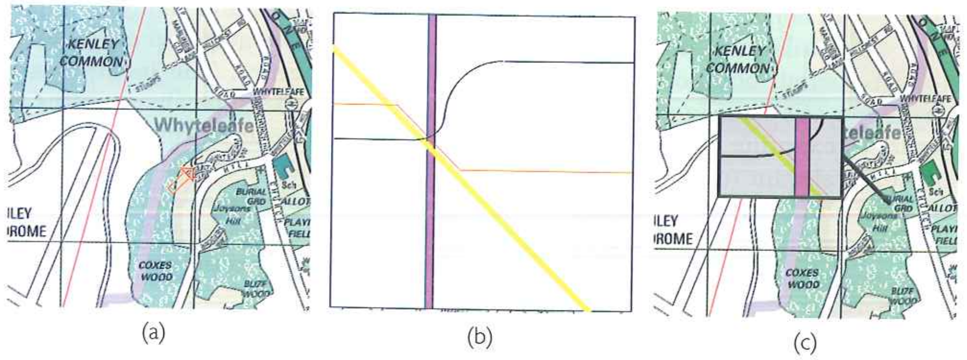

FIGURE 4.29 Illustrating the concept of a magic lens. (a) shows a conventional map of an area, (b) shows the location of services (gas, water and electricity pipes) in the same area, and (c) a (movable) magic lens shows services in an area of interest, in context

interactively – by 'bringing the tool to the data' – is a valuable facility and is called a *magic lens* (Stone *et al.*, 1994). Part of its attraction might lie in the metaphor of the familiar magnifying glass. Again, generalization is possible, for example to the effect of two superimposed lenses and to the class of so-called 'see-through' tools (Bier *et al.*, 1994). An illuminating example of the magic lens technique is provided by the field of bioinformatics. Figure 4.30 illustrates the use of a movable magic lens to view the atomic structure within the molecular surface of a protein.

