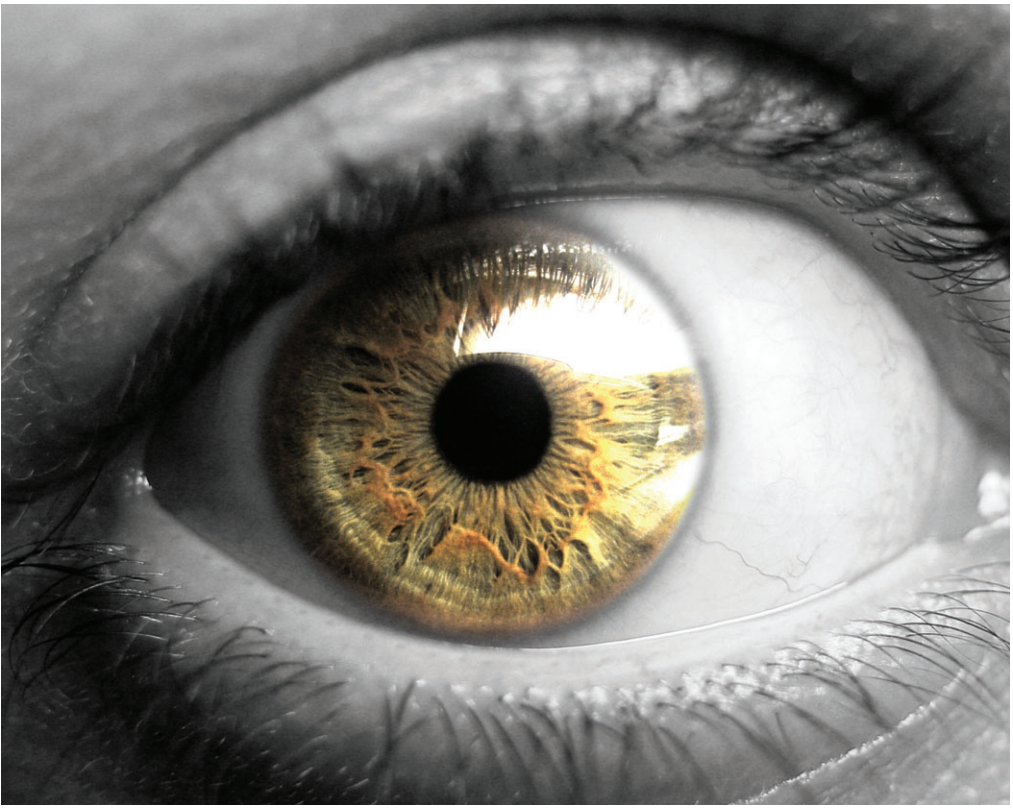
# Eye on the future

**James Weatherhead looks at the next stage in usability**





doi:10.1093/itnow/bwi027

**Most modern advances in IT have been in technologies that seek to automate functions previously performed by humans. This is, of course, perfect for systems that are repetitious or do not require a higher level of intelligence. However, for the foreseeable future the human remains the key component of a truly useful computer system.**

A technology, called eye-tracking, previously used in the fields of medicine and psychology, has been adopted into IT and is now being used to increase the efficiency of the ever more important interface between human and machine. Eye-tracking has much to offer the IT world. Consider how helpful it would be to know that users of your software really did see the helpful hints you carefully positioned on the screen. Or, think about how you would have designed your 'how-to instructions' if you had known people responded quicker to images, text, or graphics. What if you could identify how much brain power people were using when interacting with the new version of your software, you could actually measure if the new version is easier to use than the previous version. These are just some of the benefits being offered to clients of companies such as US-based EyeTracking, Inc.

## What is eye-tracking?

Simply put, eye-tracking is the process of using video cameras, a computer, and some clever software algorithms to monitor a person's eyes, with the goal being to determine where the person is looking and indeed how a person looks around their environment to interpret that environment.

Eye-tracking systems typically capitalize on a phenomenon called the 'bright pupil effect' (or an adaptation called the 'dark pupil effect'). This effect is generated when certain configurations of LEDs, operating in the near infra-red wavelengths, are used to illuminate a person's eye. While the result is not detectable to the human eye, IR sensitive cameras will show that the pupil illuminates brightly, much like that of an animal when caught by a car's headlights at night. This clearly measurable reaction enables easy identification of the pupil by software algorithms employed by eye-tracking hardware.

