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Literature Review Report
Current and Future Eye Tracking
Experiments on Web and Print
Document Feature Attractiveness

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Introduction

The rapid development and increasing use of the World Wide Web for information source and an electronic commerce tool make web usability studies grow in importance. Several web design checklists have been developed that focus on features such as page layout, navigation, loading time, color and font use, organization of information content, images, advertisements, active links, etc. These features may attract users and control users' satisfaction with the website. As described in the Roshanak's paper (SAFAVI, 2009) the design of a usable website requires simplicity, naturalness, ease of use, security, trust, accuracy, text font, images, personalization, customization, search capabilities and others. Roshanak summarized all these features in just one expression, and that is to be user friendly. He suggested that a website can achieve its purposes by being user friendly. As we understand from the word itself, user friendliness is more related with user's behavior.

The main question is whether there is a complete collection of features, whether some of these features are more important than others to attract and satisfy users with the website and to motivate them to revisit the websites. The same question can also be asked for the case of printing industry such as newspapers and magazines. For which features and for which properties of each feature in the newspaper or magazine the users attracted more? Which of the features will likely make the users to read the particular newspaper or magazine over and over again?

Even if most of these checklists are theoretically driven or have a theoretical foundation, this research study plans to systematically investigate features in the web environment and printed documents that attracts users attention to a particular page, that influence user satisfaction and that will make them to revisit the website or the print again. Knowing how the customers or the readers see the websites or prints is the basic and fundamental idea for this study. Eye tracking research will enable us to record where exactly users look on the website or printed documents. Then one can use these records and some additional user comments to identify those important features for user attraction and satisfaction.

Using Eye tracking technology (Jakob Nielsen, 2010) for researches' have been conducted since 19th century for perceptual psychology. In 21st century it also started to be used in commercial studies in addition to academic studies. There have been number of very wide and good studies of websites and prints with Eye tracking. Number of small studies, focused on a very narrow group of websites or single website, newspapers or magazine have also been done. In this survey we tried to cover as much as possible studies which have been done in this area. We give a higher priority for recent works.

Eye Tracking

Eye tracking is the process of measuring the point where we are looking called gaze or the motion of an eye relative to the head. It is following the path where a person is looking. Eye tracking evolved quickly with the help of modern technology (Katrien Wijnen, 2008). Where eye movement was still analyzed by means of direct observation in the 1800s, new techniques automatically generating data were developed from the 1950s. With a current technology (eye tracker) it is possible and very easy to follow the path and to see the point where the users focus or look on the computer screen. An eye tracker is a device for measuring eye positions and eye movement (Jakob Nielsen, 2010); (Shrestha, 2009); (Areej Al-Wabil, 2008); (Duchowski, 2007). Eye trackers are used in different areas of researches including the visual system, psychology, cognitive linguistics and product design. There are a number of methods for measuring eye movement.

The movement of the eye can be measured by Eye trackers using several ways. The non-contact optical method is the frequently used method for measuring eye movement. In this method, infrared light is reflected from the eye and sensed by a video camera or some other specially designed optical sensor. When the infrared light reflected from the users face, there is much better reflection from the user's retina than the other parts of the eye. It is because retina absorbs visible light and reflects infrared light. When the light enters the retina then a large proportion of it is reflected back. This will make the pupil to appear as a bright and well defined disc which is known as the "bright pupil" effect. The corneal reflection is also generated by the infrared light and creates a small sharp glint which is called first Purkinje image (see Figure 1).

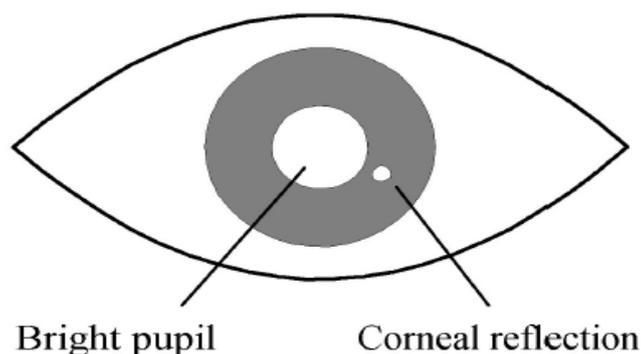


Figure 1: Corneal reflection and bright pupil as seen in the infrared camera image (Source: (Poole, 2004))

The information is then analyzed to extract eye rotation from changes in reflections. Video based eye trackers typically use the corneal reflection (the first Purkinje image) and the center of the pupil as features to track over time. A more sensitive type of eye tracker, the dual-Purkinje eye tracker, uses reflections from the front of the cornea (first Purkinje image) and the back of the lens (fourth Purkinje image) as features to track.

A human vision has two parts. One is Foveal vision which is a small central area with a very high resolution. It covers only 2 degrees of the visual field. This is as much as human can see clearly. The second is the Peripheral vision which covers the majority of the visual field with less important resolution. The image formed in this area is very blurred. Since the part of the image that humans can see clearly is very small, the eye would have to move across the item of interest.

Eye movement is typically divided into fixations and saccades. When the eye is resting on something, it is called fixation and the eyes quick movement from one fixation to the other are called saccades. The resulting series of fixations and saccades is called a scanpath. Most information from the eye is made available during a fixation, but people do not see clear images during a saccade. Hence, the locations of fixations along a scanpath show what information loci on the stimulus were processed during an eye tracking session. On average, fixations take about 200 ms during the reading of linguistic text, and 350 ms during the viewing of a scene. Preparing a saccade towards a new goal takes around 200 ms. Eye trackers necessarily measure the rotation of the eye with respect to the measuring system. If the measuring system is head mounted then eye-in-head angles are measured. If the measuring system is table mounted, then gaze angles are measured.

Just by watching the patterns of the eye movements' one can draw a conclusion. Knowing where the people look actually tells us something about the people behavior. According to the mind-eye hypothesis, people do not have to be always totally understood what they are looking, but if they are looking, they are usually paying attention. It is true mainly when they are concentrating on a particular task. People have a nature that they tend to look at same thing that they are thinking about. Under natural viewing conditions humans tend to fixate on specific parts of the image that interests them naturally. The term gaze, in general, is used to mean focused attention. There for one can conclude that fixation equals attention. A series of erratic eye movements might suggest that a user was confused by a disorganized stimulus whereas a series of controlled eye movements might show that a user was looking at interesting locations. The density of these movements also helps to establish their level of focus and understanding.

Users might look for longer time at certain text because it is relevant and interesting for them or it is because the writing is hard to read. The people focus on particular position for long time alone can't tell us whether the content in that position is good or bad. We can't say that certain design element is bad just because it is ignored. Any conclusion about the eye tracking data must include knowledge of users' intents and the usability impact of their behavior. Those websites or prints that allow people to focus on the things that they want to focus on are those websites or prints which make people to return to them again and again.

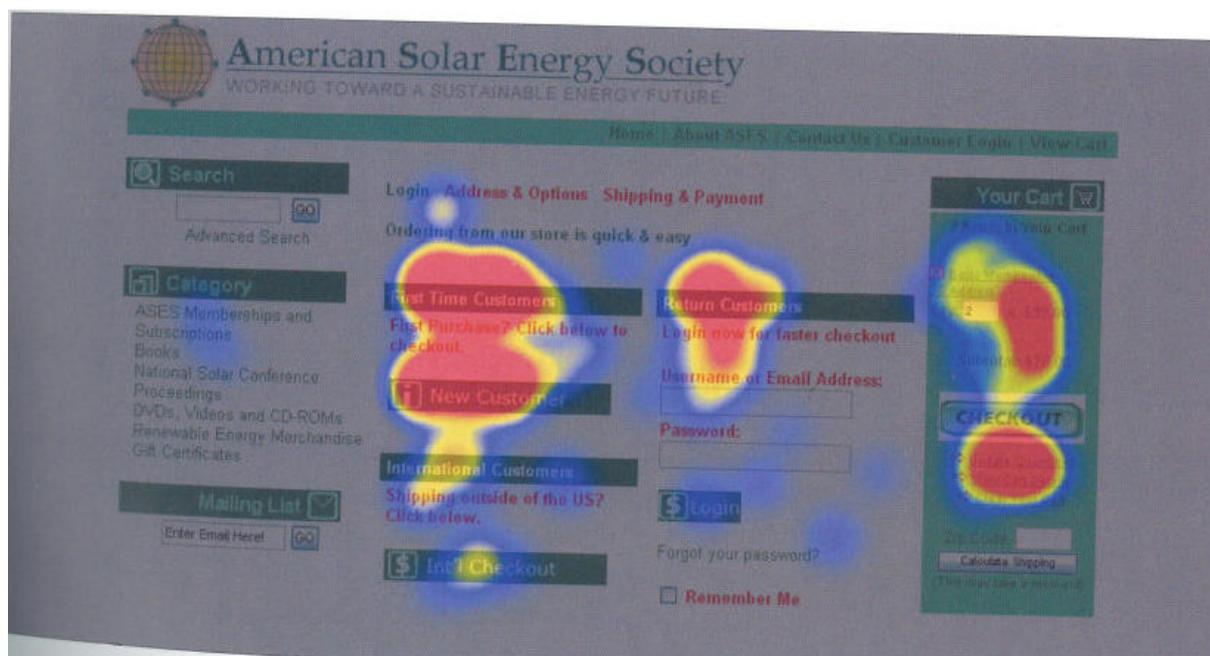


Figure 3: Heat map (source: (Jakob Nielsen, 2010))

Not only user's fixations, their purpose in mind should be considered too because it will affect the way they look at a particular page. The task the user has been chosen or asked to do is the main determining factor for their looks. It is always good first to determine who are the users and what are they trying to do and then plan the eye tracking experiment accordingly. The users' past experience will also affect their look. Therefore, it is not the problem of the eye tracking that people looks differently on the same page. It is something one can find whatever type of research method he/she followed. One good example for these will be found in the following link <http://www.youtube.com/watch?v=ubNF9QNEQLA>

As described in Alex Poole and Linden J. Ball survey (Poole, 2004), eye-movement tracking, in general, represents a significant, objective technique that can give useful advantages for the in-depth analysis of interface usability. Eye-tracking studies in human computer interaction (HCI) become great and significant tool for usability-testing methods used by commercial and academic HCI researchers. As the technology becomes increasingly cheaper, less invasive, and easier to use, the use of the method in HCI studies continued to grow.

This survey focuses on the study of using eye tracking for web usability and print studies only. But eye tracking has many other and countless applications (Jakob Nielsen, 2010). These includes, study the usability of application software's, study the effectiveness of advertising, medical and market research, advertisement analysis, experimental brain science examination, mental testing and treatment ... Eye trackers also can be used as input devices. If the computer knows where the user is looking, the software can adjust more information about the things that the user cares about most.

We found some basic eye tracking terms with their description. We think that it will be good to mention some of them, here. There are a lot more terms, which are used most frequently in eye tracking experiment, with their explanations in Alex Poole and Linden J. Ball survey (Poole, 2004). One can refer them if he/she is interested for more terms and phrases.

Eye tracker: Device used to determine point-of-regard and to measure eye movements such as fixations, saccades, and regressions. It works by tracking the position of various distinguishing features of the eye, such as reflections of infrared light off the cornea, the boundary between the iris and sclera, or apparent pupil shape.

Eye tracking: A technique whereby an individual's eye movements are measured so that the researcher knows where a person is looking at any given time, and how their eyes are moving from one location to another.

Eye-mind hypothesis: The principle at the origin of most eye tracking research. Assumes that what a person is looking at indicates what they are currently thinking about or attending to. Recording eye-movements can, therefore, provide a dynamic trace of where a person's attention is being directed in relation to a visual display such as a system interface.

Fixation: The moment when the eyes are relatively stationary, taking in or "encoding" information. Fixations last for 218 milliseconds on average, with a range of 66 to 416 milliseconds.

Gaze: An eye tracking metric, usually the sum of all fixation durations within a prescribed area. It also called "dwell", "fixation cluster", or "fixation cycle".

Point-of-regard: Point in space where a person is looking. Usually used in eye tracking research to reveal where visual attention is directed.

Regression: A regressive saccade: is a saccade that moves back in the direction of text that has already been read.

Area of interest: An area of interest is an analysis method used in eye tracking. Researchers define areas of interest over certain parts of a display or interface under evaluation, and analyze only the eye movements that fall within such areas.

Saccade: An eye movement occurring between fixations, typically lasting for 20 to 35 milliseconds. The purpose of most saccades is to move the eyes to the next viewing position. Visual processing is automatically suppressed during saccades to avoid blurring of the visual image.

Scanpath: An eye-tracking metric, usually a complete sequence of fixations and interconnecting saccades.

Methodology

Here we are going to give a brief summary of methodologies followed by the two books: (Jakob Nielsen, 2010) and (DR. Pegie Stark Adam, 2007). The way they choose their participants, the method of study they followed, the way they conducted their experiment sessions and the way they analyzed their eye tracking data, finally, will be a good lesson for everyone who is planning to do eye tracking research.

