wonderful focus and intensity of activity that brings people together extremely effectively and nowhere is this more powerfully demonstrated than in the design project. Much recent mid-career management training has been based around the 'away-day' and the project as ways of building teams and collaborative practices. However in the design office the danger seems to be the reverse. The design team has become such an obvious organisational structure that most design offices put nearly all their resource into these teams. This leaves little effort for the conscious reflective thinking that might more easily enable knowledge to be transferred between projects.

Thus the group or team in design can be both a force for enhancing creative thinking within the project and yet also a force for separating out projects and thus an obstacle to learning and developing the organisation as a whole.

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15

Design as conversation and perception

Language can become a screen that stands between the thinker and reality. That is the reason why true creativity starts where language ends.

Arthur Koestler

a reflective conversation with the situation

Donald Schön

In this chapter we shall look at design as a process based on conversation and perception. In essence this means how designers come to understand problems and get ideas about solutions through a process that is conversation-like. A process that involves changing the way the situation is perceived by 'talking it through'. As the designer Kenneth Grange put it 'you do have to ferret around . . . to find that which is then suddenly obvious to you' (Cross 2001a).

In a professional context design is very often progressed by teams or groups as we saw in the previous chapter. Sometimes there are teams of designers from the same professional background usually because a job is too large or complex to be handled by one person. Sometimes the nature of the object being created involves many specialist areas and requires a multi-professional design team. In both such cases the design progresses at least partly through the conversations that take place between these team members. Normally such conversations are not recorded and so their importance as part of the process has consequently been rather underestimated in much design research. That these conversations are indeed important

only becomes apparent when we study designers in actual practice and talk to them about their process. I held a series of discussions with a number of leading architects that were used as part of my research for *Design in Mind* (Lawson 1994). Those conversations will help us here.

When the architect Ian Ritchie was describing his work he made it very clear that conversations within his team and with other players such as the client were central to his way of working.

> The first move is to talk through the brief, understand what has led to it, understand fundamentally what it is about and that conversation is primarily about building up a level of confidence, of trust. That is the very first move and it's nothing about buildings, it's not about solutions or ideas about buildings.

We shall return to Ian Ritchie's design conversations in due course. What is interesting here is the way in which Ritchie clearly emphasises the importance of his conversations with the client and in this case is quite explicit about using a language that is not about solutions.

First we should introduce a more fundamental way in which design can be seen to be essentially a conversational process. We can even imagine design to be a conversation when performed not by a team but by an individual designer. Donald Schön first suggested this idea when he talked of how a designer 'has a conversation with a drawing' (Schön 1983). In Schön's view, design drawings are part of the mental process of thinking about a design. In this view of design the designer performs the act of drawing not to communicate with others but to pursue a line of thought. As the image of the drawing develops it enables the designer to 'see' new possibilities or problems. More recently we have seen designers using computers and as a result having 'conversational' interactions with their computers about their designs. In the second and third editions of this book I included chapters on designing with drawings and designing with computers. In this edition both those chapters are replaced by this one. Since the third edition of this book I have also written much more extensively on the nature of design drawings and the way knowledge is encoded in them. I have also explored the problems of interacting with drawings or models in computers (Lawson 2004). In this chapter then we shall explore the whole idea of design conversations whether they are between people, between designers and drawings or computers or even carried out reflectively in the minds of individual designers.

Conversations and narrative

One of the most common forms of conversation is that of narrative. As we saw in Chapter 12, narrative can be used as a design tactic. The idea of telling a story in order to develop and give consistency to a design is quite popular. Some researchers from a linguistic background have begun to explore design conversations and concluded that the 'base mode of the conversation is narrative' (Medway and Andrews 1992). Although as designers talk to each other they move through more than one style of conversation, they usually return to a style similar to that of telling a story. We shall therefore begin our investigation by exploring the idea of narrative in order to see how this progresses our understanding conversations in design.

It is not uncommon for narratives to begin with some 'scene setting'. Although of course this may happen at several points in a story, nevertheless it is more common early in the piece. Scene setting most obviously involves describing the situation and the characters or dramatis personae. Major characters must not only be named and introduced but also given some characteristics that will enable us to interpret their utterances and actions. This also happens in design. We shall return to the design conversations of Ian Ritchie to explore this further. The first example is from his project for a new railway station for London Underground.

