
101	1	537	210	2.99	-13.2	3.9	1.5	585.0	7
102	1	537	214	2.99	-13.3	3.9	1.2	585.0	7
103	1	533	215	3.00	-13.3	4.0	1.5	585.0	7
104	1	532	214	2.98	-13.3	4.0	1.1	585.0	7
105	1	536	214	2.98	-13.4	4.0	1.0	585.0	7
106	1	536	211	3.03	-13.4	4.1	1.3	585.0	7
107	1	535	215	3.01	-13.4	4.1	0.9	585.0	7

108	1	535	222	3.00	-13.5	4.2	0.8	585.0	7
109	1	534	214	3.02	-13.5	4.2	1.2	585.0	7
110	1	510	211	3.01	-13.5	4.2	0.6	585.0	-1
111	1	388	217	3.04	-13.6	4.2	0.4	585.0	-1
112	1	322	217	3.06	-13.7	4.3	0.8	585.0	8
113	1	309	217	3.05	-13.8	4.3	0.7	585.0	8
114	1	310	216	3.04	-13.9	4.3	1.1	585.0	8
115	1	313	216	3.06	-14.0	4.4	1.3	585.0	8
116	1	312	224	3.04	-14.0	4.4	1.1	585.0	8
117	1	312	223	3.04	-14.1	4.4	1.1	585.0	8
118	1	309	224	3.04	-14.1	4.5	1.2	585.0	8
119	1	307	223	3.03	-14.1	4.5	1.1	585.0	8
120	1	310	218	3.04	-14.1	4.5	1.5	585.0	8
121	1	314	223	3.04	-14.1	4.5	1.0	585.0	8
122	1	313	222	3.02	-14.1	4.6	1.5	585.0	8
123	1	309	223	3.01	-14.1	4.6	1.1	585.0	8
124	1	310	226	3.01	-14.1	4.6	0.9	585.0	8
125	1	313	220	3.04	-14.1	4.6	1.2	585.0	8
126	1	309	222	2.99	-14.1	4.7	0.7	585.0	8
127	1	305	226	3.01	-14.1	4.7	0.8	585.0	8
128	1	305	222	3.01	-14.2	4.7	1.0	585.0	8
129	1	309	225	3.03	-14.2	4.7	0.5	585.0	8
130	1	312	226	3.05	-14.2	4.8	0.8	585.0	8
131	1	309	220	3.05	-14.2	4.8	1.1	585.0	8
132	1	305	226	3.01	-14.2	4.8	0.9	585.0	8
133	1	307	229	3.07	-14.1	4.9	0.7	585.0	8
134	1	312	221	3.06	-14.1	4.9	1.2	585.0	8
135	1	309	215	3.06	-14.1	5.0	1.5	585.0	8
136	1	304	222	3.04	-14.1	5.0	1.1	585.0	8
137	1	306	227	3.06	-14.1	5.1	0.5	585.0	8
138	1	306	222	3.09	-14.1	5.1	0.8	585.0	8
139	1	329	222	3.07	-14.0	5.1	0.4	585.0	-1
140	1	348	220	3.06	-14.0	5.1	0.8	585.0	9
141	1	349	218	3.05	-13.9	5.2	0.6	585.0	9
142	1	349	222	3.06	-13.9	5.2	0.4	585.0	9
143	1	349	221	3.05	-13.9	5.2	0.6	585.0	9
144	1	348	218	3.02	-13.9	5.3	0.6	585.0	9
145	1	348	221	3.02	-13.8	5.3	0.2	585.0	9
146	1	352	219	3.04	-13.8	5.3	0.7	585.0	9
147	1	350	216	3.03	-13.9	5.4	1.1	585.0	9
148	1	347	215	3.01	-13.9	5.4	1.2	585.0	9
149	1	352	216	3.02	-13.9	5.5	1.1	585.0	9
150	1	354	222	3.02	-13.9	5.5	0.8	585.0	9
151	1	349	218	3.00	-13.9	5.6	0.9	585.0	9
152	1	351	218	3.01	-13.9	5.6	0.8	585.0	9
153	1	354	220	3.03	-13.9	5.6	0.7	585.0	9
154	1	370	217	3.02	-13.9	5.7	0.6	585.0	-1
155	1	391	218	3.01	-13.8	5.7	0.2	585.0	10
156	1	392	214	3.02	-13.8	5.7	0.6	585.0	10
157	1	395	216	3.02	-13.8	5.7	0.5	585.0	10
158	1	397	221	3.02	-13.8	5.8	0.2	585.0	10
159	1	391	218	3.03	-13.8	5.8	0.7	585.0	10
160	1	391	220	3.03	-13.8	5.8	0.3	585.0	10
161	1	390	219	3.04	-13.8	5.8	0.7	585.0	10
162	1	388	215	3.03	-13.8	5.8	0.8	585.0	10
163	1	390	219	3.03	-13.8	5.8	0.5	585.0	10
164	1	386	221	3.02	-13.8	5.8	0.8	585.0	10
165	1	372	219	3.01	-13.8	5.8	0.3	585.0	11
166	1	367	216	3.02	-13.8	5.8	0.5	585.0	11
167	1	370	217	3.01	-13.8	5.8	-0.0	585.0	11