Participants:

For Jakob Nielsen and Kara Pernice's book (Jakob Nielsen, 2010), they conducted very large eye tracking study in terms of number of observers participated, the breadth and number of websites examined and the types of tasks observed. Their findings are based on 1.5 million fixations which resulted from more than 300 participants with 85 assigned tasks. The participants were with the following demographics.

- Age : between 18 – 64. Most of the participants where in the age 30-49.
- Web experience: participants with low, medium and high web experiences.
- Gender: about 58% of the participants were females and the rest were males.
- Employment: Full-time, Part-time, unemployed, homemaker, retired, ...
- House hold income: less than some amount, greater than some amount or in between, according to the country standard
- Level of education: high-school graduate, collage graduate, ...
- Ethnicity: white, black, Hispanic, others
- Residence: in a city or rural area

Most of their participants, about 60%, were college graduates or more, white and rich with income more than \$50,000. More than 80% of their participants were full-time employees and live in the city. They choose these participants because they represent their customers.

On the other hand, for the Poynter Eyetrack07 research (DR. Pegie Stark Adam, 2007), they recruited subjects using strict screening criteria concerning age (17-61), gender (Male and Female given equal 50/50% quota) and frequency of reading the paper or website (only those read there newspaper or website within last 7 days), eye glasses (only those not wearing eyeglasses), Employment (70% employed and 30% unemployed). Totally, 605 people take part in the experiment and completed the study in four cities.

The criteria we choose for selecting participants depends on the type of study we are conducting. Some studies might need to include more unemployed people, people from all ethnic group equally balanced, more people from rural area, etc. others may choose different representative participants.

Even if most of the peoples who read newspapers and websites have normal vision, there are considerable numbers of peoples who use eye glasses for reading purposes. Eye glasses might prevent the tracking of a clear corneal reflection. It might disturb the quality of the eye tracking session. Since, the number of newspaper or website readers with eye glasses is significant enough it will be a good idea to search for a mechanism which will allow them to be the part of eye tracking experiment.

Eye tracking study is highly subjective. Changing the above criteria might change their overall results. People in New York might not have same preference or behavior like people in Norway or Arabic country. People in big cities might not have similar behaviors like people in the small cities. There are a wide variety of cultural changes. Therefore, it is hard to say that this particular study will represent all the people in the world not even all people in USA but they were a very large study which takes very long time and resources.

Dianne Cyr et al.'s eye tracking experiment to gain insight into how internet users perceive human images as one element of website design (Dianne Cyr, 2009) shows that there are subtle differences in the perception of human images across cultures (Canada, Germany, and Japan), see figure 4. (Cyr, 2004); (Evers, 1997); these works also show the acceptance of website design features differs among cultures. Among those features user reactions to images is one of them (Barber, 2001); (Sun, 2001). The results of some researches (de Mooij, 1998); (Hong, 1987) also prove our idea of cultural differences. They said communication styles differ across cultures and highly individualistic countries like Canada and the United States prefer more factual and text advertising, while collectivist countries like Japan prefer more symbolic messaging.

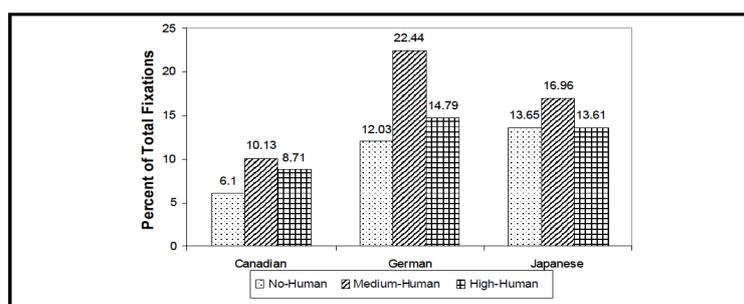


Figure 4: Average Number of Fixations on Manipulated Images across Cultures (source: (Dianne Cyr, 2009))

Method of studies:

Poynter Eyetrack07 researchers (DR. Pegie Stark Adam, 2007) used a portable type of eye tracking equipment (The Mobile Eye) which is developed by applied science laboratories in Bedford, Mass for both print and website studies, figure 5a. Its lightweight optics and two small cameras were mounted on the subjects head (cameras on the right eye on the optics). One camera record the position of the eye at 60 frames per second, the other camera record what the subject was viewing at the same speed. These two images will create a video with a crosshair over the newspaper or monitor which represent

the subject's cornea's position. Since the Optics was connected to a portable mini DVCR, the reading session was recorded to a digital video file on a computer for about 15 minutes for each participant.



Figure 5: a) Poynter Eyetrack07: Eye Tracking equipment



b) Poynter Eyetrack07: example of their coding system

This way of analyzing the eye tracking data was difficult and cumbersome. They were counting and describing each element they want to study in some sort of their own coding system, figure 5b. They created a codebook that identified by number the elements they want to measure. The coding was more complicated for the case of online studies than print studies. After different groups perform the coding of all 15 minutes videos in the order that the participants were viewing the newspapers or websites, and after a severe consideration of repeatability of the codes, they deliver the dataset for media mark for data analysis.

The data analysis group analyzed more than 102,000 fixations on more than 300 unique elements within the publication in order to identify trends and patterns in reading behavior. They analyzed difference between tabloid and broadsheet, prints and online reading patterns. They also cross reference the data set with demographic information like age, gender and reading frequency. They compared the number of elements viewed with those available to be seen by readers in the study in order to describe the comparisons in statistical form.

As described in (Jakob Nielsen, 2010) the book, usability methods can be divided into quantitative and qualitative approaches. Quantitative studies measure the usability data numerically. For example, the sentence "80% of the people prefer the advertisement to cover only half of the page on newspapers" is qualitative way of study. Quantitative studies measure usability data in richer insight and observation.

For example, the sentence “the advertisement on this website was not effective because people can’t see it and that is because of some design problems” is a quantitative way of analysis. In addition to these there are also two main ways of analyzing the data from the eye tracking research: Heat maps and Gaze plots or Gaze replays.

They also mentioned that for an effective heat map creation of a given web page, one need to include eye tracking records from 30 users so that it can be averaged across many users. That is for avoiding the effect of the large variability in individual user eye movements. They used consistent task-timing methods and predetermined success score. Sometimes when they have to ask the users for some quantitative feedback, there were extra fixations while talking which might disturb eye tracking data. It is very important to discount these instances by the time of fixation counts or generating heat maps.

The methodology followed by Jakob Nielsen and Kara Pernice group (Jakob Nielsen, 2010) was much easier and very straightforward to understand and visualize. Since it is current work they have the possibility to use new technologies. Heat maps and Gaze plots are the easiest ways to analyze eye tracking data these days.

Test Session:

During the test session (Jakob Nielsen, 2010) tasks were captured by the eye tracker and the time and scores were controlled by the facilitators. Users were free to point out when they were finished or want to stop. Taping the peoples face and activity during test session by a video camera, as a backup, is also a great idea.

It is a good practice to including the following activities in each user sessions. First, welcoming the user and there should be a consent form (users permission), then identifying the users’ interest (interest questionnaire). As described in (DR. Pegie Stark Adam, 2007) every person is very unique: facial structure differs, the shape of their eyes also differs a lot. Therefore, Calibration of the eye tracker is very important and will be done next. Tasks will be presented and observed scores will be taken. Finally, post-task questionnaires and retrospective process will be done. In the post task questions users will describe their satisfaction, frustration, and confidence after each task. In the retrospective process, users will be presented part of their test session and they will give comment.

Some variables might prevent a person from participating. Some of the variables mentioned in (DR. Pegie Stark Adam, 2007) the eye tracking the news book include: if the participant forget to follow the instructions like not to read the newspaper or the website before he/she come in to the research, people who require glasses, the natural shape of some people eye or the position of their eyelids.

They (Jakob Nielsen, 2010) used two types of tasks: Open-ended tasks in which users can do anything they want on the web. They can choose any site they want, and Closed tasks in which users were asked to do specific things in the chosen particular site. Different types of websites have been used including web search engines, Newspaper website, corporate websites and e-commerce websites. Whereas the (DR. Pegie Stark Adam, 2007) study used only open-ended tasks in a sense that they can read anything they want on one page but they are not allowed to leave the site, which inhibited ‘linking out behavior’. The choice is up to the researchers and it also depends on the area of the study.

Even if it is difficult to replicate a person’s environment during a test session, it is important to make participants to sit comfortably and to read as they normally would. For example, people read newspapers and magazines in the coffee shops or living room. They might read websites in their house or offices. It will be difficult to create exact same experience but we should make sure to make the conditions unobtrusive and uniform. The eye tracking instrument should allow participants to move freely to sit back on their chairs and to raise or lower the newspaper or magazine.

Measures:

Most of their (Jakob Nielsen, 2010) measurements were qualitative. They watched people behavior like the thing they were trying to do, the position and the content they were looking at, for how long they looked on an element? And the position and the content that people never looked at. They finally tried to find out the reason why people did look or didn't look at things. They also listened to users comments which are given during the task session or between tasks.

In addition to qualitative measures, they (Jakob Nielsen, 2010) used the following basic quantitative measures. **task time**: how long it took a user to complete a specific task, **number of fixations** people spent at different stages of tasks (they were desired or wasted?), **success score**: how much of a task the user completed in the end, **errors**: how many times users selected a wrong feature in the interface, **Miscues**: elements that attract the users eye and attention at the wrong time and **users' subjective satisfaction**: is the user very happy or least happy?

These all quantitative and qualitative methods of conducting and analyzing the eye tracking research are common for most of the studies we have been reading. Only the eye tracking data can't tell us about the participants feeling and behavior as a whole. Preparing different types of questioners and interviews in addition to eye tracking data is very helpful for drawing a conclusion (Card, 2001).

This (Jakob Nielsen, 2010) book point out three basic criteria which are important to form conclusion that can be generalized and used as useful design guideline for all websites or criteria for judging the validity of an eye tracking study.

1. Representative users: the participants should include as much as possible people which represent the intended customers.
2. Realistic task performance: usability is always highly context dependent. So using real tasks during test session is very important
3. Different types of websites: one can't generalize results from one website to many others. It is better to try to cover as many as possible websites which cover as wide as possible areas.

Overview of Findings

In this portion of the report we are going to summarize the major findings found by different eye tracking researches. These findings mainly focus on the features which attract users to a particular website, newspaper or magazine. We also list features which will increase the user satisfaction and will make a particular user to revisit that website, newspaper or magazine.

Web Page layout

The first thing that user encounter during a website visit will be the layout of the web page. Higher consideration should be given for the layout design during web page development. Messy or difficult designs will create problems for people to find what they are looking for. Users are scanners. They do not want to spend lots of their time on the unpleasant site unless they really need the thing they are looking for.

Jakob Nielsen and Kara Pernice (Jakob Nielsen, 2010) give lists of elements in their book which will attract users eye during their visit to a particular web page. They also pointed out the position and the way to place most important contents in order to grasp user's attention.

One of the problems which results the cluttering of websites is the mismatch of user goals and business goals. Organizations might want too many things to appear on the main locations where as users might not like messy web pages. Organizations should balance the things that they want people to do at their site and what really people want to do. They should systematically plan the pages by considering

questions like: What do people want when they come to their site? What they want people to see and do when they come to their site? What the priority areas that users most drawn to are in their design? Designers should determine how much information belongs on one page and choose important contents and should have courage to drop what is less important.

The way people look at the web page differs a lot. There is no common way, common pattern or sequence that people look at web pages. People might have more probability to have similar look patterns if they are doing the same task on the same web page and if they have the same past experience. They sometimes gravitate towards the same general area. But they still do not look in the same point with in that area. Even with these similarities the people look pattern on features still differs. It depends on the layout of the site, whether the users are attracted to the feature story, an image, add ... A combination of layout and content most of the time shows what draws or repels people's eyes. There for, a strong task analysis and knowledge about your users will help you create sites with the elements people want in the places they expect to find them. That way, it will be possible to design a page in such a way that features attract the user's eye at the right time.

After analyzing the gaze plots of different participants of their eye tracking research (Jakob Nielsen, 2010) they give the following page elements that designers should consider and use during their development of websites.

Designers should:

- Place perceptible menus, with some graphics and color demarcation, on the top left corner.
- Place a Home button in or near the menu on the far left of all pages except the home page.
- Place a logo in the upper-left corner of all pages.
- Place a shopping cart icon, open search field and login/logout feature in the upper-right corner of all pages.
- Place utility navigations which are visually weaker than the main/global navigation at the very top or very bottom of pages.
- Offer white space, borders and color to help users see the sections and the topics within them in just one fixation. People looked all over the site if it is light and simple design.
- Give headings for each section and set them off using different formatting.
- Eliminate the least important items which will make the most important items to be easily visible by the users.
- Place the contents in more visible and usable way. The placement of contents and visible and usable visual design are more important than page density. Page density alone has a little effect on user's attention.
- Place most important, basic and related to page title or topic information in priority spots, figure 6 and 7. Priority spots are those areas with visual priority on the page and these include:
 - The uppermost section of the content area, after the menu
 - Bigger or bolder type, underlining or colored type or colored background with careful considerations not to make them look like ads.
 - Using attractive features even in understated areas than the higher-priority spots will draw people's eye towards the place that we want them to look. Each page design can determine which areas are its priority spots.
- Place vital information in visually escalated areas with clear priority spots.
- Focus on their main or top tasks. Since there are lots of different kinds of tasks that people might want to do on a site, focusing on all of them is not enough.
- Name web features based on users thinking and based on the users desire to do on the page. Unclear terminology or cryptic name can repel users even from the important feature they are looking for.