> We had a conversation yesterday about some smoke vents for the London Underground station which we designed. Obviously these are major features in a project like this.

So the story begins and the designer introduces us to some characters, smoke vents, and tells us that they will be significant in the narrative, or in this case the design. He then describes how the design team conversation explored the nature of these characters and effectively developed 'personalities' for them.

> We came down to air and it wasn't the kind of pragmatic issues and practical issues about how to move air, would air provide us with a central notion of how we could then develop a concept for a building. Is it dirty? Is it clean? What's the hierarchy of the air that's coming up the down pipe? That was finding, if you like, a kind of poetic notion, before we even think about a building or a concept for a building.

This seems rather like an author trying to work out how a character would behave in a dramatic situation given a particular background, personality and motivation. In another example Ian Ritchie was talking about how he arrived at the forms he used for his

remarkable glasshouses in the Parc de La Villette development in Paris. He introduced these elements of the building on which he was working, which was to be a kind of science museum (Fig. 15.1).

> We worked on these glasshouses in Paris which were in a way three places where the architect had asked for a view out at the park, he wanted vegetation and landscape, and he wanted to use solar energy. So you had the monumentality of these three glass boxes. Talking with people it became apparent, much more to me than them, that you couldn't do all these things because a greenhouse is about steaming up and not about looking out.

What we see here then is a process of introducing the objects as characters (glasshouses), defining their desired characteristics (views
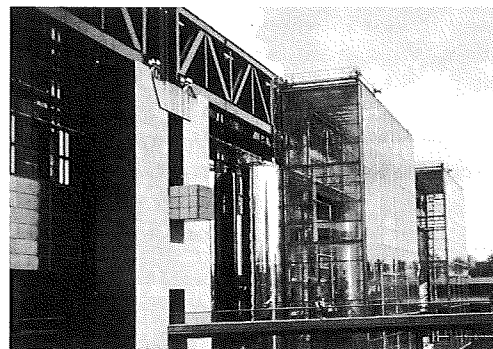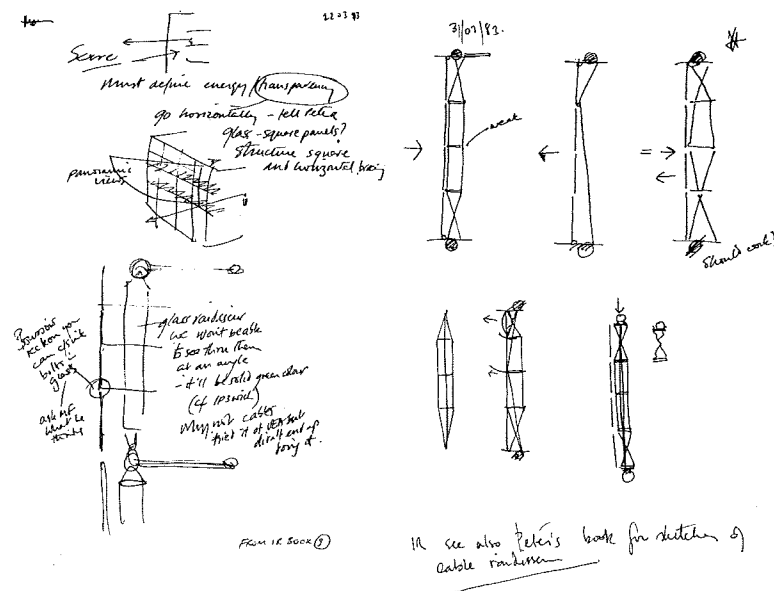

Figure 15.1
Two pages from Ian Ritchie's sketchbook exploring the ideas of transparency and panorama in the design of the glass pavillions at La Villette. The photograph shows the end result

out, vegetation and landscape, solar gain) and then through conversation identifying conflicts between them in terms of the possibilities for physical realisation. This first important step in the design conversation therefore is that of identification. This is very similar to what Schön called 'naming' (Schön 1984). Naming however seems too simple a word to describe properly what is happening here. Even in a normal conversation when you introduce someone, in addition to naming them, you often say something about them, perhaps where they work or who they are married to or some other aspect of their life which is relevant to the current context of the conversation. So it is in design conversations that the significant elements are not just named, but that their very character begins to be explored.