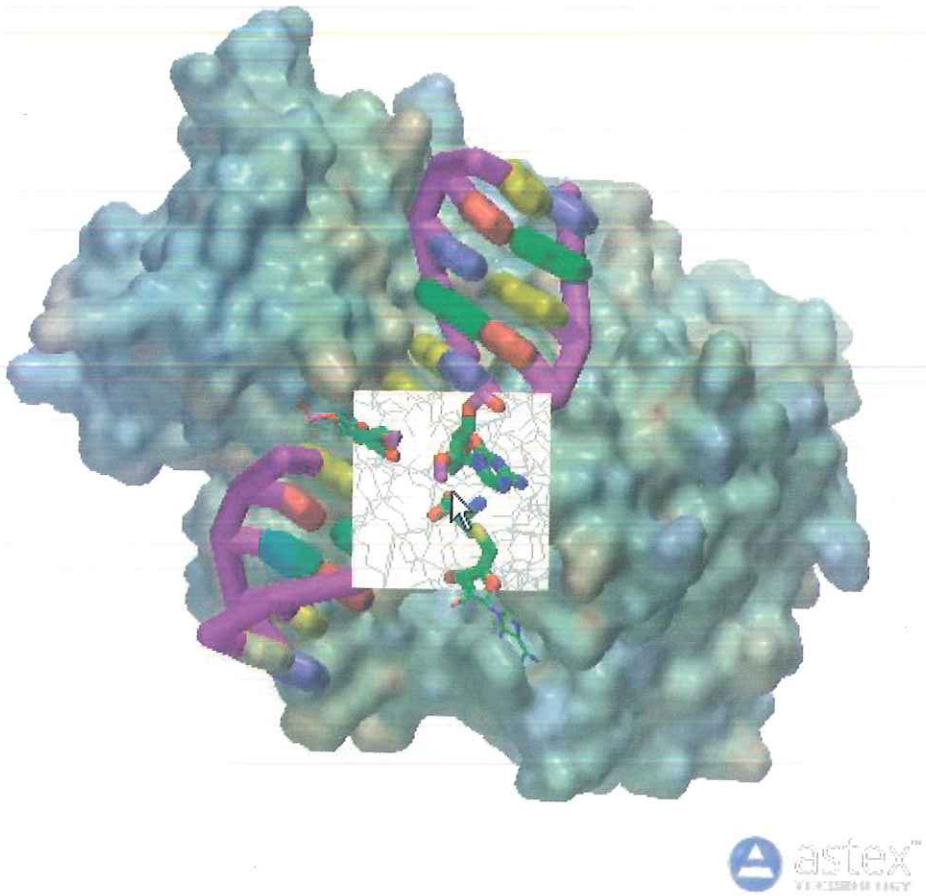

FIGURE 4.30 A molecular surface of the protein transferase coloured by electrostatic potential bound to DNA shown as a schematic (ID = 10mh). The magic lens window allows a view of the atomic structure bonding to be shown, with the bound ligand structure highlighted as cylinders, thereby providing a view inside the protein *(By kind permission of Tom Oldfield and Michael Hartshorn)*

Combined distortion and suppression

When to focus and when to filter is a common design challenge. In some applications a combination of distortion and suppression can be beneficial. The bifocal display, of course, combines the two, since information items in the distorted regions usually benefit by not being displayed in full detail. It may be possible to use Furnas's DoI concept to automatically determine item representation in the distorted region, though it is more likely that a visual designer will create rules particular to a given application.

An example of combined distortion and suppression is shown in Figure 4.31 and employs the concept of rubber sheet distortion (Kadmon and Shlomi, 1978) illustrated in Figure 4.32. The task for which the application was proposed arose from a scenario in which a user is staying in a hotel in Manchester and wants to visit his Aunty Mabel in Huddersfield about 40 miles away. To support this task we first imagine a map of Northern England to be printed on a rubber sheet which is then pushed from behind to display Manchester and Huddersfield in sufficient detail (Figure 4.31) to allow street-by-street navigation in both cities, to and from the termination of the motorway. In addition to this distortion, we recognize that, once on the motorway, detail is not important to the user, for whom just the occasional landmark can provide comforting reassurance that the journey is proceeding as planned. For this reason only landmarks are retained along the motorway, all other details being suppressed.

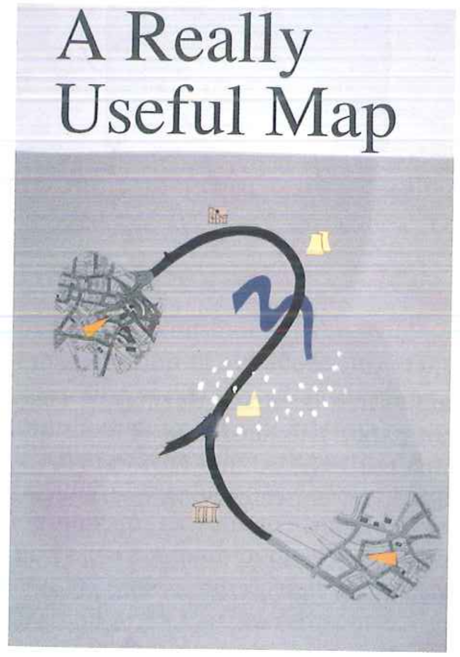

FIGURE 4.31 A combination of rubber-sheet distortion and suppression leads to a map appropriate to a journey from one city to another

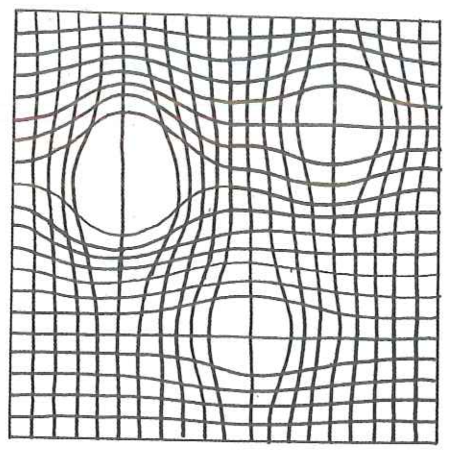

FIGURE 4.32 The rubber-sheet distortion technique employed in the map of Figure 4.31

A reminder of the fact that representation and presentation are usually inextricably linked, and of the consequent danger of focusing on one to the exclusion of the other, is provided by a recent solution to the 'keyhole' problem presented by PDAs and mobiles. With the halo technique (Baudisch and Rosenholtz, 2003), circular arcs on a map (Figure 4.33) are associated with unseen locations of points of interest. The short arcs appearing on the PDA are representations of the unseen locations and adopted as such in view of the human user's ability to form a mental model of the complete circle and hence the unseen location at its centre.