- Categorize the priority and importance of contents and the physical section of the page, in order to avoid most of the above mentioned problems. Then one can match the importance of the information with the priority area and likely viewing order of the page (figure 6 and 7).

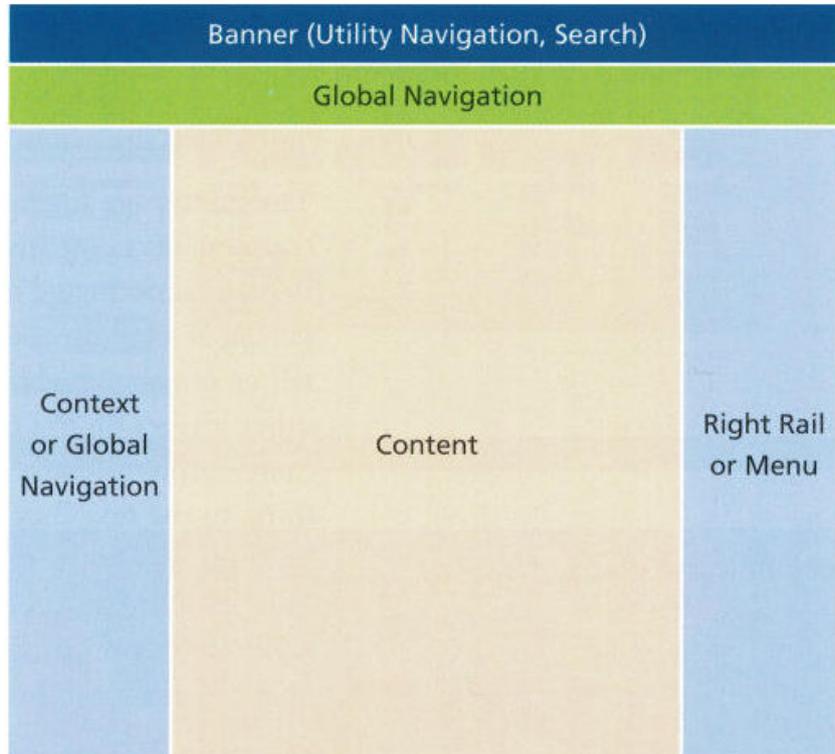


Figure 6: Commonly used page layout for most of the websites



Figure 7: Users attention distribution: users look on the upper left of the content area for high priority information

- Use well-placed white spaces than busy, unrelated, low-contrast images for providing a visual or cognitive break. Otherwise we will be wasting those places. No user will be looking at it any way.

Designers should not:

- Place a Home button on the home page
- Offer all information in a homogeneous format, instead break apart them.
- Make headings look like ads and ignored by users while they are formatting them.
- Worried more about page density, instead of worrying about the placement of the contents
- Mismatch priority which means the content doesn't match locations in terms of importance.
- Include miscues: the design element that attracts users' attention in the wrong times and disrupts their progress. They are problems since they force users to spend their time on unnecessary information.
- Make important information in a box or small images or sectioned off formats. That is because of Banner blindness, the resemblance of boxed, small images and sectioned off areas to promotions, and user's desire to protect them from a potential unnecessary advertisement will make them to miss a feature they truly needed.
- Use too many types of interface elements on the page since they will draw user's attention in to the wrong place.
- Mix business with pleasure. Users should be able to finish the task they are coming for other than killing their time on watching entertaining things.

Once one design his/hers web page following the above guideline, it is advisable to conduct his/her own eye tracking research in order to further improve the page and for finding out miscues and fixing them. Miscues related with Errors from the four basic quantitative measures (Task time, Success, Errors and User's satisfaction). But errors are actual clicks in the wrong direction whereas miscues are just a look. Miscues affect all the other measures. They might force the users to make their own decision. They have very high effect on task time and user satisfaction.

Goldberg et al. used eye-tracking methods to test the performance of the participants in completing several tasks on a web portal page (Goldberg, 2002). Their research demonstrated that:

- there are more regular horizontal eye movements between different portlets on a page than vertical ones
- the headers in a portlet were not usually visited before the body and
- that searches didn't become more directed as a screen sequence increased

Pan et al. Also studied the determinants of web page viewing behavior (Pan Helene, 2004) and they concluded that web page viewing behavior is driven by the gender of participants, the order of web pages being viewed, and the interaction between site types and the order of the pages being viewed.

In general a successful site is the one in which the most important features are easy for people to see and use. In order to create such website designers should critically look on and follow the above design guidelines which are proved by wide eye tracking experiment (Jakob Nielsen, 2010).

We didn't find research done on the layout of print documents. Sometimes it is important to know where people look for ads in newspapers or magazines, where in the magazine or newspaper they usually look for the main contents of the magazines or the highlights of the news, the logo, the name, titles of each topic or chapter in the magazine or newspaper. Studying whether the page density or placement of contents is important or not and identifying priority spots of magazines and newspapers is also not a simple thing. In general, making a detail page layout eye tracking research for high number and variety of magazines and newspapers should be considered.

Text

We found out from Kami and Greg's work (Leppert, 2006) that reading information from a computer screen causes the users to read information up to 25% slower than from paper copies (Neilson, 1999). Web users are therefore very eager to obtain the required information as quickly as possible, and they are not prepared to read the text patiently. For this reason, web users scan website content for information rather than critically reading each word (Fichter, 2005). Therefore the text content must

be written in styles which are advantageous to scanning. It is recommended (Fichter, Web Development over the Past 10 Years, 2005) to use “chunking”; that is, the use of headlines, bullets and short sentences. They are very important to increase usability and make the website more accessible to a user. However, if the website information can't be chunked then presenting it with a format which is suitable to download and print, like pdf, will be interesting.

Roshanak's study about GUI of e-commerce websites (SAFAVI, 2009) also mentioned that the goal of such website is to achieve high level of user participation therefore the website must be completely transparent and easy to understand for users. The designer should avoid using technical and unclear terms and try to make every aspect of the site completely clear and transparent for all the users.

Texts are everywhere in the web and in prints. They are included in images, in ads, in animations ... everywhere. Texts in ads will have their own property which might vary a lot with texts for content. All texts should be large enough and clear enough to be read by users but the size, the color and the style of the text might depend on their task. Different colors can be selected for different types of text. Text in the navigation bars might have some sort of colors, text in contents mainly are black and text for ads may be larger in size, might be bold and with colorful background. We also mentioned which type of text attracts people in different parts of the web or print in their respective section. For example, we give detail lists of text properties in the ads in the advertisement subsection of this section.

Image

Images are a powerful part of web pages and prints design that will play their own role in user's satisfaction and attraction towards a particular website or printed document. We consider images as good images if they explain a concept, invoke and express a feeling, transfer information faster than words and make people's experience with the website or with a print more appealing. Otherwise, they will just confuse the users. They will be ignored and will be total wastage of time and the space.

People, who read newspapers or magazines, might have completely different way of observing images than people who read websites. Websites present higher number of images than print industry. Images on websites are colored most of the time where as black and white images used broadly in the print industry. These and more technology related factors will affect the readers behavior and make the way the website readers perceive images more different than the way the newspaper or magazine readers do.

The different properties of images will affect the way of people's observation at them. Their size, color, content and the way they are presented on the web page or print also have a big influence on the people's response for that particular website and print. Here we are going to present those properties of pictures which makes them the good once for a certain website and print.

Images on the web:

As we found out from (Jakob Nielsen, 2010), most of the web users are scanners: they rapidly make a decision what they are going to look at. Depending on their context and type, people only look at 42% of the images presented to them and they only look at them for less than $(2/10)^{th}$ of a second. Usually, people treat the unattractive images in the web page as an obstacle that they have to go around. Therefore images better be carefully selected and presented on the web in order to get those limited attentions of users. Here we are giving the lists of characteristics that the images people look at most have in common and lists of suggestions on how to choose a perfect images for a websites. Therefore for a good web design designers have to see and follow the following to do and not to do lists.

Designers should:

- Use colorful images with high contrast and high quality since they attract people's eye more. Even small product images in e-commerce site which are often used as navigation should be clear.

- Always use images which possess magnetic features like: (Dianne Cyr, 2009)
 - Smiling and attractive faces
 - People looking at the camera
 - Images with sexy bodies (both for women and men)
 - Appetizing food
 - Clear instructions or information ...
 - Captions which describes the identity of the person in the image or information about the object in the image
 - Real attractive people with some imperfections get more attention than stock arts or perfect faces.
 - People look more and longer on attractive people than non-attractive once.
- Present images on the web page which has somewhat related content or main idea that they tries to tell to the users.
- Use images with High contrast between the subject and background. It draw people's attention.
- Consider People's motivation or expectation since it makes even very bad images get looks. For example, one can look on basketball team image, even if it is with low quality, if he/she is interested in Basketball.
- Know that bigger images are preferred over small images. Images should be big enough that users could perceive them and understand their content or message as fast as possible. Instead of much of good things like an assortment of tiny bad images on the page, it is better to use very small number of (1 or 2) good icons.
- Use images with simple background. People like to look at images of an object against a very simple background than the crowded one. They actually spend more time on images with complicated background but we can't say that they were happy during that time. They might be using exhaustive review to try to decipher the image. Therefore using simple background images will be preferable, see figure 8.
- Be careful when using people images. Images incorporating number of people will get more fixations than images with single person. But still these images should be placed on the web page by considering all the above concepts.

Simplicity Wins

Image Attributes	Amount Viewed (Avg.)	Seconds Viewed (Avg.)	Number of Fixations(Avg.)
Single object	26%	2.13	7.74
Multiple objects	20%	1.61	6.33
Simple background	28%	2.05	7.60
Crowded background	14%	2.50	8.19

Figure 8: Background simplicity and user's attention

- Know that it is recommended to use more original images than stock images. Stock images are ignored by the user's 85% of the time.
- Make available some sort of zooming mechanism or some way of presenting more detailed and bigger images of the icons in e-commerce sites and give the name, price and cover information. People may sometimes want to see more detail of the product they are interested in. they are willing to open up large images too.
 - Sometimes the name of the images and the price can be as important as the images itself.
 - Album covers are so important on music sites. They used to identify a specific album, artist, or style of music.

Designers should not:

- Use unclear and low contrast images
- Overly reduce Images rather than cropping them whenever we need them to fit in small places.
- Use very small images. The poyntor's eye tracking research (DR. Pegie Stark Adam, 2007) also confirms that larger image attract the highest percentage of viewers and the longest viewing duration.
- Use more detailed images rather than using more iconic images (which instantly convey what they are) and images which are easier to interpret.
- Make the web page too busy using images
- Include images that look like advertisements otherwise they will be unnoticed. People made erroneous image ignoring (they mistakenly conclude that an image is an ad) in the following cases:
 - If the image deviates greatly from the rest of the site in color and style
 - If it is placed and shaped like an ad (top horizontal banner, long rectangle on the right side).
 - If it has a single color background
 - If it includes a highly formatted text and images in the same box.
 - If it is animated
- Add images to the web page just to fill the white space or to give users a visual break. Users prefer a short page with clear, large text or a single and useful image.
- Ignore all black and white images. Even though color images attracts the eye more than black and white once, very sharp and clear black and white image can get a lot of attention too. But shades of gray have less contrast than shades of colors and they attract eye less than colored once.

On the web people show the following characteristics while they are looking at images.

- People usually distracted and attracted by a photo of good looking, half-naked person. They used to look at the sexual areas of humans in web images.
- People also look at the genital areas of animals, especially dogs. Since they included websites with only dogs, ducks and sharks, it happens to be a dog private area which attracts people's eye. What will happen if websites with other animals like donkey, horse ... included? We never know.
- People seem to be more attracted to blood, skin pointy things and body parts. When a lot of skin or blood is showing, most of the people take a look at it.
- We people in nature are curious about something on which others give attention. If other people are spending time to look at something, we think we have to look at that thing too. On the web too, when someone is looking at something in an image, users look at it too.
- Users also look at photos of healthy and delicious foods.

In related researches, about graphical user interfaces of websites, icons (small graphical images that represent files and commands and are accompanied by labels) are used more frequently. Michael D. Fleetwood and Michael D. Byrne's analysis of the eye-tracking data (Byrne, 2006) revealed that participants made virtually no fixations on icons that they had previously fixated. That means that participants had almost perfect memory for where they had looked. This issue actually creates some debates between researchers. Some researchers have different opinion about whether people have memory for where they have looked in a visual search context. Some of them suggest that participants have no memory for where they have searched, for example (Wolfe, 1998). However, other researchers have found that people do indeed show search patterns that would indicate that they have memory for where they have looked, for example (Byrne, 2006) and (Peterson, 2001).