Here, in this design context then, Ritchie leaps in his conversation from the abstract ideas about 'vegetation' and 'solar gain' to his own experience of how these two are normally realised physically in a glasshouse. This experience leads him to see a conflict between the steamed up greenhouse and the 'views out' which are also desired in this case. This central and elaborate process of introducing characters is more than simply 'naming' and we shall therefore call it 'identifying'.

Conversations and negotiations

What we see next in Ian Ritchie's design conversation is a process of reconciliation of the conflict. As we shall see this is done through a very clever trick. It is all a matter of how you look at the problem it seems. Look from the right angle or perspective and the problem vanishes.

> There was a conflict and what we homed in on was in fact a notion of transparency, it wasn't about material. It was about how you define transparency. It took us actually quite a long time, in the end we decided that we had to play something on a clear surface to tell you that it was there. Of course the irony is that you use glass and when you're working perpendicular to it, its magic as it disappears, but as soon as you go oblique to it then it is opaque. So we learned from those conversations about the concept of transparency.

First of all then Ritchie attempts to 'think through' the problem by introducing the idea or concept of transparency. He realises that steamed up glass in conventional greenhouse frames will not achieve the 'views out'. However he also recognises the irony that a perfectly clear glass is invisible and gives no sense of being there. Next he

begins to talk about the technicalities of the solution rather than the abstractions of the problem.

> The idea that you have got a transparent plane and it's very big, 40 m high or whatever, you then have to develop an idea of how to hold it up. The notion of transparency; if it's not understood by everybody, very clearly, is very easy to miss, and in fact we missed it – three of us together and though we defined transparency, we ended up with a kind of vertical structure, a square grid. But then we were trying for the bracing of the glass, the wind bracing and everything else, we weren't relating it back to transparencies.

> Certain problems had emerged, things like maintenance, things like cost, and all these are extra. Then we suddenly realised that part of the idea of transparency was panorama, if this transparency had panorama you've got it. To us this implied horizontality which introduced other problems for us like maintaining something with a horizontal structure. Eventually that was how we arrived at the form you see.

Now we can see how this exploration of the materials that could be used in the solution had led to a form with which Ritchie was unhappy. His unhappiness relates to their failure to produce a solution that achieved the 'transparency' he had identified as a key quality of the desired 'views out'. Suddenly comes this moment of insight in which a new concept is introduced, that of 'panorama'. This carries with it an assumption of horizontality in the glazing pattern which changes the form from its previous vertical emphasis.

What is important here is just how much progress is made through this conversation. It matters not at all whether there are one or many designers, the process seems to be the same. A conversational interaction with the situation is taking place in which drawings and ideas each have their place. The ideas are undoubtedly processed through concepts described in words. These words have enormous significance since they represent a complex set of characteristics some of which may help the designer to see a way of proceeding. The drawings appear to reveal problems and enable the designer to see unsatisfactory situations. Together these two powerful forces combine to make the very essence of design thinking. However it is the very introduction first of 'transparency' and then of 'panorama' that enables Ritchie here to view the problem in such a way that all the conflicts are resolved. It looks much more like a form of negotiation than a form of moving from problem to solution based on some theoretical knowledge.

This introduces us to another common form of conversation that is helpful to our enquiry here. We shall now explore the idea of conversation as negotiation. In negotiation two or more parties

begin with disparate positions about some common purpose. The parties come into the negotiation taking different views and having different objectives but with a willingness to try to reach some form of agreement that all parties can accept. We can see the design process as one of negotiation too. Famous and public negotiations are often very tricky. For example in any industrial relations dispute or international squabble over territory the parties seem completely irreconcilable for most of the conversations they hold.

The problem and solution views

In fact the negotiation between problem and solution in design turns out to be every bit as tricky to resolve. Earlier on in this book the argument was advanced that problems and solutions have a curious relationship in design. In Chapter 3 we arrived at a diagram showing the design process as a negotiation between problem and solution (see Fig. 3.7). In Chapter 4 we saw how design solutions are often integrated responses to design problems. In fact one of the most beautiful examples of this integration can be seen even earlier in the book in the description by George Sturt of the dished cartwheel (see Figs 2.4 and 2.5). Later in Chapter 6 we saw how the architect Denys Lasdun described features of his National Theatre in London as integrated solutions. In both these examples what we see is that a single idea in the solution, the dish shape of the cartwheel or Lasdun's 'strata', simultaneously solves many problems. As we have also shown in Chapter 5, success in solving those problems cannot necessarily be measured using a single metric. For example we cannot measure the goodness of a view and the energy efficiency of a window with the same kind of scale. Even worse, the relative importance of all the problems a designer is solving is also not easy to establish clearly or objectively. It is no wonder then that negotiating a 'good' solution to a complex design brief is so tricky.