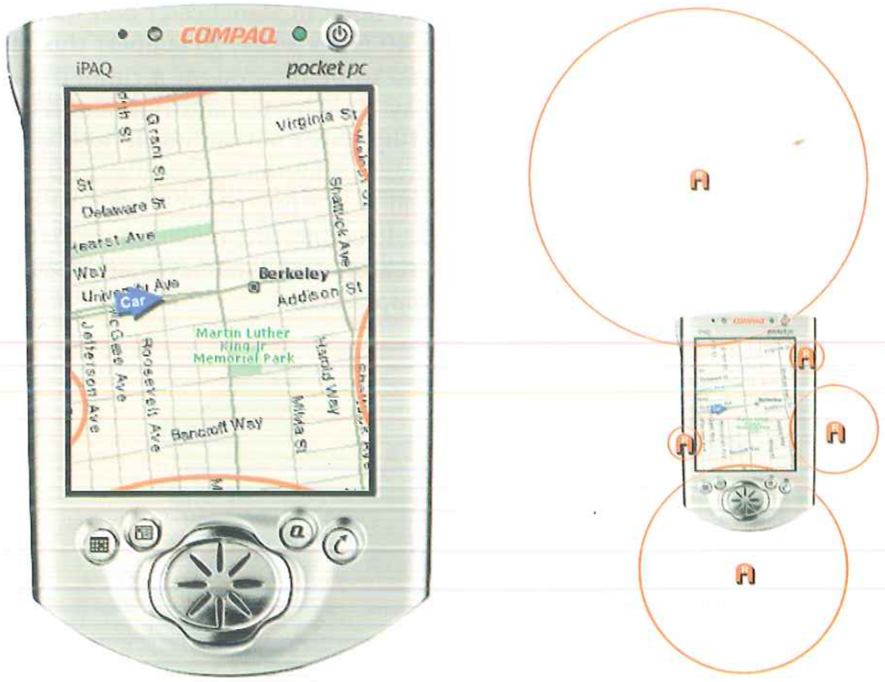

FIGURE 4.33 The use of representation (by a 'halo') to provide context for a small display
(By kind permission of Patrick Baudisch)

Historical note

While the introduction of distortion and suppression occurred during the early 1980s, it is not surprising that the need to maintain a balanced view of focus and context was identified even earlier. For example, in 1973 we find Farrand (1973) remarking, on the basis of his extensive industrial experience in engineering design, that

> *windowing . . . forces man to remember 'what part the viewed portion plays with respect to the total scene'*

where 'windowing' means 'scrolling', and that

> *an effective transformation must somehow maintain global awareness while providing detail*

where the transformation referred to is that from an existing large diagram to a more useful one in a limited display area. In the same thesis Farrand coins the popular term 'fisheye' (which nowadays appears to refer both to distortion and suppression) and quotes an even earlier (1971, unreferenced) comment that

> *. . . there is a need for presenting a display with 1. sufficient detail for interaction, while 2. maintaining global vision of the entire scene.*

4.1.5 Zoom and pan

The presentation techniques discussed so far – scrolling, overview+detail, distortion and suppression – have all been concerned with the most effective use of available display area. To these we must now add the processes of zooming and panning. *Panning* is the smooth, continuous movement of a viewing frame over a two-dimensional image of greater size (Figure 4.34), whereas *zooming* is the smooth and continuously increasing magnification of a decreasing fraction (or *vice versa*) of a two-dimensional image under the constraint of a viewing frame of constant size (Figure 4.35). The choice of view location afforded by panning, and the ability of zooming to allow a continuous transition between overview and detail by variable magnification, render panning and zooming valuable processes.