Maps, explanatory graphics or charts

People also look at images that convey information or process than simple generic images. It is a good idea to use simple informational images to reinforce or further illustrate the text. Remember that sometimes people prefer an image than text especially when the subject is technology. Here are the major findings we have further.

- Poynter's eye tracking research also shows that an overwhelming majority of graphics eye stops online were on weather and traffic maps which are located at top right of home pages of newspaper websites.
- People also look at the maps which are easy to read and understand. Confusing elements are ignored by users.
- Map interfaces should still offer a text alternative for accessibility.
- Maps should have good contrast and labels.
- People are more attracted to real-life images than to hand-drawn ones on the web. But once they look at web illustrations, they look longer and harder at them than at photos.
- Cartoon-like illustration are ignored by adult users
- As the findings of the eye tracking research (Jakob Nielsen, 2010) shows us, there is no need to waste money and space on the web page for clip art illustrations. Instead using custom images that can serve as value-added content for our web page should be used.

Moving Images or animations:

Websites might use animations to get attention, to show a process, to show number of images and messages on one piece of screen space on the web page, for entertainment and to communicate. Animations may be helpful or annoying for users. One should include them if they fulfill the following facts found from the eye tracking study (Jakob Nielsen, 2010).

- If they are instructional animations, people watched them very closely.
- They should be slow, clear and controllable.
- There should not be much text, since it is not possible to read text while watching a demonstration.
- Text which will back up the moving information along with the instructional animation is very helpful too.
- They should be related to the content of the web page.
- Using features like progress indicators are very nice uses of animations on the web. They easily communicate the users that the system is working for them. Including short explanatory text along with the indicators is also a good idea.
 - Do not give messages with animations which will send or urge people away from their main task.
 - Adding a clever and simple delighting element during the waiting process in the progress indicator animation is a smart designer idea. Rewarding information or something fun for the eye can make the wait more pleasant.
- The animation shouldn't be too long and it shouldn't distract people from their task.
- It is preferable to add the play, pause, resume and replay controls to the right or below the animation. Because they are very important elements and people usually check for them on those areas.
- As we already know how much time people will spend to look at non-interesting images, it will not be difficult to guess their reaction for non-interesting videos. People will might just listen to the audio and read the surrounding text without even watching the images in the video.

- The loading time for videos is also critical. People will be very disappointed if they waited long and if they find out that the video is not that much interesting as they were expecting.
- As long as people have selected to watch a show or movie, they will enjoy and pay attention to it, even if it is very small.

There are a lot to be done in the area of web usability and animation and videos. Not only the loading time but also the quality, the size, speed ... of the videos might affect user's satisfaction. The writers of the book (Jakob Nielsen, 2010) mentioned that it was not possible to capture animations and videos in gaze-plot images or heat maps till the time of their publishing. But here in color lab, Raju Shrestha did the summer work (Shrestha, 2009) which will make possible to use eye tracker to record the gaze of viewers of video sequences. Probably using his method and performing eye tracking experiments for web usability of animations and videos will be interesting and easier.

Images in prints:

We find out from the Poynter's study (DR. Pegie Stark Adam, 2007) that image features which catch user's attention in prints are more or less similar with the image features for websites. The quality and contrast of the image, the simplicity of the image and the background should be similar as described above for images on the web.

Sometimes they differ a lot. As we know people's behavior when they read a newspaper and when they visit, for example, e-commerce website can't be the same. There are few large photos on web than on prints. Smaller and clear images are preferable for websites where as large photos catch users attention on prints. Therefore we can't expect similar image features will work for getting people's attention both on prints and online all the time. Here we summarize the important features of images which make people tend to perceive them.

- Large photos attract much more attention on broadsheet and tabloid readers than small and medium sized photos.
- For broadsheet readers color images received much more higher attention than black and white once while for tabloid readers both get as much attention as expected.
- Mug shots get very low fixations. They are almost ignored all the time. But adding an interesting caption can increase the people's interest.
- Images of real events occurring in real time drew more attention than staged photos.
- In newspapers cutlines are read by users as the captions or legends on websites. Those cutlines that accompanied photos appearing as part of a lead story package or a regular story package were more likely to be seen than cutlines of photos for standard stories.
- Explanatory graphics like maps and charts drew lots of attention in prints. But charts drew less than expected attention where as maps and illustrations get lots of attention from user, more than expected, on both broadsheets and tabloids.
- Listings which include obituaries, sports and business agates, horoscopes, puzzles and games receive very low visual attention. But among them obituaries drew the most eye stops in broadsheets, while sports agate generated the most eye stops in tabloids and online.

Advertisements:

Advertisements are becoming important parts of our visual world these days. Organizations want their advertisements to be effective that their potential customers should get the ads interesting and should spend time looking at them. These positive evaluation and stable memory is expected to be transformed in to positive attitude towards their products and many purchase decisions (J.Hyönä, 2003). Therefore one should consider important features of advertisements for such success when he/she design a website, newspapers or magazine ads.

Meng Zhang studies the importance of design psychology for designing of advertisements (Zhang, 2009). This report mentioned that the introduction of design psychology provides a new thinking for the information transmission and internal structure of Ads design. A good ads design should conform to people's physical and psychological structure, effectively convey the message, and satisfy the

audiences to a maximum extent when they obtain information, to achieve very efficient purpose. It also shows that design psychology provides a new way of art and design. Meng Zhang finally suggested that any design should meet the needs of social developments since it will be constantly challenged with the development of human society. Therefore continues human-ad interaction studies should be done.

Studies using eye movement to study the processing of ads appeared since the 1960. Ralph Radach et al (J.Hyönä, 2003) summarize the major eye movement researches till 2003. The compilation of these eye tracking studies for advertising research are given in table 1. In this table aspects of eye movements are termed as amount of attention.

Table 1: Eye tracking studies in advertisement research

Reference	Factors examined	Aspects of Eye movement that were analyzed
(Robinson, 1963)	Ad size	Amount of attention per ad and number of saccades between ad quadrants
(Starch, 1966)	No factor is examined	Amount of attention per ad
(Krugman, 1968)	Repetition	Number of 1 x 1 inch ad element that are fixated
(Treistman, 1979)	No factor is examined	Amount of attention per ad element
(Kroeber-Riel, 1979)	Erotic illustration	Number of eye fixation per ad element
(Staelin, 1983)	Ad structures	Amount of attention per ad element
(Young, 1984)	Size and clutter	Looked at outdoor board, product advertised and copy or not and number of fixations per ad
(Bogart, 1983)	No factor is examined	Number of fixations per ad
(Janiszewski, 1993)	Length of copy	Amount of attention per ad element
Warlap and (Janiszewski W. , 1993)	Conditioning	Order of fixation on soda brands
Krugman (al, 1994)	Type of warning	Amount of attention to the warning and time to first fixation on the warning
(Lohse,1997)	Color, size and position	Amount and order of attention to ads

Advertisements on the web:

Some advertisements on the web are created for the main purpose of getting clicks. Others are meant to inform a message. Still some are simple reminders that a certain company or product exists. It might be for buying something, remember something or learn something new. In general, we all know that all ads are a call to action.

Determining the moment and the way people look at advertisements on the web and what features of advertisements attract their attention is very crucial for advertisement industry. Eye tracking research will help a lot for such tasks. There have been number of eye tracking researches done for identifying important features which will make one ad to be successful for its intended purpose.

All the content, the appearance and the placement of ads on web are very important for drawing user's attention. According to Jakob Nielsen's and Kara Pernice's results (Jakob Nielsen, 2010), during their search for either some specific information or for shopping on web, people tend to look at ads that seems helpful at the moment they encounter them. People look at only 36% of the ads on the web. But they don't even give them longer time and fixation. They only spend one-third of a second and 1.5 fixations which is not long enough to convey a complex marketing idea. It is like a survival technique, saving time by ignoring unhelpful ads. The percentages of ads that people look at and the number of

fixations that people spend on them differ a little when they are doing specific task (34%, 1.44) and when they are just browsing(39%, 1.56).

And also, people look at ads more when they are doing e-commerce tasks than when they are doing other types of tasks or browsing. People who are shopping usually read sponsored links even people who do not need suggestion for their products look at text ads. Tasks usually have very little effect on how much people look at ads specifically but they affect how people look at the whole web page.

People tend to look longer at ads which can give them something important in less than a second and a couple of fixations. The percentages of ads that people looking at depend on the types of the ads, see figure 9 and 10.

- 88% of ads that match the style of the site get people’s attention. Because they look much like other features in the page, people may think of them as helpful internal promotion or navigations.
- 52% of text ads looked by people, because people think they get quick information from them without hard work.
- 52% of graphical ads with separate images and text get peoples fixations. In this case, the images drew the people’s eye and the corresponding text on a plain colored background is another draw.
- 51% Sponsored links on Search pages including those on the top and on the right of the page looked by users since they expect that they might be related with their queries and for some inexperienced users they might look like organic links.
- Only 35% of graphical ads with the text which is not separated from the image perceived by the people. Text on any pattern or complex background is more difficult to read and it is less attractive to users.
- Since people have been annoyed by animated ads in the past, they are now tired of them. Only 29% of animated ads are actually looked by people.

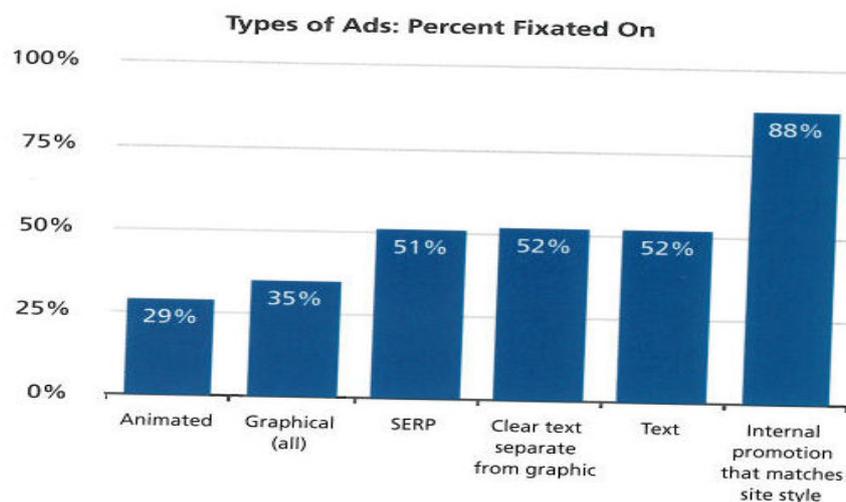


Figure 9: People’s attention for different types of ads in percentile

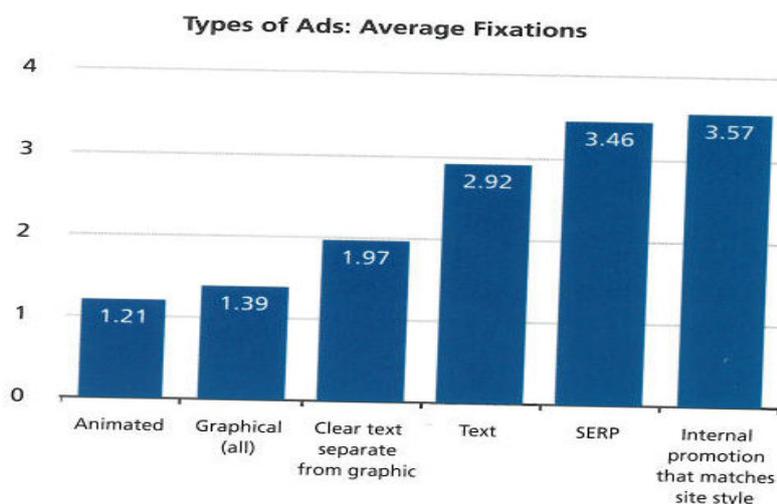


Figure 10: People's average fixations for different types of ads

Here we list some important tips we get from (Jakob Nielsen, 2010) eye tracking research. These points will give web designers a good way of designing and placing different types of ads on their websites.

Designers should not:

- Place ads at the top of the pages, instead place it on the right of the page. People look for longer time at more number of graphical ads without texts on the right than graphical ads without text on the top of the page.
 - People ignore banners at the top of the pages than those at the right of the page. This banner blindness might be one of the reasons for people's longer fixation on right side graphical ads.
 - The right area of the page sometimes includes related and important contents. Therefore, people usually expect user interface elements and look at there.
 - The right rail area is always closer for users than the top rail area. For example, if the user focuses at the bottom of the page.
- Place ads on the pages where users are focused for other purposes. Ads on the page, especially home pages, where users are narrowly focused on a graphical user interface widgets such as search box are useless. No user is going to see them.
- Use unrelated and useless ads for users. When users look at an ad that they expected to be helpful but they immediately find out that it is not, they feel like they are being tricked. And they will move on to something else and they don't look the area again ever. They called (Jakob Nielsen, 2010) this behavior of people as hot potato.
- Separate external ads more clearly. External ads which are ads for unrelated organizations, products or services should not much the style and color plates of the website. If they match in style users might expect something and will be disappointed when they get something else. Usually, people look for something that does not look like the rest of the website contents when they need to see external ads.
- Give images high places than texts. Since texts are more powerful in ads, designers should give attractive images equal or less space than texts and images should be adjacent to the text, not background for it, during graphical ads design.
- Use not working user interface (UI) in ads. People are attracted to user interface elements like open fields and drop down lists even in the ads but tricking people by malfunctioning UI elements is not a good idea.