In fact it turns out that this tension between a problem view and a solution view of the situation is at the very heart of the way designers have to think. It is what makes design as an activity not only so challenging and frustrating but also so satisfying and compulsive. We have seen repeatedly in this book that designers tend to be 'solution focussed' rather than 'problem focussed' in their approach. I have written in *What Designers Know* about the way in which designers seem to accumulate knowledge about solutions (Lawson 2004). The role of this knowledge in helping to form

the guiding principles we have discussed in Chapter 10 is also explored. In essence designers tend to have relatively little theory that enables them to get from problem to solution. Rather they tend to acquire considerable stores of knowledge about solutions and their possibilities or affordances.

So designers have the task of negotiating reconciliation between these two views of the situation they are dealing with. The problem view is expressed generally in the form of needs, desires, wishes and requirements. The solution view on the other hand is expressed in terms of the physicality of materials, forms, systems and components. Since these two views share no common language this reconciliation requires some very clever mental tricks indeed. In this view of the design process then we do not really see designing as problem solving in the traditional sense of that phrase. We do not see designing as a directional activity that moves from problem through some theoretical procedure to solution. Rather we see it as a dialogue, a conversation, a negotiation between what is desired and what can be realised.

Skilled facilitators of negotiations know that progress is often best made by avoiding some areas of dispute where resolution appears difficult and concentrating on others where things look more promising. Often this results in reaching some agreement on minor areas with a consequent build up of feelings of confidence and trust which then carries over into considerations of the more intractable issues. Some experienced designers have suggested that the drawing may cause problems in this negotiation with a client. The use of words rather than graphical images can offer a less solution-oriented view in this process. The well-known British product designer Richard Seymour has described how he presented ideas to British Rail who wanted to develop a new InterCity train. They had invited a number of leading designers to submit proposals. The Seymour/Powell submission was not based on drawings but on the verbal explanation to British Rail that their design would be 'heroic' in the manner of the British Airways Concorde and that it would once again make children want to become train drivers as in early times (Fig. 15.2). Similarly the Czech architect Eva Jiricna has described how she communicates with her clients in verbal rather than graphical media. She tells how 'I try to express in words what they (the clients) want, and then I try to twist it into a different statement and then draw it' (Lawson 1994). Through this device Eva seems to be able to avoid her clients making prejudgements based on their previous experience of the kinds of rather hi-tech materials she often employs. The verbal
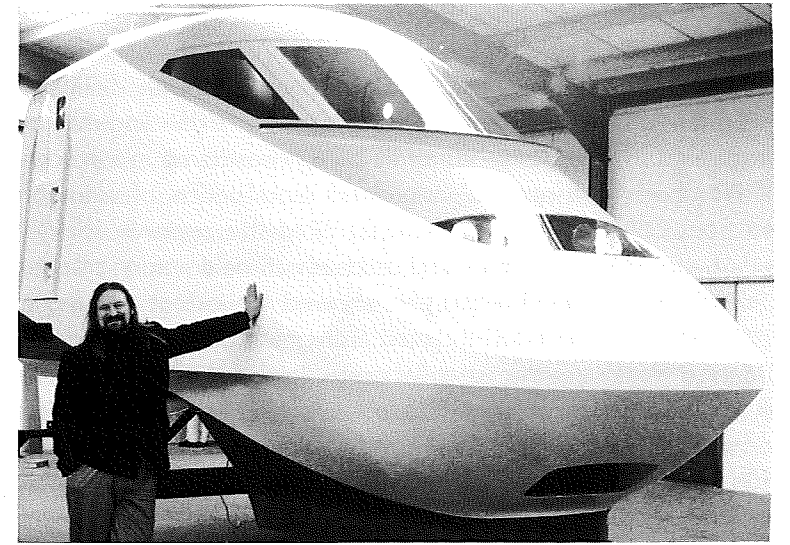

Figure 15.2
Richard Seymour with his design for a train intended to make children want to become engine drivers again

description allows people to interpret shades of meaning not allowed by the drawing. In the same way we can easily be disappointed by the film of a book we have previously read. During the reading we will have built up our own image of the characters and places which the film has no alternative but to contradict.