The amount of data generated by eye-tracking systems is vast, and it needs to be. The eye moves incredibly fast. Those that have not seen eye-tracking are often astounded by the sheer speed at which people take in information. The hardware typically used for our usability research is a very accurate system that measures the eye location of both eyes at 250 hertz, to an accuracy of approximately 10x10 pixels. Even at this high sampling rate, there are gaps in-between samples as the eye scans around the screen.

Eye tracking is a tool that lets us collect data in a realistic, non-intrusive manner. Its unique contribution to IT is that it allows us literally to see our displays through our users' eyes. By monitoring their eyes we can tell whether they actually saw the navigation on the website and couldn't find what they

are looking for, if they were confused by it, or if they couldn't find the navigation at all. Similarly, we can tell if individuals saw a particular banner advertisement but couldn't remember it, or if they didn't see it, or if they purposely ignored it.

## The eye is a window to the brain

Whereas eye-tracking enables us to see through the eyes of another, capitalizing on arguably one of the most important of our six senses, the index of cognitive activity (ICA) enables us to delve into the mind. The ICA is a new and revolutionary technique that builds on pupillometry, another eye-based technology related to the basic eye-tracking methodology described here.

Whereas eye-tracking shows how people view an interface to gather information, pupillometry studies how the pupil changes as these interactions occur. There are two primary drivers for pupil change: ambient light in the room (including that of office lighting and computer displays) and cognitive effort. It is this second driver that is of interest to

> *Eye-tracking systems typically capitalize on a phenomenon called the 'bright pupil effect'*

us for usability purposes. While the link between pupil change and cognitive effort has been know for some time, a process for filtering the cognitive effort signal from the light and other noise inherent in the pupil signal was not available. Recently, the ICA metric was developed to fill this need.

It is now possible to generate both the exact path the eye(s) take as they look for information on a software interface as well as the level of cognitive effort that is being expended as the user searches for the target information. This information is very powerful, not only providing us with an objective measure of difficulty experienced by a person working with an interface, but just as importantly, letting us know when the user 'tunes out' (or gives up) on a task.

## Usability that packs a punch

At the most simplistic level, eye-tracking reveals what seems to be the most basic and obvious of information: Did the person find the item of interest? With subjective techniques, it is not

> *How do you know whether your sales are low – because people aren't interested in your tag line or because 10 per cent of your visitors just don't even see it?*

uncommon for a person – even when asked directly – to incorrectly report whether an item was seen or not. Now think for a moment, if you have a product on your website, how do you know whether your sales are low – because people aren't interested in your tag line or because 10 per cent of your visitors just don't even see it?

Obviously specific expertise is required to run a usability study of any sort, and the inclusion of eye-tracking in a study adds to that burden. However, some companies offer consultancy services that take care of everything from study design and subject recruiting, through eye-tracking studies and analysis services for their clients. What is delivered is a set of recommendations for usability 'fixes and enhancements' substantiated by the concrete evidence of the eye-data and subsequent analysis. Video clips of users viewing are especially valuable.

Eye tracking and the ICA can also be applied to usability problems beyond those of computer interfaces, such as mobile phones, control station testing, airline cockpit usability and more. For those of you who are concerned with usability (and that should be most readers), I can assure you that eye tracking is well worth some investigation.

## The future of 'eye power'

Now well established, the ICA has joined a small group of physiological measures that have opened a gateway to a new line of research and potential computer systems of the future. This new line of technology has been dubbed 'augmented cognition systems'. The goal of this science is not the norm of trying to make the ultimate computer to replace all human functions but, instead, building a system comprising human and machine and utilizing the strengths of both sub-systems to create maximum efficiency from the duo.

This area is growing with support from both commercial and military sectors. Futuristic products already being investigated include: command and control systems that can change automation levels to increase/decrease workload on the user, ensuring that the user is kept focused on the job at hand, and automotive applications that can provide increased safety through shifting levels of automation, enabling the driver to pay more attention to the core driving controls and the road ahead.

## in a nutshell

- Eye-tracking technology, has been adopted into IT and is now being used to increase the efficiency of the human/machine interface.
- Eye-tracking shows how people view an interface to gather information.
- It is now possible to generate the exact path the eyes take as they look for information on a software interface.
- Eye-tracking delivers a set of recommendations for usability 'fixes and enhancements' substantiated by the concrete evidence of the eye-data and subsequent analysis.
- 'Augmented cognition systems' is a science trying to build a system comprising human and machine and utilizing the strengths of both to create maximum efficiency.

**James Weatherhead MBCS is president of EyeTracking, Inc.**
**Email: jweatherhead@eyetracking.com**
**www.eyetracking.com**