- Think that all animation ads are not useful. As far as it includes clear, simple texts with simple background and images separated from the texts, animated ads also get attention from the users. It might not be as long as or as much as other ad types but it gets comparable fixations when it includes those important features we described above for graphical and text ads.

Designers should:

- Place sponsored ads at the top of the page. People look at sponsored ads at the top more than those on the right. They usually checked sponsored links that appeared first on the page before the search results. Some of the reasons why text ads or sponsored links are more attractive for users than the other types of ads include:
 - Sponsored links are text and texts are generally easier to register than graphical ads.
 - Their content is much related to the subject people are looking for.
 - Their design is very simple and placed on the white background. It makes them easier to scan and read.
 - They don't compete with the message of the web page. They are all formatted similarly.
 - Users look at sponsored links on the non search engine pages, because they know that they are relevant and related to page content, from their experience.
 - The authors (Jakob Nielsen, 2010) strongly recommend and witnessed the effectiveness of sponsored links with SERPs and non-SERPs.
- Place ads in relation to the other content of the page. Since all elements, in a page, compete each other, ads placement in relation to other contents in the page is very important. Advertisers, marketing professionals, and web designers should figure out the way to place the ad so that it will work with the other elements of the web page.
- Place their ads on a page with content that interests users or helps them get a task done but doesn't monopolize their attention. The Poynter's (DR. Pegie Stark Adam, 2007) result also shows the closeness of the ads to the popular editorial content increases the number of fixations.
- Know that sometimes people look at ads that appear in an area where they were expecting to see something else. They (Jakob Nielsen, 2010) called this phenomenon reverse banner blindness.
- Design internal ads using similar color scheme, typeface and over all style with website. It is also good to place the ads within the page boarder, not as the very top or far right of the page.
- Know the three criteria. In the (Jakob Nielsen, 2010) book, they give one good way of assessing once promotion for lookability. First, the designer will need to give one point for his/her ads if they meet the following three criteria.
 - It is static
 - It includes just plain text on a plain background or it matches the site's style
 - It is "above the fold"

Then the higher the score is the more likely the promotion will get looked at.

- Use images with magnetic properties. All those magnetic properties which attract user's eye mentioned above for images also works here for graphical ads too. Features like, more faces than the rest of people's body, more visible skin colors, smiling face, close-up faces looking to the camera ... are useful to draw users to ads.
- Use screen shots for software ads. They offer better explanation than text about the particular software product.

- Use the moment of page loading. Most of the time users look at animations as a page loads because only the first page of the ad has appeared and has not yet animated. Designers can use this opportunity for making their ads to get user’s attention.
- Use static ads most of the time. According to Poynter’s study (DR. Pegie Stark Adam, 2007), banner ads and small ads get higher user attention than Display ads. The worst types of ads were wallpaper ads. They get only 2% of the eye stops on ads. Introducing moving or animated elements in all those ads decreases users attention except for horizontal banner ads located below the navigation bar (increases from 21% to 68%), see figure 11.

AD TYPE	Stationary ad eye stops	Rotating/moving ads eye stops
Number of Eye Stops	1,777	670
Horizontal banner ad below navigation bar	21%	68%
Vertical banner ad	5%	2%
Display ad	25%	23%
Small ad	50%	8%

Figure 11: Percentages of online eye stops on ads by type and motion

We also find out from Mariea and May’s work (LWIN, 2007) that 11% of adults found banner ads “useful.” Banner ads were viewed more than popup (4%) and comparable to e-mail (10%) but not as useful as “key word web page links” at 26% (Simmons, 2004). They also show that banner ads are not viewed as irritating Website features and their exposure significantly increases the purchase likelihood for current customers (Manchanda, 2006).

Advertisements and main contents should be presented for a user in a scientific way, in a way that both can achieve their intended purpose. To do that, web designers should give time and should carefully plan the way and the position of ad’s placement. Website users can be satisfied by a particular website which includes both ads and contents as long as the ads and the content placed accordingly. If the ads look like ads and contents look like contents, people will function happily.

These days’ websites include multimedia presentation of information beyond static text. Websites often include radio and television commercials, sound, animation, and screen changes. It is very interesting, useful and up-to-date idea to conduct eye tracking research for such ads using video gaze map.

Print Advertisements:

According to Poynter’s eye tracking research (DR. Pegie Stark Adam, 2007), viewing of advertising in both broadsheet and tabloids was remarkably high. The color the size, the position of the ad affects its observance by the newspapers readers, just like the ads on the web.

The ads on print and online differ a lot in nature. Almost all ads online are in color, some are animated, some has drop down listings, and full page ads don’t exist on the web. It is obvious that one can’t include animation ads in newspapers or magazines. Therefore the nature of the technology itself is one factor for the differences between online and print ads.

The following are the main and important features of advertisements in the newspapers which will draw user’s eye and attention.

- Ads with a size smaller than a quarter of a page were viewed less than those of larger sized ads in both tabloids and broadsheets.
- The ads covering a half page and to almost full-page attracted the same attention as full-page ads. It has big impact on price. Since full and half page ads have almost equal attention from the users, there will be no need to pay for full page advertisement.
- Ads presented along with editorial content on the page have higher and longer fixations than full-page ads.
- The closeness of the ads to the popular editorial content increases the possibility of user's attraction for it.
- Ads in color drew 2 or 3 times as much than black and white ads. There is also a price issue here. One should compromise between the price for color print and the advantage he/she will get because of higher user's attention.

Which page will be good for ads to get more attention from people, front pages or the others? For print advertisement, once we determine the page, then the location in that page will be the next question. At the middle, left, right... which one? (Lohse, 1997) Research on yellow page ads, shows ads at the end of a page nearly never looked at because people scan a page from top to bottom in some kind of order. Detailed position investigation should be done for wide range of newspapers and magazines.

Keir and Duffy (Keir, 2001) also tried to see how different goals of magazine visitors may influence the visual processing devoted to different aspects of an advertisement. They show that subjects spend more time on text elements than graphical elements of the ads. Viewers tend to read text first in the ads. People also focus on the ads which have content more related with their goal. Detail eye tracking research need to be done for prints just like eye tracking research of Web ads by Jakob and Kara (Jakob Nielsen, 2010). Almost all types of print industries like newspapers, magazines, journals, yellow pages ... and almost all features of ads like position, content, size... should be covered.

In the Poyntor's study (DR. Pegie Stark Adam, 2007) and the others eye tracking studies we described so far, most of the work have been done on topic of eye movement and ad processing in the initial selection and early processing phases. They mainly focused on the design features (size, color ...) of the ads and question like how to attract customer's attention. But Ralph Radach et al (J.Hyönä, 2003), performs eye tracking research which more focuses on the customers decision in favor of long term processing of the ads and analyzed whether customers acquire and understand the information presented in the ads.

They categorize the advertisements in to two. Explicit ads: when they represent the target product directly with a related headlines and Implicit ads: when they include pictures and texts neither of which are directly related to the product. The implicit once will be more complex to understand for users. Advertisements which pose an intellectual challenge will take more time to understand but may be liked and remembered by users. Some think that ads should be clear and straight forward. Which of these ads are more effective?

Ralph Radach (J.Hyönä, 2003) results shows that implicit advertisements were more likable by users that means they are more effective economically since likability is a very powerful predictor of sales behavior (A.L., 1998). They show that their participants spend more significant time to process implicit ads than explicit once. They spend higher mental effort to process the information presented in the implicit ads. The implicit type of ads also rated to be more interesting once. Having these all results one can conclude that implicit print ads are more effective than explicit print ads.

They also analyze a variation in task with a region of interest in the ads. They find out that the task has high consequences for the distribution of viewing time and fixation position. People give longer fixation time for regions which relate to their task. For the tasks which are sort of evaluations people fixate more on the pictures where as brand names gets the lowest fixation and therefore it is irrelevant

for evaluation tasks. In the case of tasks which are more of paraphrasing, the number of fixations on headlines, pictures and brand names was almost equal. They show that there were processing time advantage for implicit ads for all regions of interest in both tasks.

Katrien Wijnen, Véronique Couvreur and Geert Van Boxem conducted an eye tracking experiment on magazine ads (Katrien Wijnen, 2008) with 131 participants and only 5 ads. They measure the impact or the stopping power (The extent to which ads can grab the attention of the reader) of the ads and the attention paths (the extent to which the ad can draw the reader's gaze towards its most relevant elements). They also perform a subjective evaluation of the ads by consumers and compute rating purchase intention, likeability, credibility, etc. these all together will give a deeper understanding of the psychological impact of the advertisements. They find out the following key findings from their experiment.

- Key visuals were focused on by more than 90% of participants
- The headlines were read by ¾ of the people.
- Logos contrasting in the other color in the ads get low (34%) percentage of viewers.
- Participants shows top down reading pattern starting from key visuals, then headlines and finally to explanations and logos.
- The ad which tells something new obtains a rather moderate score (50%-100%).
- The ads with entertainment aspect are also get good scores from participants (66%-100%).

People's Reading Behavior in Newspapers

A number of eye tracking experiments which are done by the Poynter Institute (DR. Pegie Stark Adam, 2007) show us number of behaviors of people while they were reading news online and on printed newspapers. Similar to the differences, we have seen above, between web and print image feature and advertisement features, people's reading manner on web and prints also differs a lot. The study shows how deep people read on web and on prints. They also analyzed people's reading pattern and sequence. We here summarized their findings as follows:

- Color makes a difference in eye movement. It specially plays an important role in life style or feature pages than on news pages.
- Color background moved the reader to the desired spot on the page
- Readers entered the printed page, if it has the largest image on the page
- Most of the readers first check the headlines before they read the text
- Captions under photos are the next commonly visited parts of the page
- Web readers enter the page through text unlike newspaper readers. When one reads online, they are more concentrated on the text just like reading a book.
- They also show that on the web, readers navigates home pages by starting at the upper left and staying there for a while before they moved to other parts of the page. Texts are the most important entry points than photos and short paragraphs read more number of times than longer once on websites.
- Online readers are impatient, they scan a lot but they will read a story which interests them. Large pictures control their eye movements but the most important thing is the attractiveness of the content. If it is so attractive and compelling, then the reader will read in more depth. Finding the right content makes the difference. Content also shouldn't be repetitive. It should be different and relevant and brief. Reading decreases as story length increases.
- Online one can update reports in time but prints should concentrate on the good story which creates the experience.
- Print readers are more methodical readers, they read top to bottom, while online readers are half scanners, they view headlines and other display elements without reading much text, and half methodical. That might be because of the structure of the news website itself encourages readers to scan. The more hierarchical way of presenting the news with headline size and packaging in prints than in websites

clearly will direct readers to the most important part of the editors and this will encourage methodical reading.

- But once they choose the story to read, online readers (both methodical and scanners) read equal amount of text where as methodical broadsheet readers (65%) read more text than scanner broadsheet readers (57%). In the case of tabloid readers methodical readers read 66% of the text while the scanners read only 45% of the text.
- Headlines and photos are first impressing features for print readers but for online readers' navigation are the first. Broadsheet readers entered the front page through headlines then photos come next. Tabloid readers entered through pictures then look to directionals like teasers. And online readers entered the home page through navigation bars, story lists and teasers then graphics (weather and traffic reports) were their second popular entry point.
- Therefore enhancing navigation elements with rollover story headlines which provide more content in them will attract and engage readers.
- Online news readers read in depth. They read more text, once they choose the story, than broadsheet and tabloid readers. This might be because of user's focus on their task during their visit to news websites. They are so interested and concentrated to find the desired content. Other reason can be the absence of jump texts on news websites. Story contents are available with their entirety without a jump.
- Considering only print readers, broadsheet reads read more text than tabloid readers.
- Once a participant selected a jump text to read on prints, more than half of the jump text was read. More tabloid jump texts (68%) were read compared with broadsheet jump texts (59%).
- For Printed newspapers, including interesting quotes, photos, subheads, graphics ... in the story pages will give readers more information and keep them engaged. One should think carefully how to place these elements in order not loss people's interest in reading.
- Headlines online should be direct, keyword-searchable and creative to be found by a scanning reader.

This study was actually conducted only for 15 minutes per each participant. People actually spend more than 15 minutes to read newspapers. Will their behavior remain constant after wards or will they be scanners like online readers?

Also reading the Sunday paper and reading the weekday papers are two different things. People reading habit during work days might not be the same like their reading habit in weekends. In weekends people will be more relaxed and have more time to read than in workdays. This research is only done for weekday papers. Will people read more deep during weekends? This should be investigated more.

What type of content is that people more attracted for? Is it puzzles, games, sport, business, entertainment or politics? Looking into these types of issues, watching which fields of news get more looks will be interesting. There is no much eye tracking experiment done in this area. It will be a good idea to see what type of content participants chose to read. Will it be the same when it is online and on prints? Will it be the same for females and males, for young peoples and old once?