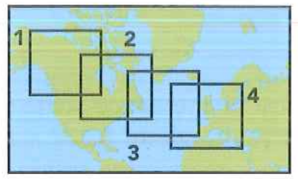

FIGURE 4.34 Panning is the smooth movement of a viewing frame over a 2D image

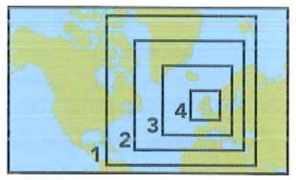

FIGURE 4.35 Zooming is the increasing magnification of a decreasing fraction of an image (or *vice versa*)

In a conventional 'geometric' zooming action no change in the data or its representation is involved, only the activity of filtering caused by the inevitable discarding of context when zooming in. In this sense zooming-in is very different from distortion (e.g. the bifocal display) whose purpose is to *retain* context in order to permit a *focusing* rather than a *filtering* action. Cairns and Craft (2005) usefully point out that zooming facilitates two different cognitive tasks. With zooming-in, extraneous information is removed from the visual field, perhaps resulting in a more manageable view, whereas zooming-out reveals hidden information, often context that is already known but perhaps cannot be recalled. It often allows a user to rediscover their location in an information space and to integrate new context within a mental model.

An analytic framework supporting the discussion of panning and zooming is provided by the concept of *space-scale diagrams* (Furnas and Bederson, 1995). In three-dimensional space (Figure 4.36) there are two dimensions of space and one (vertical) of scale (hence, a space-scale diagram). Four copies of a map are shown, each magnified by an amount proportional to its position along the scale

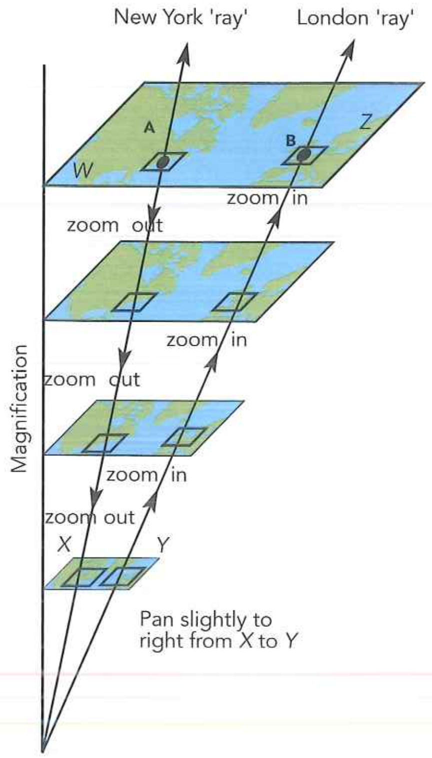

FIGURE 4.36
A space-scale diagram relevant to combined zooming and panning

axis. Note that a *point* in the map becomes a *ray* in the space-scale diagram. The user's viewing window is represented by a rectangle of *fixed* size which when moved horizontally in the diagram corresponds to panning and to zooming when it moves along a ray.

The nature of a space-scale diagram can be illustrated by a familiar combination of pan and zoom that can help maintain a user's mental model of data. With reference to Figure 4.36 we assume that a user has been looking at New York City and now wishes to view London. A horizontal movement of the viewing frame (from W to Z) – i.e. a pan – might seem the obvious move, but most of the rapid transition would mainly show only the Atlantic Ocean. A better transition will be one involving a gradual zoom-out to X (perhaps to include the Eastern Seaboard of the USA and the map of the United Kingdom), a pan across the Atlantic to Y but with both the USA and England in view for most of the time, and then a zoom-in to London (Z) once the United Kingdom begins to fill the picture. A similar combination of pan and zoom is employed very effectively by Google Earth, and the automatic combination of zoom and pan has been studied extensively by Cockburn and Savage (2003).

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As pointed out, the zooming action illustrated above is often referred to as *geometric zoom*. It is continuous and, when zooming in, results in filtering and the loss of context, but with the advantage that magnified detail is available. In many situations, however, it is inappropriate for a change of view to be continuous: a more useful change may be a *discrete* one in which *additional detail* as well as pure magnification is provided. An example would be a change from the overview of the North of England (Figure 4.5, left) to the detail of Huddersfield