168	1	372	219	3.01	-13.9	5.8	-0.1	585.0	11
169	1	371	215	3.02	-13.9	5.7	0.2	585.0	11
170	1	372	215	2.99	-13.9	5.7	-0.2	585.0	11
171	1	372	219	2.98	-13.9	5.7	-0.2	585.0	11
172	1	373	224	2.99	-13.9	5.7	-0.5	585.0	11
173	1	366	217	2.97	-13.9	5.7	-0.3	585.0	11
174	1	309	213	3.02	-13.9	5.7	-0.3	585.0	-1
175	1	250	214	3.00	-14.0	5.7	0.3	585.0	-1
176	1	235	217	2.98	-14.0	5.7	-0.3	585.0	12
177	1	242	216	3.01	-14.0	5.7	0.0	585.0	12
178	1	242	212	3.00	-14.0	5.7	0.1	585.0	12
179	1	241	215	2.99	-14.0	5.7	-0.1	585.0	12
180	1	239	217	3.00	-13.9	5.7	-0.1	585.0	12
181	1	243	215	2.99	-13.9	5.7	-0.6	585.0	12
182	1	244	214	3.02	-13.8	5.7	-0.3	585.0	12
183	1	247	221	2.98	-13.8	5.7	-1.2	585.0	12
184	1	242	220	3.01	-13.8	5.7	-0.4	585.0	12
185	1	241	214	3.02	-13.7	5.7	-0.2	585.0	12
186	1	242	218	2.99	-13.7	5.7	-0.9	585.0	12
187	1	240	221	3.00	-13.7	5.7	-1.0	585.0	12
188	1	240	215	3.02	-13.7	5.7	-0.4	585.0	12
189	1	240	215	3.00	-13.6	5.6	-1.0	585.0	12
190	1	239	215	3.02	-13.6	5.6	-0.4	585.0	12
191	1	240	219	2.98	-13.6	5.6	-1.3	585.0	12
192	1	238	218	3.00	-13.6	5.6	-0.8	585.0	12
193	1	237	212	2.99	-13.6	5.6	-0.5	585.0	12
194	1	239	220	2.99	-13.5	5.6	-1.2	585.0	12
195	1	238	218	3.00	-13.5	5.6	-0.7	585.0	12
196	1	237	218	2.98	-13.5	5.6	-1.5	585.0	12
197	1	239	216	2.99	-13.5	5.6	-1.0	585.0	12
198	1	243	220	2.99	-13.5	5.6	-1.5	585.0	12
199	1	245	219	3.02	-13.6	5.7	-0.9	585.0	12
200	1	242	217	2.99	-13.6	5.7	-0.8	585.0	12
201	1	245	229	2.98	-13.6	5.7	-1.0	585.0	12
202	1	247	239	2.96	-13.6	5.7	-1.1	585.0	13
203	1	252	237	3.01	-13.6	5.7	-0.6	585.0	13
204	1	253	236	2.99	-13.6	5.7	-0.7	585.0	13
205	1	248	234	3.01	-13.6	5.7	-0.5	585.0	13
206	1	251	235	2.98	-13.6	5.7	-0.6	585.0	13
207	1	255	239	2.98	-13.5	5.7	-1.1	585.0	13
208	1	252	241	2.98	-13.5	5.8	-1.1	585.0	13
209	1	253	238	3.02	-13.5	5.7	-0.5	585.0	13
210	1	252	236	3.00	-13.4	5.7	-0.8	585.0	13
211	1	252	240	3.01	-13.4	5.7	-0.8	585.0	13
212	1	253	235	3.03	-13.3	5.7	-0.2	585.0	13
213	1	252	234	3.02	-13.3	5.7	-0.4	585.0	13
214	1	255	236	3.02	-13.2	5.6	-0.6	585.0	13
215	1	253	237	3.00	-13.2	5.6	-0.8	585.0	13
216	1	250	237	3.04	-13.1	5.6	-0.7	585.0	13
217	1	261	241	3.01	-13.1	5.6	-0.9	585.0	13
218	1	279	240	3.07	-13.0	5.6	-0.6	585.0	-1
219	1	294	238	3.05	-13.0	5.6	-1.0	585.0	14
220	1	292	237	3.08	-12.9	5.6	-0.6	585.0	14
221	1	295	237	3.07	-12.8	5.6	-0.8	585.0	14
222	1	303	242	3.05	-12.7	5.6	-1.1	585.0	14
223	1	294	243	3.06	-12.6	5.7	-1.0	585.0	14
224	1	294	238	3.11	-12.5	5.6	-0.6	585.0	14
225	1	299	239	3.05	-12.4	5.6	-1.1	585.0	14
226	1	297	244	3.08	-12.3	5.6	-1.4	585.0	14
227	1	290	242	3.08	-12.2	5.5	-1.6	585.0	14