Here we are watching users doing specific task like reading news. They also cover only 4 newspaper companies. Different newspaper companies will follow different style of design. As the design changes the way people look at the newspaper also changes. People also sometimes read newspapers just to see ads or to check out some images. People reading magazine also has different purpose than those who read newspapers. Therefore it is hard to relay on the findings of these study for whole print industry. They are only for these 4 newspapers. Therefore conducting very big and wide eye tracking experiment for prints including different types of newspapers and magazines will not be a bad idea.

User's behavior with websites and printed documents

Neilsen and Pernice studied the user's viewing behavior on the web in depth with the help of eye tracking technology (Jakob Nielsen, 2010). Examining user's behavior or understanding how people view our website will help us to design it accordingly. The more we can predict their behavior the better our design will be.

They mentioned that people only click on the things that they looked at. People's eye attraction precedes getting people's click. In order to get click on particular link, first we need to attract people's attention towards that position.

This study also shows that, people used to leave the web page or look harder if they can't find the information they want. The website should have easy and attractive design in order to motivate users to dig in to it and stay there for the information they want. If the website is not attractive they will leave immediately. They might sometimes stay on bad web pages. The following reasons might motivate them to stay.

- A friend advice: their friends might refer them towards the website they like or trust
- A referral from Google search page: Google search results promises users the answer
- A website with a good reputation
- A credible- sounding site
- A need to get information from specific site. For example, to get a product from a certified agency or a particular company.

People might look at an area of a page again and again. This looking and re-looking of particular areas, links or menus is called exhaustive review. People's exhaustive review in one web page indicates the poor design and not good layout of that page. The page might be disorganized or very crowded. Eye tracking experiment is very helpful for finding out whether people review a particular web page exhaustively.

People also might look for longer time and over and over again on one particular area because they are interested and taking a pleasure. This voluntarily and happily extended looking is referred as desired exploration. Desired exploration indicates that the person likes the content and he/she is enjoying himself/herself on the site.

Sometimes, people can stay on a web page without enjoying the exploration but it is still productive. This obligatory and acceptable looks are called necessary review. Sometimes, for people to understand and engage with a feature, they just need to look at it more. It is predictable and tolerable. We can't identify the user's view as exhaustive, desired or necessary just by using eye tracking data. We need to know user's motivation and goals.

If the information in one website is complicated the user might be forced to read the same information over and over again. This reading or looking the same thing repeatedly is called repeated review. It is different from exhaustive review. Exhaustive review is when the user look at many different things many times. There will be a number of repeated reviews during exhaustive review. Repeated review can also occur as stand-alone behavior. If people reread letters or words it is some sort of regression. Regression is a well known eye behavior and it indicates that that word or writing was confusing.

The study also shows that the complicated concepts or complicated pages made the users to retreat to the elements they understand which will led them to miss important ideas and draw erroneous conclusions. People might make incorrect conclusions for two reasons.

- When the correct information is not attractive, not believable and understandable
- When the wrong information is more attractive, simple and more attention-grabbing

Momentum behavior is a behavior users' show when they look at but do not choose an option that could help them because they have already selected a course and are sticking to it. They will become loyal to the way they have already chosen. The book mentioned two reasons why this Momentum behavior happens.

- If the part of the interface (name, style or placement) are not strong enough to attract users when they need them
- People always follow an inferior path just to get their task done. They do not care to follow the most direct route. They think that to find the better route might be difficult and will take them long time to try. People stick to their inefficient methods for doing tasks throughout their entire session at a site and possibly every time they use a particular site.

When people see something important but don't act on it immediately and having it in mind for future reference they call it logging. They are probably doing something else by that time but they still have in their mind that this important command is another possible way to complete their task. If they do get caught up, they can change their direction if the new way is simple and straightforward enough. When they return to the new option they have, we can say that they logged away.

Other very important user's behavior mentioned in this book is selective disregard. It is much related with selective attention. It is a phenomenon in which people pay attention only to the things that are currently important to them. Their eye tracking data shows that people also do not look at the things that they don't think they need at the time. They give four reasons for this people's behavior.

- Once they used the element, they will know that it is there and they will not look at it again
- They might be confident with the website's layout and they will ignore elements they don't need right then.
- Having in mind the specific design of the current site, they then expect the element to appear in certain place and will ignore it by the time they don't need it.
- People will decide just by rough appearance of elements when perceived through peripheral vision or by its location. If they don't consider it as useful element then they will ignore it.

Therefore, when people do not look at an area of a Web page, it may not only be the design problem. It might be selective disregard. They might have already looked at the area or seen something like it and purposely decided not to waste fixations on it.

In their eye tracking experiment they noted that the users viewing behavior after they selected one link can show the users confidence on it. Once they selected the link which they are confident enough with, they will wait the page to load by watching around at other elements of the page they are on. If they click on the link which they are not confident about, they will continue to look at the same link while they wait the next page to load and this process is called post-click verification. The authors of the book consider post-click verifications of menu items as regression and somewhat negative behavior.

People also have post-click looking behavior. They will look on parts of a page after making a selection. This is very important since users' used to notice some things during this moment, things they never give attention during their active use of the web page. This moment can be used for promotions and display important messages.

Sometimes people will look constantly at the browser while they are working. This can be referred as perpetual viewing. They might look at the URL, the blank pages or the browser buttons, even sometimes away from the monitor. Most of the times they tend to focus on what is in front of them. They are impatient too. They can't stay focus on useless parts of the pages. They don't even wait for the whole page to load. As the interface elements of the page appear on the screen, they look at them instead of waiting till the whole page finished loading.

Designers should also not that the first one or two fixations on a page as it loads are residual looks. They are based on where they were looking on the previous page. They do not indicate that the person is interested on that area. They are less important to be considered. But they can be useful to place some things users would want from the previous page in the same location in the loading page.

EyeTrack07 research on online and print newspapers, (DR. Pegie Stark Adam, 2007) also shows that the online readers read for shorter duration than print readers. Most percent of their participants said that they spend about 15-30 minutes for reading online newspapers where as they spend 30 – 45 minutes for printed newspaper reading. Not only the duration but the number of times they visit the printed and online newspapers also differ. Most of their participants report that they visit the printed newspaper 2 three times per day where as online readers only visit news site just once per day.

This research also shows the user preferred sections in both printed and online newspapers. Print participants most frequently prefer to read local news and main news sections. Business sections are the sections on prints that have less number of readers. On the other hand breaking local news are the most popular sections for online readers. Checking the weather is the second popular activity of online readers.

Their eye tracking findings and their participants responses for the questionnaires proves the “skim and dive” reading behavior of online readers. These readers just scan the home page and they will read in-depth, only the subject they are interested in. The print news readers also first look at front page headlines of the A section and read articles that interests them. Also half of the participants for a print reading said that they usually look at the advertisements, even though, they don't think that they will get important information from them.

Women and Men

Jakob Niensens's and Kara Pernice's book of eye tracking experiment for web usability (Jakob Nielsen, 2010) also covers the gender differences when people look at people's images. They tried to see whether the way men and women look at people's faces on the web differs or not? They found out that men and women have the same fixations for ordinary images. Their way of looking differs for sexier images. Female users focused on their task rather than looking on sexier ladies and look only at related items whereas male users sometimes deviate from their task and give more fixations to the faces of the male model.

Other important observations found in this study include:

- Images of women gets more look than images of men. People spend 21% more time looking at images of women than of men.
- During performing some kind of task on the web, men users tend to look at sexual body parts, of both men and women, more than women do. It actually did not affect their task success rate or timing.
- Men look at women's faces more than women do and more than they see on male's faces.
- Women look at men's faces more than men do and more than they see on female's faces.
- Men look at female's body more than females look at male's body.

In contrary, Hae Won Ju's and Kim K. P. Johnson's (Johnson, 2010) Eye Tracking experiment for fashion advertisements show that the model was a more important element in processing the fashion advertisement than the other components of the advertisement like headline, product,... there experiment was conducted with 80 college women who were enrolled in retail merchandising classes, Sixteen advertisements with models which were drawn from issues of Elle, Cosmopolitan, Vogue, Harper's Bazaar, and Lucky magazines published between 2006 and 2008. The highest fixations from those women were on the models rather than the other parts of the advertisements. This finding suggests that of the advertising elements investigated, the model had the greatest potential to be an influence on the young women.

This contradicts from the above findings of Jakob Niensens's and Kara Pernice's. The contradiction might be the result of the difference of participants. In Jakob Niensens's and Kara Pernice's work the participants were in the age range from 18 to 60 where as Hae Won Ju's and Kim K. P. Johnson's work the participants were young women with the high test in fashion and in the age range from 18 to 30. Young women who usually read fashion magazines like that have a higher tendency of comparing themselves with the models. That might be because they have low self esteem (Martin, 1993), a tendency to make appearance comparisons (McGill, 2004) or internalized the thin ideal (Durkin, 2007). Women with these three behaviors are discovered to perform social comparisons in the mentioned literatures. On the other hand, women participants for Jakob Niensens's and Kara Pernice's experiment might have been more self confident and those who do not internalize the thin ideal.

EyeTrack07 research on newspapers reported that among their participants men were looking for sport scores much more than women. Women were more likely than men to visit sites for breaking news, national and international story, entertainment news and nightlife.

Gender differences in perceptual processing also had been reported by Jones, Stanaland, and Gelb (Jones, 1998). They found out that males and females reacted differently to images, which in turn affected subsequent memory performance. In addition, Meyers-Levy and Maheswarm demonstrated that males and females differ with respect to selection processes (Meyers-Levy, 1991). They show that females often engage in comprehensive processing of all the available information, while males tend to focus their attention on a fewer number of areas other than important once. Qian Li, Linyan Sun and Jiyang Duan's research results also demonstrated that there is a significant difference between females and males on fixation duration (Qian Li, 2005). They result showed that females exhibited significantly longer mean fixation durations than males. This can be good evidence that females tend to do more cognitive effort than males when scanning the web pages.

Children and Over 60's

Internet for Children:

Not only adults, children's preference can also be influenced by ads. For example, if one child saw a picture of Spiderman drinking Pepsi, then there will be high probability that he/she will order Pepsi for a drink in restaurants. Therefore, children's ability to identify advertisements and their ability to understand advertisements both on web and prints is very important. There is no much work done in this area these days.

Moondore Ali et al. studies children's ability to identify web ads (Moondore Ali, 2009). They found an age related increase in children's ability to identify the advertisements. The 6-year-olds distinguished about one-third of the advertisements, 8-year-olds distinguished about half, and the 10- and 12-year-olds distinguished about three quarters. They also refer number of works done by different researchers which shows that children can distinguish television ads perfectly at the age of 5 but even 12 years old children can't distinguish web ads 100%. This might be because there are fewer distinct cues that can be used to identify a web advertisement. Web advertisements are just part of a web page, and the advertisement may include images and text styles that are not very different from the ones that make up the rest of the page (Fielder, 2008). One of the guidelines for web ads, which is using similar style as the rest of the page might not work for children. Also in Moondore Ali et al. experiment they only consider one cue which is the presence of price. Children will assume one image or content as ad if it has a price related with it. There are other cues that children might use to identify web ads like animations. They should be studied in more detail with the help of eye tracking technology.

One might think that older adults (55-60 years old) will be less proficient than younger adults and teenagers and perhaps even children at searching for information on Web pages, Based on everyday experience and the results of numerous research studies. The reasons for that include the following.

- Older people generally use less imagery in processing information than younger people
- They experience an age-related decrease in the ability to process complex pictorial information
- They gradually undergo a reduction in the useful field of view
- They often report difficulties with situations involving visual distracters or visual clutter, and
- They are less able to distribute attention and use a spotlight or serial scanning mechanism, while younger people seem capable of distributing attention from the foveal region using a parallel mechanism.

And also one might think that children will be less proficient than teenagers or younger adults at searching for information on Web pages for the following reasons.

- Children's eye-movement patterns often bear little resemblance to the visual stimuli
- Children are less likely than adults to fixate the most informative portions of visuals, and
- Young children exhibit longer fixation times and longer fixation latencies.

Sheree Josephson and Michael E. Holmes performs eye tracking experiment in order to prove the above speculations (Sheree Josephson, 2004). They found out that older adults who are devoted Internet users are able to rapidly and accurately find information, while children who have never known a world without the Web don't behave all that much differently from teens or adults of various ages. They show that age is not a determining factor for eye-path difference during information search on the web.

EyeTrack07 research on newspapers (DR. Pegie Stark Adam, 2007) also shows that younger readers were checking weather information more frequently than older print and online news readers. Older peoples prefer to cite reading a columnist. Neilsen and Pernice, in their book (Jakob Neilsen, 2010), also suggest that the text and images in childrens site should make difficult information easy to understand. They also show that Cartoons don't get any looks from adult users.

Internet for Over 60's:

These days, the internet using habit of people with age over 60's is negative. They didn't use or enjoy internet and some other technologies like young people do. That is not because they don't like internet or other computer technologies. In our opinion, they need internet more than adults need it. They are the once can't walk as they want and need something to communicate to the rest of the world from their room, they are the once sit in their room all day and need something to spend their time with ... Internet will be very helpful to make their life enjoyable.

