4. Attention and Memory

Contents

Attention

The human brain is limited in capacity. It is important to design user interfaces which take into account the attention and memory constraints of the users. This means that we should design meaningful and memorable interfaces. Interfaces should be structured to be attention-grabbing and require minimal effort to learn and remember. The user should be able to deal with information and not get overloaded.

Our ability to attend to one event from what seems like a mass of competing stimuli has been described psychologically as **focussed attention.** The **"cocktail party effect"** -- the ability to focus one's listening attention on a single talker among a cacophony of conversations and background noise---has been recognized for some time.

We know from psychology that attention can be **focussed** on one stream of information (e.g. what someone is saying) or **divided** (e.g. focussed both on what someone is saying and what someone else is doing). We also know that attention can be voluntary (we are in an attentive state already) or involuntary (attention is grabbed). Careful consideration of these different states of attention can help designers to identify situations where a user's attention may be over-stretched, and therefore needs extra prompts or error protection, and to devise appropriate attention attracting techniques.

Sensory processes, vision in particular, are disproportionately sensitive to change and movement in the environment. Interface designers can exploit this by, say, relying on animation of an otherwise unobtrusive icon to indicate an attention-worthy event.

Focussing attention at the interface

Techniques which can be used to guide the user's attention include:

- Structure – grouping, based on the Gestalt laws
- Spatial and temporal cues – where things are positioned or when they appear
- Colour coding, as described in the previous chapter
- Alerting techniques, including animation or sound

Important information should be displayed in a prominent place to catch the user's eye

Less important information can be relegated to the background in specific areas – the user should know where to look

Information not often requested should not be on the screen, but should be accessible when needed

Note that the concepts of **attention** and **perception** are closely related.

Multitasking and Interruptions

In a work environment using computers, people are often subject to being interrupted, for example by a message or email arriving. In addition, it is common for people to be multitasking - carrying out a number of tasks during the same period of time by alternating between them. This is much more common than performing and completing tasks one after another.

In complex environments, users may be performing one **primary** task which is the most important at that time, and also one or more less important **secondary** tasks. For example, a pilot's tasks include attending to air traffic control communications, monitoring flight instruments, dealing with system malfunctions which may arise, and so on. At any time, **one** of these will be the primary task, which is said to be **foregrounded**, while other activities are momentarily suspended.

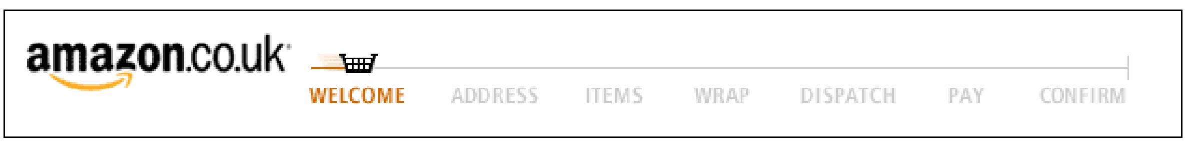
People are in general good at multitasking but are often prone to **distraction**. On returning to an activity, they may have forgotten where they left off. People often develop their own strategies, to help them remember what actions they need to perform when they return to an activity.

Such external representations, or **cognitive aids** (Norman, 1992), may include writing lists or notes, or even tying a knot in a handkerchief.

Cognitive aids have applications in HCI, where the system can be design to provided them –

- the system should inform user where he was
- the system should remind user of common tasks

For example, Amazon's check out procedure displays a list of steps involved in the process, and indicates what step has been reached.



Automatic Processing

Many activities are repeated so often that they become automatic – we do them without any need to think. Examples include riding a bike, writing, typing, and so on. Automatic cognitive processes are:

- fast
- demanding minimal attention
- unavailable to consciousness

The classic example used to illustrate the nature of an automatic operation is the **Stroop effect**. To experiment with this, look at the colour sheet at the end of this chapter.

This experiment demonstrates **interference**. The interference between the different information (what the words say and the colour of the words) your brain receives causes a problem. There are two theories that may explain the Stroop effect:

- Speed of Processing Theory: the interference occurs because words are read faster than colors are named.
- Selective Attention Theory: the interference occurs because naming colors requires more attention than reading words.

If a process is not automatic, it is known as a **controlled process**.

Automatic processes
- are not affected by limited capacity of brain
- do not require attention
- are difficult to change once they have been learned

Controlled Processes
- are non-automatic processes
- have limited capacity
- require attention and conscious control (Shiffrin & Shneider, 1977)

Memory Constraints

The human memory system is very versatile, but it is by no means infallible. We find some things easy to remember, while other things can be difficult to remember. The same is true when we try to remember how to interact with a computer system. Some operations are simple to remember while others take a long time to learn and are quickly forgotten.

An understanding of human memory can be helpful in designing interfaces that people will find easy to remember how to use.

Levels of Processing Theory

The extent to which things can be remembered depends on its meaningfulness. In psychology, **the levels of processing theory** (Craik and Lockhart , 1972) has been developed to account for this. This says that information can be processed at different levels, from a **shallow** analysis of a stimulus (for example the sound of a word) to a **deep** or semantic analysis. The meaningfulness of an item determines the depth of the processing – the more meaningful an item the deeper the level of processing and the more likely it is to be remembered.