228	1	271	246	3.07	-12.1	5.5	-1.9	585.0	15
229	1	260	249	3.05	-12.0	5.4	-2.2	585.0	15
230	1	266	250	3.07	-11.9	5.3	-2.7	585.0	15
231	1	266	259	3.07	-11.8	5.2	-2.6	585.0	15
232	1	264	263	3.05	-11.6	5.2	-3.0	585.0	15
233	1	265	262	3.05	-11.5	5.1	-3.4	585.0	15
234	1	266	261	3.06	-11.4	5.0	-3.6	585.0	15
235	1	269	259	3.08	-11.4	4.9	-3.3	585.0	15
236	1	263	255	3.05	-11.3	4.8	-3.2	585.0	15
237	1	263	255	3.09	-11.2	4.8	-2.7	585.0	15
238	1	327	236	3.13	-11.1	4.7	-2.0	585.0	-1
239	1	489	213	3.09	-10.9	4.7	-2.4	585.0	-1
240	1	509	211	3.10	-10.7	4.7	-2.5	585.0	-1
241	1	496	204	3.11	-10.6	4.6	-1.6	585.0	16
242	1	499	207	3.11	-10.5	4.7	-1.7	585.0	16
243	1	502	211	3.10	-10.4	4.7	-1.6	585.0	16
244	1	498	208	3.09	-10.3	4.7	-1.6	585.0	16
245	1	501	203	3.14	-10.2	4.7	-0.9	585.0	16
246	1	504	206	3.09	-10.1	4.7	-1.5	585.0	16
247	1	505	211	3.12	-10.1	4.6	-1.7	585.0	16
248	1	502	209	3.08	-10.0	4.6	-1.7	585.0	16
249	1	498	203	3.13	-10.0	4.5	-1.1	585.0	16
250	1	499	199	3.13	-10.0	4.5	-0.2	585.0	16
251	1	501	204	3.10	-10.0	4.5	-0.8	585.0	16
252	1	517	211	3.07	-10.0	4.4	-1.6	585.0	-1
253	1	532	213	3.11	-9.9	4.3	-2.0	585.0	17
254	1	534	212	3.11	-9.9	4.2	-1.6	585.0	17
255	1	538	208	3.11	-9.9	4.1	-1.4	585.0	17
256	1	535	202	3.12	-9.9	4.0	-0.8	585.0	17
257	1	533	204	3.12	-9.9	3.9	-0.8	585.0	17
258	1	536	211	3.12	-9.8	3.8	-1.7	585.0	17
259	1	525	214	3.12	-9.8	3.7	-2.2	585.0	17
260	1	454	211	3.17	-9.8	3.6	-2.5	585.0	-1
261	1	322	213	3.17	-9.8	3.5	-1.8	585.0	-1
262	1	280	209	3.14	-9.8	3.4	-1.1	585.0	18
263	1	273	202	3.19	-9.9	3.3	-0.5	585.0	18
264	1	276	206	3.14	-9.8	3.2	-0.2	585.0	18
265	1	273	214	3.10	-9.8	3.1	-0.9	585.0	18
266	1	274	215	3.14	-9.7	3.0	-1.0	585.0	18
267	1	273	208	3.13	-9.6	2.8	-0.5	585.0	18
268	1	269	206	3.13	-9.5	2.7	-0.1	585.0	18
269	1	268	210	3.11	-9.3	2.6	-0.0	585.0	18
270	1	271	214	3.13	-9.2	2.5	-0.1	585.0	18
271	1	275	219	3.10	-9.0	2.3	-0.7	585.0	18
272	1	271	220	3.10	-8.8	2.2	-1.2	585.0	18
273	1	258	221	3.13	-8.7	2.1	-1.4	585.0	18