There are so many reasons for their disconnection from the internet world. (Anna Dickinson, 2005) One of the fundamental problems is inappropriate interface designs. Older people find internet interface designs difficult to use than young adults. Their insignificant experience with computers also has its own impact.

Therefore it is very important to find solution for these technological exclusions by searching effective way to include older adults in to the internet world. (Anna Dickinson, 2005) This work demonstrated that Cybrarian, their special designed system for e-mail only, was significantly more usable by older people than an industry standard one and these shows that it is possible to develop appropriate system for many of older people who perceive internet as 'alien'. These specialized systems should be different from the usual once in many ways, including a simplified interface, reduced clutter on the screen, reduction of terminology, clear and simple navigation paths, and a particular type of 'help'. These kinds of systems will develop confidence in older people and encourage them for further exploration.

In the book of Nielsen and Pernice (Jakob Neilsen, 2010), it is mentioned that people older than 65 shake while they hold the mouse or they squeeze the mouse harder. They make a click on the item that they want after several tries most of the time. Therefore, poor contrast between the text and the background, text on the background images, tiny text and flowery typefaces will also make them work harder even to just read the content on the page. For that reason they might forced to lean into the screen and stay like that for long periods of time. This will bring them eye and back problems.

Several researches also demonstrates that older adults are likely to encounter difficulties to internet use in terms of vision (Carmichael, 1999); (Hawthorn, 2000), cognition (Czaja, 2003); (Salthouse, 1996); (May, 1999) and manual dexterity (Ranganathan, 2001); (Chaparro, 1999). Based on these findings (Anna Dickinson, 2005) the group gave the following guidelines of interface designing for such type of users.

Level of functionality:

- Only essential functionality for a working email system to be included.
- Each screen to have a very clear primary function.
- The number of actions / buttons per screen kept to a minimum (fewer than 10)

Accessibility:

- Larger than average clickable targets (32 and 26 pt size recommended).
- Larger than average fonts (14 point as a minimum).
- High contrast choice of colors for text and background.
- Accessibility features compatible with the W3C guidelines.

User interface paradigms:

- Simple and very consistent select and operate paradigms.
- Clear conventions for the positions of buttons and information.
- No new or poorly established interface paradigms which were unlikely to be understood by the user group.
- Avoid scroll bars if possible, and definitely do not use nested scroll bars.

Terminology:

- Terminology which was understandable by the user group.

Personalization:

- Some personalization to allow for people with poor eye sight or dexterity, for example the ability to easily increase text size.

More work is needed to identify what the most important parameters are needed to attract Older people to the technology. These all works have been done without the help of eye tracking technologies. One can do a detail analysis and try to figure out how these people perceive the internet, which elements make the internet very hard to them, and what should have been done to avoid these complexities using eye tracking experiments.

Print vs. Web

Eye tracking researches for print and websites have been conducted for long time and we believe still there will be number of researches going on. In this survey we tried to cover as much as possible works done in this area. Since printed documents and websites are two different things, one might expect that the findings of the eye tracking researches on them will also vary a lot. But we understand that they have a lot in common. Of course there were some completely opposite users behaviors on their web visit and print reading. In this section we discuss those similar and different findings.

People's behavior itself differs when they read online and on prints. The environment they are reading in and the nature of the technology has its own influence for the people's behavioral differences for print and online reading. Usually, people check websites while they are in office, in the middle of work and at home. In contrary people used to read newspapers or magazines during their leisure time, in weekends, in the morning on the way to office ... People are more relaxed when they are reading printed documents than websites. During reading websites the brightness of the screen might make their eye to be tired or they might not feel comfortable with the screen resolution or some other reasons. People do not read for long time online, they are always in the hurry.

We observe that the information available on the website or a print was much more mixed up. There are usually unrelated advertisements with the main purpose of the website or the print. There are different types of information in different format. For that reason the way people look at the web page or print layout differs a lot. People have the same unpredictable behavior while they navigate the web page and print pages. But as we already mentioned some researches show that the way people inter to a web page or newspapers differs. People first look for images on printed newspapers where as they look on navigation bars and other texts on the top left corner first when they visit a web page. But it all depends on the layout and content of the pages.

There are also images both in prints and online and they are a powerful part of them. In both cases images has a high power to influence user's satisfaction and attraction towards the page. Therefore web designers and print designers should give more thinking while choosing images for their pages. There are some differences in images features which will attract user's attention in print and online. Among them size of the image and the color of the image are included. We noted that on print very

smaller and black and white images are more common than websites. But still black and white images can transfer the necessary information for users in both Medias as far as their contrast is high. It is well known that colored images has higher contrast than black and white images. Print industries probably need to perform cost analysis having in mind both the expense of using colored images and the profit which can be achieved by using colored images but for web designers color is not a problem. Most of the features for Maps, explanatory graphics or charts are very similar for both prints and websites. One important difference here can be the chart puzzles and similar things are very popular among print readers where as they always been ignored by web users. In general, the similarity we got between the print image features and web image features which attracts user's fixations is much higher than their differences. The most important thing is that in both cases images considered to be good images if they explain a concept, invoke and express a feeling, transfer information faster than words and make peoples experience with the page more appealing. Otherwise, they will be total wastage of user's power, time and the owner's space and money.

Advertisements on web and print are more similar to each other. The way people attracted and interpret ads on websites and prints is almost the same. The color the size, the position of the ad affects its observance by the print readers and online readers equally. There are some differences resulted from the technology difference. For example using animated ads, popup and videos on prints is impossible. Actually these types of ads on web are also ignored a lot than static image ads. Therefore the most important and common, for both print and web, ads are static image ads. The three important criteria mentioned before are: static, includes just plain text on a plain background or matches the site's style and is "above the fold". There is also one important capability which is only available online. It is the user's ability to click on links and get more additional information about one ad which is impossible in print ads. On the other hand people actually look at ads most of the time, even if their task is not related with the ad, for longer duration on prints than online. This might be because there are high numbers of ads on web than prints and users are so much more tired of online ads than print ads. People also think of web as a very big and wide thing and they don't think they will have time to see everything there. Therefore, they will only focus on their purpose and look at the things that they think are important. In case of print readers, they are much more relaxed and they might have time to see everything in the paper, even ads. Generally, all the content, the appearance and the placement of ads and similarity of its style with the main content of the page on web and prints are very important for drawing user's attention.

We didn't find research done on the layout of print documents. Sometimes it is important to know where people look for ads in newspapers or magazines, where in the magazine or newspaper they usually look for the main contents of the magazines or the highlights of the news, the logo, the name, the titles of each topic or chapter in the magazine or newspaper. Studying whether the page density or placement of contents is important or not and identifying priority spots of magazines and newspapers is also not a simple thing. In general, making a detail page layout eye tracking research for high number and variety of magazines and newspapers should be considered.

We also need to check what type of people's images will attract different type of users more in prints. The type of the users can be based on age and sex. We have seen different features of people's images such as skin color, blood, and sexy bodies ... will attract users more on websites and some of the features will do the same on prints too. Since there hasn't been any detail research like this for images in print, we can't be confident to generalize and give similar conclusions about printed images like images on the web.

Will these attraction factors be the same for first time visitors and regular visitors?

Users' satisfaction with a website is one of the many goals web designers or print designers want to achieve. Satisfied users may spend longer at a website or print, may revisit it later, and may recommend it to others. Therefore, it is useful to determine what makes a user satisfied with a website

or a print as well as finding the potential dissatisfiers. In order to do that conducting eye tracking experiment for first time visitors and regular visitors will help a lot.

(Ping Zhang, 1999) Ping, Ruth, Silvia and Gisela show that it will be helpful to differentiate both hygiene and motivating features according to their relative importance for user satisfaction on a particular website. They use Herzberg's (Herzberg, 1966) motivation-hygiene theory as guidance to identify and distinguish features that may be considered hygiene features from those that could be considered motivators in web environments. Their Hygiene and motivating features of a website are given in the table 2 and 3 respectively.

Table 2: Hygiene features of a website

Herzberg's Hygiene Factors	Specific Examples of Herzberg's Hygiene Factors *	Theorized Application to the Web Environment	Theorized Examples of Possible Hygiene Features in Web Environment
Working condition	Light, temperature, furniture, office size, "tools or equipment" to get tasks done, first impression or general appearance	First impression or general appearance	<ol style="list-style-type: none"> 1. Brightness of the screens/pages 2. Utilization of the screen size (viewable size of the screen) 3. Screen background color and pattern 4. Sharpness of displays (including images) 5. Eye catching image(s) or title on the homepage that makes you want to continue exploring the site
		Basic functions/features that help to get tasks done	<ol style="list-style-type: none"> 6. Live/broken links 7. Consistent use of link colors within the web site 8. Existence of unloadable items that are not central to the task (e.g. non-found images are used as bullets or decoration) 9. Need to scroll to view the homepage 10. Need to scroll to view the detailed/content pages 11. Robustness of the web interface (user mistake-tolerant, few bugs) 12. Stability of the site: should be consistently available for access 13. Support for different platforms and/or browsers 14. Search function/engine to work with large amount of info on the web site
Salary	Wages	N/A	
Company policy and administration	Procedures or rules of doing things; pace of feedback from administration; privacy and proper use of employee's private information; in general the bureaucratic aspects of the working environment	Requirements for doing tasks	<ol style="list-style-type: none"> 15. Length of the procedure to complete a task (e.g. steps/pages/actions to go through in order to get certain info) 16. Time on learning to use and becoming skillful at using the site
		Feedback or response	<ol style="list-style-type: none"> 17. Length of a page's loading or responding time 18. Indication of system action time expectation (e.g. long loading time warning)
		Access restriction	<ol style="list-style-type: none"> 19. Access restrictions (e.g. one needs to pay a fee, to sign on, to enter a password, or to provide some private info before one can access task-related info)
		Privacy and data confidentiality	<ol style="list-style-type: none"> 20. Collection of user's data without user's knowledge (including using cookies, write to user's local machine) 21. Informing users that their information will be collected 22. Declaration of specific use of the information that users need to provide (e.g. declare for statistics only, not to provide to the vendors, not for marketing purpose, etc.)
Interpersonal relations	Co-workers attitudes, perceptions and trust	Credibility of owners/designers and the website: trust and trustworthy	<ol style="list-style-type: none"> 23. Identification of site owners/designers 24. Credibility of the website owner/designer 25. Credibility of the website (e.g. the site won awards) 26. Number of times the website has been visited (e.g. shown by a counter)
Interpersonal relations	Co-workers attitudes, perceptions and trust	Web owners/designers' attitudes and perceptions	<ol style="list-style-type: none"> 27. Information about improper or controversial materials 28. Indications of gender or racial/ethnic biases and stereotypes
Supervision	Authority; guidance & support; availability of the supervisor, technical support	Authority and availability of owners/designers	<ol style="list-style-type: none"> 29. Authority of the web designer/owner 30. Indication of the purpose or objective of the web site or potential audience 31. Availability of designer/owner for further information (e.g. email)
		Navigation	<ol style="list-style-type: none"> 32. Working navigation aids (buttons or links) where necessary 33. Be able to know where to get started with the site's primary features 34. Be able to determine current position within the site 35. Simple and clear directions for using the website

Table 3: Motivating features of a website

Herzberg's Motivation Factors	Specific Examples of Herzberg's Motivation Factors *	Theorized Application to the Web Environment	Theorized Examples of Possible Motivational Features in Web Environment
Work Itself	Work-related tasks are challenging, stimulating, interesting, meaningful, useful, creative, fun	The information seeking tasks	36. Interestingness of the browsing task 37. Challenge of the browsing task 38. Usefulness of the browsing task to job/work, school, etc. 39. Meaningfulness of the browsing task 40. Fun to explore
		Quality of the information content: what a website covers ** (relevant, timely and current, complete and accurate, objective and novelty, understandable, consistent)	41. Task-relevant information 42. Relevant links (to the task, context, or information content) 43. Amount of irrelevant information (such as online ads, meaningless images) 44. Up-to-date information 45. Indication of addition of new information in the future 46. Complete/comprehensive/inclusive/adequate coverage of information 47. Precise/accurate and referenced information 48. Objective, unbiased information 49. Indication of limitations of information (e.g. source, coverage, date last modified) 50. Novelty and interesting information 51. Understandable information 52. Appropriate detail level 53. Coherent content that supports the web site's intended purpose/objective
		Presentation/organization of information: how a website covers information ** (information architecture, aesthetic and affective, learning consideration)	54. Logical organization of information within the website (e.g. by topic, by date, from broad to narrow) 55. Familiar terminology 56. Consistent use of terms and graphics 57. Overview, table of contents, summaries/headings 58. Scannability of a page (incl. chunks, screen uncluttered, highlights, etc.) so that users can easily scan the page to get info without reading line by line 59. Visually pleasing screen layout 60. Visually pleasing color use 61. Multimedia that adds information value 62. Variety of media (audio, video), formats (visual oriented or analytical oriented), types (use of examples, questions, plain descriptions) for different learning or thinking styles 63. Use of humor
Achievement	Successful task completion.	Task completion	64. Achieved results for the task 65. Quality of the task results 66. Time spent on the task 67. Problems solved (e.g. users may encounter unexpected problems while conducting the task and eventually solve the problems)
Responsibility	Certain control or power over the environment; make job related decisions with a minimum supervision	User control	68. User control of amount of information accessed 69. User control of procedures/steps of accessing information 70. User control of difficult levels (or details/depth) of information to be accessed (e.g. headings and details in a page allows a user to decide to either read heading or go for more details) 71. User control of pacing (how fast to go through the website) 72. Opportunities for interactivity
Advancement & Growth	Professional advancement; Growth potential in task capability, knowledge or skills	Knowledge or skills gained	73. New skills, knowledge gained by doing the tasks on the website
Recognition	Recognition by peers or supervisors for performance; real skills and capacities are put to use on jobs	Recognition by owners/designers on knowledge and skill levels	74. Assumed/recognized audience's knowledge and skill levels

They pointed out that for browsing users, in addition to hygiene features, motivators have a critical role in attracting the user to a site and maintaining user interest in that site. They suggested that the user's character also influence their satisfaction. The threshold of *not being dissatisfied* for hygiene and motivation seekers is different.