(Figure 4.5, right). Another example was shown earlier in Figure 3.21 where car prices were supplemented by details of make in view of the extra space made available by the restriction to fewer cars. Another example based on the Spatial Data Management System (SDMS) (Herot, 1980; Herot *et al.*, 1981) is shown in Figure 4.37 (A to C). In certain circumstances a ship's captain needs to be aware of a collection of available ships (View A), but may then require details of a particular ship (View B). The transition from View A to View B is not solely a geometrical zoom: if it was, the text describing the ship would have appeared in A and would have been unreadable and probably distracting. The transition is also discrete and we use the term *semantic zoom* because the meaning conveyed by the new view differs from that conveyed by the old one. While View B may be satisfactory for a while, additional detail – and even a pictorial rather than an iconic image of the ship – may be required: here, a purely semantic zoom to View C is needed. We have, in fact, already seen an example of semantic zoom within the bifocal display, where the representation of an object differs between the focal and distorted regions (Figure 4.8).

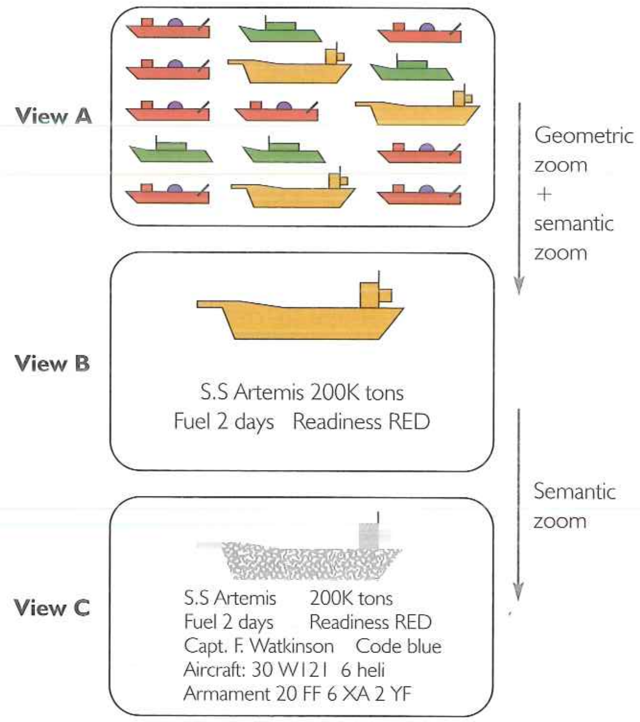

FIGURE 4.37
A combination of geometric and semantic zoom

All the examples of semantic zoom shown above stress the way in which it differs from geometric: with the latter an entirely automatic process (magnification) is involved, whereas with semantic zoom a *new representation* is involved. The design of the selective suppression associated with semantic zoom is far from being automatic; the interaction designer must understand the task that is being performed and the way it is carried out to be able effectively to design the sequence of data representations that will constitute semantic zoom. Such design is far from straightforward: there could well be a trade-off between content needed as a reminder of the previous view, content required for an overview and content to impart new understanding. An example illustrating these and other design issues is provided by a case study (Section 6.5).

4.2 Time limitations

4.2.1 Rapid serial visual presentation

Bringing selected data to the visual attention of a user can involve more than just a choice of layout within a given display area. Another design freedom available to the interaction designer is the opportunity to present data *sequentially* (and often quite rapidly) rather than *concurrently*. An example from the physical world is the familiar activity of quickly riffling through the pages of a new book in order to gain, in the space of a few seconds, some idea of its content. That activity can correctly be described as *rapid serial visual presentation* (RSVP). In its digital form a collection of images is presented (Figure 4.38) by showing each one separately, and in the same location, for a short period of time, typically 100 milliseconds. Even at such a rapid presentation rate there is a very good chance that a user will be able to correctly identify the presence or absence of a sought-after image. With the availability of the RSVP mode we now begin to see alternatives to the use of display area: the RSVP mode shown in Figure 4.38 (the 'slide-show mode') is now an alternative, for example, to the concurrent and therefore non-sequential presentation of the images at reduced size (Figure 4.39) in what we shall refer to as the 'tile mode'.