Meaningful Interfaces

This suggests that computer interfaces should be designed to be meaningful. This applies both to interfaces which use **commands** and interfaces which use **icons** or graphical representations for actions. In either case, the factors which determine the meaningfulness are:

- Context in which the command or icon is used
- The task it is being used for
- The form of the representation
- The underlying concept

Meaningfulness of Commands

The following guidelines are examples taken from a larger set which was compiled to suggest how to ensure that commands are meaningful (Booth 1994, Helander, 1988):

- Syntax and commands should be kept simple and natural
- The number of commands in a system should be limited and in a limited format
- Consider the user context and knowledge when choosing command names.
- Choose meaningful command names. Words familiar to the user
- The system should recognize synonymous and alternative forms of command syntax
- Allow the users to create their own names for commands

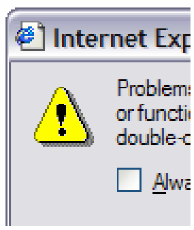
Sometimes a command name may be a word familiar to the user in a different context. For example, the word ‘CUT’ to a computer novice will mean to sever with a sharp instrument, rather than to remove from a document and store for future use. This can make the CUT command initially confusing.

Meaningfulness of Icons

Icons can be used for a wide range of functions in interfaces, for example

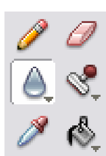
- Labeling e.g. toolbar item, web page link

- Warning e.g. error message



- Identifying e.g. file types, applications

- Manipulating e.g. tools for drawing, zooming



- Container e.g. wastebasket, folder

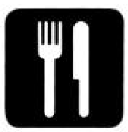
The extent to which the meaning of an icon is understood depends on how it is represented. **Representational form of icons** can be classified as follows:

Resemblance icons – depict the underlying concept through an analogous image.

the road sign for "falling rocks" presents a clear resemblance of the roadside hazard.

this represents the Windows calculator application, and resembles a calculator

Exemplar icons – serve as a typical example



a knife and fork used in a public information sign to represent "restaurant services". The image shows the most basic attribute of what is done in a restaurant i.e. eating.

this represents Microsoft Outlook – the clock and letter are examples of the tasks this application does (calendar and email tasks)

Symbolic icons – convey the meaning at a higher level of abstraction

the picture of a wine glass with a fracture conveys the concept of fragility

this represents a connection to the internet – the globe conveys the concept of the internet

Arbitrary icons – bear no relation to the underlying concept

the bio-hazard sign consists of three partially overlaid circles

this represents a software design application called Enterprise Architect. There is no obvious meaning in the icon to tell you what task you can do with the application

Note that arbitrary icons should not be regarded as poor designs, even though they must be learned. Such symbols may be chosen to be as unique and/or compact such as a red no entry sign with a white horizontal bar, designed to avoid dangerous misinterpretation.

Combination Icons

Icons are often favoured as an alternative to commands. It is common for users who use a system infrequently to forget commands, while they are less likely to forget icons once learnt. However, the meaning of icons can sometimes be confusing, and it is now quite common to use a redundant form of representation where the icons are displayed together with the command names.

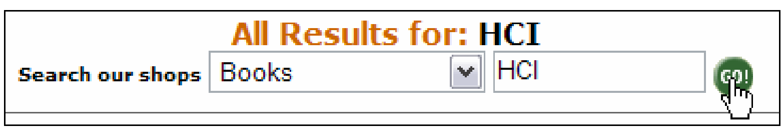
The disadvantage of this approach is that it takes up more screen space. This can be reduced by using pop-up tool tips to provide the text.

Icons in Web Pages

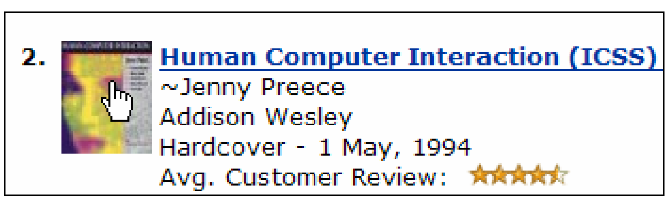
The use of graphical representation in web pages tends to be quite different to that in other interfaces. Most user actions (links) are usually represented by text (although the text may actually be an image).

There is often isolated and specific use of icons and graphical representations for links. The following examples are from amazon.co.uk.

- Buttons to submit forms, e.g. search boxes:



- Images of items - the user can click to get more information on the item:



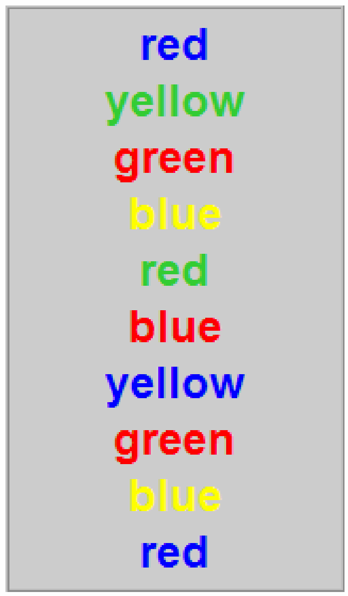
- Links to specific site features, e.g. shopping basket:

Icon use in web pages is sparing for a number of reasons, for example:

- Pages often convey information and branding graphically, so it would be difficult to focus attention on icons among other graphical content.
- Graphical links are often banners to focus attention to a small number of specific items
- The web browser has its own set of icons

Interference: The Stroop Effect

Don't *read* the words below—just *say* the colours they're printed in, and do this aloud as fast as you can.



If you're like most people, your first inclination was to read the words, 'red, yellow, green...,' rather than the colours they're printed in, 'blue, green, red...'

You've just experienced **interference**.

When you look at one of the words, you see both its **colour** and its **meaning**. If those two pieces of evidence are in conflict, you have to make a choice. Because experience has taught you that word meaning is more important than ink colour, interference occurs when you try to pay attention *only* to the ink colour.

The interference effect suggests you're not always in complete control of what you pay attention to.