Fixation Data: (60 Hz Sampling Rate)

fix indx	Fixation X (pix)	Fixation Y (pix)	Sac Dur (cnt)	Fix Dur (cnt)	Fix Start Samp
0	278	203	0	8	0
1	259	227	0	13	8
2	303	223	1	18	22
3	376	219	1	18	41
4	469	215	1	9	60
5	451	220	0	13	69
6	502	215	1	7	83

7	534	214	1	19	91
8	310	222	2	27	112
9	350	219	1	14	140
10	391	218	1	10	155
11	371	218	0	9	165
12	241	217	2	26	176
13	252	237	0	16	202
14	295	240	1	9	219
15	265	256	0	10	228
16	500	206	3	11	241
17	533	209	1	7	253
18	273	211	2	12	262

Appendix F - Specimen “areas of interest” file

```
# bookmarks list
#
# Name, Top left: x,y - bottom right: x,y - w,h - label
# -

State Bookmarks
website_1a.bmp -1 -1 -1 -1 -1 -1 Article_title
website_1a.bmp -1 -1 -1 -1 -1 -1 Section_name
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website_1b.bmp 229 651 341 663 113 13 Article_title
website_1b.bmp -1 -1 -1 -1 -1 -1 Section_name
website_1b.bmp -1 -1 -1 -1 -1 -1 Site_name
website_1c.bmp 343 651 456 663 114 13 Article_title
website_1c.bmp -1 -1 -1 -1 -1 -1 Section_name
website_1c.bmp 229 651 334 663 106 13 Site_name
website_1d.bmp 229 651 341 663 113 13 Article_title
website_1d.bmp -1 -1 -1 -1 -1 -1 Section_name
website_1d.bmp 351 651 456 663 106 13 Site_name
website_1e.bmp 403 651 516 663 114 13 Article_title
website_1e.bmp 343 651 394 663 52 13 Section_name
website_1e.bmp 229 651 334 663 106 13 Site_name
website_1f.bmp 229 651 341 663 113 13 Article_title
website_1f.bmp 351 651 402 663 52 13 Section_name
website_1f.bmp 411 651 516 663 106 13 Site_name
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website_2a.bmp -1 -1 -1 -1 -1 -1 Article_title
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website_2a.bmp 229 671 324 683 96 13 Site_name
website_2b.bmp 229 671 389 683 161 13 Article_title
website_2b.bmp -1 -1 -1 -1 -1 -1 Section_name
website_2b.bmp -1 -1 -1 -1 -1 -1 Site_name
website_2c.bmp 333 671 493 683 161 13 Article_title
website_2c.bmp -1 -1 -1 -1 -1 -1 Section_name
website_2c.bmp 229 671 324 683 96 13 Site_name
website_2d.bmp 229 671 389 683 161 13 Article_title
website_2d.bmp -1 -1 -1 -1 -1 -1 Section_name
website_2d.bmp 398 671 494 683 96 13 Site_name
website_2e.bmp 436 671 550 683 115 13 Article_title
website_2e.bmp 333 671 427 683 95 13 Section_name
website_2e.bmp 229 671 324 683 96 13 Site_name
website_2f.bmp 229 671 389 683 161 13 Article_title
website_2f.bmp 398 671 492 683 95 13 Section_name
website_2f.bmp 501 671 550 683 50 13 Site_name
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website_3b.bmp 230 631 471 643 242 13 Article_title
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website_3c.bmp 230 631 307 643 78 13 Site_name
website_3d.bmp 230 631 471 643 242 13 Article_title
website_3d.bmp -1 -1 -1 -1 -1 -1 Section_name
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website_3f.bmp 230 631 471 643 242 13 Article_title
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website_4b.bmp 229 411 454 423 226 13 Article_title
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website_24f.bmp 407 491 466 503 60 13 Section_name
website_24f.bmp 475 491 552 503 78 13 Site_name
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# website list
# Name, Top left: x,y - bottom right: x,y - w,h - label
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website_1.bmp 101 462 249 503 149 42 Section_name
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website_2.bmp 264 330 520 346 257 17 Article_title
website_2.bmp 261 292 480 310 220 19 Section_name
website_3.bmp 203 211 518 239 316 29 Site_logo
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website_5.bmp 251 372 308 390 58 19 Section_name
website_6.bmp 225 212 779 315 555 104 Site_logo
website_6.bmp 358 442 765 459 408 18 Article_title
website_6.bmp 360 395 491 416 132 22 Section_name
website_7.bmp 120 192 542 243 424 52 Site_logo
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