Perhaps surprisingly, the RSVP technique offers a potential solution for a very wide range of everyday tasks (Spence, 2002). There are, for example, many occasions on which it would be beneficial to 'riffle' rapidly through an unsuitably labelled folder ('New') to 'see what's there' or to see whether that folder contains a diagram whose location has been forgotten ('is it here?'). In a meeting where

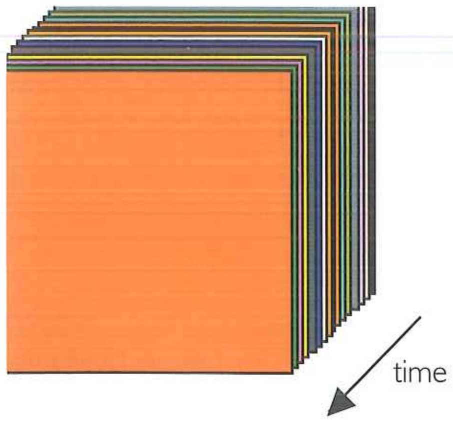

FIGURE 4.38 Rapid serial visual presentation (RSVP). A collection of images is presented, one at a time, at a rapid rate (e.g. ten per second)

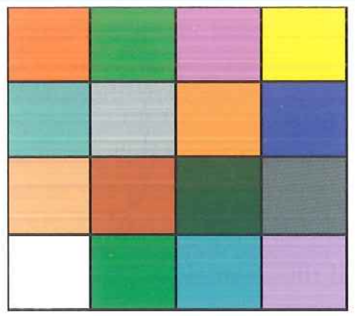

FIGURE 4.39 The concurrent presentation of a collection of images

participants have all their reports on their laptops, the task of finding a page of interest in a report is often approached in an RSVP manner, the rapid search enhanced by the user's memory of the appearance and location of that page ('the page with the greenish diagram bottom left, about half-way through'). On arriving home in the evening to watch television the question 'what's on?' might usefully be answered by some sort of riffling action through images taken from the many television channels. Searching among your photo collection for a known image to show to a friend is often achieved by riffling through a collection in a shoebox and can now be achieved by digital RSVP (e.g. iPhoto).

Even if a problem is ill-defined ('What can I buy Mum for Mother's Day?'), a rapid sequential view of items in either a paper-based or online catalogue can serve the user well and has much in common with a brisk walk around a department store. To address this problem, Wittenburg *et al.* (1998, 2000) demonstrated 'floating RSVP' in which images appear to start 'a long way away' and then 'move towards' the viewer, in a manner similar to that in which motorway signs appear to move towards you when you are driving. Figure 4.40 is a snapshot of the use of such an online department store; cursor position over the two arrows on the right-hand side permits manual control of the direction and speed of movement. Another variant of RSVP, called 'collage RSVP', was proposed by Wittenburg *et al.* (1998, 2000) again in the context of online buying and employs the metaphor (Figure 4.41) of depositing images (book covers in the illustration) on to a table top. Even though previous images will thereby eventually be masked, there is opportunity to identify one of interest and also to reverse the presentation. Lam and Spence (1997) combined manually controlled RSVP with the bifocal principle to provide convenient access to a library of films (Figure 4.42). RSVP also offers valuable potential to ameliorate the limitations of small display area in what might be termed a 'space-time trade-off'. This was explored in the context of Web browsing from a mobile by de Bruijn and Tong (2003) (see Section 6.3).

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A very different application of RSVP was investigated by Tse *et al.* (1998) and Komlodi and Marchionini (1998). The task addressed was that of discovering whether you want to watch a particular video or film, but without the need to start watching it at the normal speed of presentation. Tse and his colleagues arranged for the potential film viewer to see a rapidly presented sequence of 'key frames' so chosen that some gist of the film could thereby be gained. It was found that successful interpretation of gist could be maintained up to a keyframe presentation rate of ten per second. Some trailers for TV movies have similar properties, so that a second or two of viewing will often lead to a decision whether or not to view the entire movie. The page-flipping metaphor used to introduce the RSVP technique was also recently employed as the basis for Flipper, a system facilitating the visual search of digital documents (Sun and Guimbretiere, 2005).

Falta ref

To exploit the many potential applications of RSVP the interaction designer needs to possess some fundamental knowledge about how human beings perform when presented with a rapid sequence of images. Fortunately, cognitive psychologists began studying such performance long before the digital implementation of RSVP was a realistic proposition.