This work is done without any eye tracking experiments but it has very important lists of features which will satisfy one website user and which will make him/her to revisit the website again. Since there is no eye tracking research done which compare the first time and regular visitors of the website, it will be a good idea to follow these lists of features and conduct an eye tracking experiment. Conducting such experiment will help us prove these motivator and hygiene features as a real user satisfaction features. In order to conduct this experiment one can follow the way Jakob Nielsen and Kara Pernice used for their wide web usability eye tracking experiment. What they did is that, they conducted big eye tracking experiment for wide variety of websites. They recorded video of each participant's test session and they collected the gaze map and heat maps of each participant and their comments from the different questioners. Finally, they analyzed the collected different types of data having in mind the theoretical web usability guidelines from W3C. They were proving and disproving them. Such a way can also be applied here. One can design one websites with different features taken from Hygiene features and conduct eye tracking experiment using those websites for first time users and regular users. After collecting the necessary data, he/she can analyze the data having in mind those hygiene and motivator features.

One other important question we need to ask is that whether the ocular behavior is determined by the familiarity to Internet. There are only little research has been done on familiarity issues. Will Schroeder had reported (Will, 1998) that even if one person never accessed the Internet, he could still achieve the same level of usability with the one much familiar to Internet. Qian et al. eye tracking data results also show that people pay out the same cognitive effort whether they are regular internet users or not (Qian Li, 2005). They then concluded that if there aren't any assigned tasks and special exercises, people with high familiarity with the Internet are not significantly different from those that are not familiar with the Internet.

Eye tracking the web in the small screens

The development of Smartphone and social networking sites like Twitter and Facebook make the amount of people using mobile devices to access the web to grow exponentially (Owoh, 2010). He also said that it's estimated that by the end of this year, over 1 billion users will be accessing the web via a mobile device. Therefore, web developers and designers should wake up and they need to understand practical techniques that will enhance the mobile web browsing experience.

A well designed website should display on devices very different from a conventional personal computer. Two examples are hand held devices and interactive television set-top-boxes. Hand held devices include a PDA with the Opera small screen browser and a cellular mobile telephone with the iMode or WAP 2 web browser. These days the Apple iPhone is the most popular one since it have a large range of accessories and be the first portable web device many people see. Using these handheld devices and the conventional personal computers are two different experiences.

Tom Worthington lists some of the differences between small screen devices and PCs (Worthington, 2006). The hand held small screen devices all have limited screen area compared to the usual PC. For that reason user of a PDA or mobile telephone, for example, can read only a few lines of text and see small images on the small hand held display. The environment where the people use these two types of technologies also differs much. PC users generally access the website in a specially designed office environment and can devote their attention to the screen. In contrast a mobile or iPod users can access the website in a noisy, distracting environment and only devoting some time to the device.

Therefore, Tom Worthington suggests that specially designing web contents for specific devices is necessary. For example, the content and interface for small-screen devices need to be design for quick and easy reading. We of course might not know the type of devices users prefer to use to access our websites. They might use PC sometimes when they are in office and they might want to access it on the train using their iPod. The target device may not be known, or may change, or resources may not available to tailor for several different devices. Following W3C's accessibility guidelines to design web contents is a great idea since they are developed with the needs of small devices in mind. He also mentioned that using CSS is very useful to detect the device used and modify the page design to suit.

We found out , from (Worthington, 2006), (Mukherjee, 2010), (Pollock, 1997) and (Owoh, 2010), the following important points that one web designer should have in mind during designing a website which is accessible from all kinds of devices (PCs and Small-Screen devices).

- The web page design needs to be able to adapt to different size and shape screens
- The PDF content should also be provided in the form of standard web pages (XHTML) since the size of the screen makes the document difficult to read
- Most of the small-screen devices don't have enough keyboard keys instead they use touch screen technology. Therefore, the important content of the web page needs to be placed first so the user sees it without needed to scroll.
- Entry of complex codes should be avoided and finger sized buttons with images on them, with alternative text for the disabled, should be used. Use textboxes only when necessary and have auto-complete/auto-suggest features to reduce errors (See Figure 12).
- Avoid too many details from the web pages. The content and interface need to be designed for quick and easy reading. Brujo Owoh said that simplicity equates to usability on mobile webs. Keep the design clutter-free and as lightweight as possible.
- The speed of internet connection is also important to consider. Web pages designed for a wide readership should be able to be used on a fast dial-up of about 43 kbit/s.
- Small-screen devices usually don't have high memory to hold programs. The browsers also might have limited features. Therefore, the designer should be smart and note these things too.
- Using an external style sheet for web page formatting, such as for font, color and positioning will make the HTML smaller and allows different CSS to be used for desktop and mobile devices.
- Designer should also note that some web browsers on small-screen devices have feature to reformat conventional web pages for small devices (Small-Screen Rendering). For example, Opera web browser increases text size, reduces the space around text, reducing images and it reformats vertical columns in sequence into one column.
- Knowing the users' devices also help web designers create content and experiences specifically for that device. That is because a mobile web application designed for one technology, for example the iPhone, will not be viewable on another technology; let us say an S60 device.

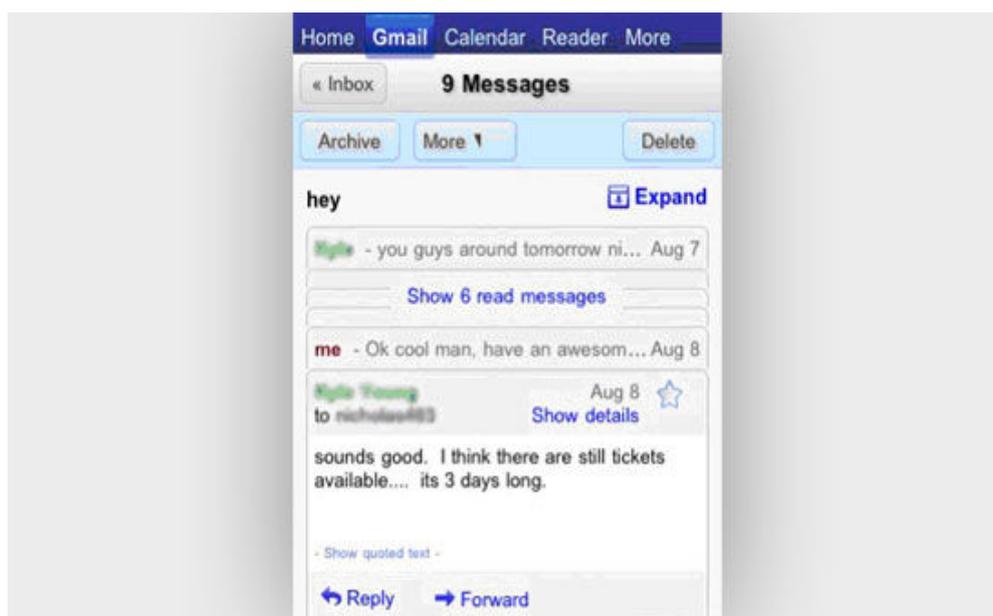


Figure 12: example for simplicity. Mobile Gmail offers easy access to the most frequently used Gmail commands and mobile keypad shortcuts. (Source: (Owoh, 2010))

In general, putting careful consideration into the design of a mobile web application must be a paramount activity that designers need to integrate into their workflows (Owoh, 2010). As we already described in the above paragraphs designing for the mobile web is not the same as designing for the traditional web. Therefore we need to learn as we go and we have to learn to adapt quickly to these new demands.

Get into our users' head, figure out what they would be most interested in and give them *just* that will be very useful. In order to do this conducting eye tracking experiment will help a lot. Unlike web usability studies for usual PCs, there is not much usability studies done for small-screen devices. There is a big need for such experiment these days.

Conclusion:

From these results of eye tracking research we can see that eye tracking provides a much more detailed level of user's behaviors to watch and analyze. What a user look at, fixate on a number of times (was it useful or waste full?), look at and act up on later or ignore later... are some of the activities we can look at using eye tracking. It is a very powerful tool of study. Using eye tracking and the traditional research methodologies one can perform deep behavioral analysis and effective web usability studies.

There are number of ideas for future eye tracking researches. Here we give a list of suggestions. Even if most of the peoples who read newspapers and websites have normal vision, there are considerable numbers of peoples who use eye glasses for reading purposes. Eye glasses might prevent the tracking of a clear corneal reflection. It might disturb the quality of the eye tracking session. Since, the number of newspaper or website readers with eye glasses is significant enough it will be a good idea to search for a mechanism which will allow them to be the part of eye tracking experiment.

Eye tracking study is also highly subjective. Changing the criteria to choose participants for experiment might change our overall results. There are a wide Variety of cultural differences in this world. Therefore, it will be hard to say that the particular study findings of our survey will represent all the people in the world. The acceptance of website design features differs among cultures. Therefore, conducting eye tracking experiment in Norway will be completely different situation and might result different results. It will be worth conducting eye tracking experiments in Norway, even if we choose similar topics like other researchers in other part of the world.

We didn't find research done on the layout of print documents. Sometimes it is important to know where people look for ads in newspapers or magazines, where in the magazine or newspaper they usually look for the main contents of the magazines or the highlights of the news, the logo, the name, the titles of each topic or chapter in the magazine or newspaper. Studying whether the page density or placement of contents is important or not and identifying priority spots of magazines and newspapers is also not a simple thing. In general, making a detail page layout eye tracking research for high number and variety of magazines and newspapers should also be considered.

These days' websites include multimedia presentation of information beyond static text. Websites often include radio and television commercials, sound, animation, and screen changes. It is very interesting, useful and up-to-date idea to conduct eye tracking research for such ads using video gaze map. There is nothing much done in this area since it was not possible to researchers to capture animations and videos in gaze-plot images or heat maps till the time of their publishing. But in color lab of Gjøvik University Collage, Raju Shrestha makes it possible to use eye tracker to record the gaze of viewers of video sequences. Probably using his method and performing eye tracking experiments for web usability of animations and videos will be interesting and easier.

What type of content is that people more attracted for? Is it puzzles, games, sport, business, entertainment or politics? Looking into these types of issues, watching which fields of news get more looks will also be interesting. There is no much eye tracking experiment done in this area. It will be a good idea to see what type of content participants chose to read. Will it be the same when it is online and on prints? Will it be the same for females and males, for young peoples and old once?

As we mentioned for a number of times, unlike the web usability studies the researches done for printed materials like newspapers and magazines are very narrow and dedicated for specific organizations or purposes. Therefore conducting very wide eye tracking research which covers higher number of newspapers and magazines will be interesting. There are also very little works done in the areas of web usability for children (<18) and old people (> 60). More work is needed to identify what the most important parameters are needed to attract Older people to the technology. One can do a detail analysis and try to figure out how these people perceive the internet, which elements make the internet very hard to them, and what should have been done to avoid these complexities using eye tracking experiments.

We have not found any eye tracking research done for the first time and regular users of websites and printed documents as well. We give very important lists of features which will satisfy one website user and which will make him/her to revisit the website again. Since there is no eye tracking research done which compare the first time and regular visitors of the website, it will be a good idea to follow these lists of features and conduct an eye tracking experiment.

Conducting eye tracking experiment for small screen devices is also an appealing idea. Unlike web usability studies for usual PCs, there is not much usability studies done for small-screen devices. There is a big need for such experiment these days.

While we were reading we found out interesting information and it will be worth mentioning it here. Probably considering a piece of software called the Enhanced Restricted Focus Viewer (ERFV) might have some advantages over using eye tracking hard wares. Peter et al. (Peter Tarasewich, 2005) published an article about this software. They mentioned the things that the software can perform but previously couldn't have been done with eye tracking equipments. These includes: automatically tracking users' attention as they view linked images, tracking the time spent on each page and the places that a user clicked (even if not on a hyperlink). The ERFV requires no increased effort on the part of the user for data collection, requires no additional cost in terms of equipment and testing overhead, and can test multiple users at the same time.

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