Nigel Cross has shown the importance of the conjunction between drawing and talking in design groups (Cross 1996). In his study a design group was trying to design a device for carrying a hiker's backpack on a mountain bicycle. Cross showed that well over an hour into the design process one member of the group introduced a design concept with the words 'maybe it's like a little vacuum-formed tray'. Prior to this point the team had been using the word 'bag' as a way of describing to each other what they were trying to create. The word 'tray' was sufficiently evocative without being too prescriptive, and this word then continued to be used by all the members of the team in turn as they drew alternative interpretations of how this might work. In the protocol that Cross was studying this moment of introducing the word 'tray' had enormous impact on the final design. Quite simply it changed the designers' view of the situation.

Eckert and Stacey (2000) showed in an interesting study of fashion designers how conversations about designs are largely based on references to previous solutions. They found that knitwear designers talking among themselves 'describe design almost exclusively in terms of combinations and modifications of design elements that they refer to either by category labels or by their origins'.

An example of this offered by Eckert and Stacey is 'a jumper like the blue one last year, but a bit longer and with a V-neck'. This research also linked the work to a previous study of helicopter designers working for GKN Westland, which suggests that this finding may be fairly generic. Thus a design currently being considered in a process was described as a recombination and modification of elements taken from previously known designs. What this research showed was that enormously complex sets of ideas can be communicated in this simple way. Of course this also showed the extent to which a group of designers needed to share a common understanding and knowledge base in order to collaborate. In the previous example then as the authors point out 'blue' or a 'bit longer' has a different meaning in 1999 than for 1996. This leads to a whole language of design based on an understanding of design concepts and precedent that is extremely powerful and economical but only works if the schemata used are shared. 'Often the referents of the designers' descriptions are nowhere to be seen, but are simply part of the designers' shared cultural experience' (Eckert and Stacey 2000).

Negotiating between the problem and solution view

Maher and Poon (1996) talk of how designers 'play around with ideas to get more understanding about the problem rather than focus on just finding a solution'. They go on to develop what they call a 'co-evolution' model of designing using the paradigm of genetic evolution algorithms. In this model they see a series of solution states each evolving from the previous one in parallel to a series of problem states again each evolving from the previous one. However in the Maher and Poon diagram there are cross-influences in both directions so potentially each evolutionary development is the product of the previous state in both the problem and solution series. They suggest that this highly ingenious notion could be implanted in software to produce design-like thought, although the examples they give do seem to belong to the world of fairly well-defined and highly constrained problems.

   In a delightful study Dorst and Cross (2001) showed real evidence of the validity of the Maher and Poon co-evolution model in some design protocols. However even more interestingly they suggest that adherence to this way of thinking may be characteristic of design processes which we consider to be creative. They set nine

industrial designers the task of designing a new litter disposal system for new trains on the Dutch railway network. Remarkably all nine designers followed a similar reasoning path which hinged around connecting various separate pieces of information about newspapers. In different parts of the brief these were identified as a significant proportion of the refuse generated on trains, often left behind on luggage racks, and as being a nuisance to the train cleaners. Again elsewhere in the brief, the client expressed a wish to develop a more environmentally friendly image. Each one of Dorst and Cross's designers finally arrived at a solution which involved collecting and keeping newspapers separately from other refuse and designing special containers for them. Thus they effectively took on a new problem; that of designing a container specifically for the cleaners to collect newspapers in. Amusingly Dorst and Cross observe that the designers also all thought they were being original and creative in doing this! As Dorst and Cross point out, this behaviour aligns beautifully with the Maher and Poon co-evolution model. It was possible to see in the protocols a process in which pieces of information in the problem were collected together to form a single idea that led to an evolution in the solution state and a redefinition of the problem.

Framing

So we have discussed the idea of conversation as negotiation. We have seen forms of this negotiation to resolve conflicts and forms of negotiation between the problem and solution view of the design situation. What is common here is the idea that somehow, through a clever mental process, some obstacle or conflict is simply removed by taking a particular view. In all such negotiation the skill lies in finding this view. In the design process the equivalent of this can be seen in an activity that Schön has called 'framing' (Schön 1984). In a way this framing process is similar to the idea of the primary generator which we introduced in Chapter 3 and discussed in Chapter 11. In the sense that it has been used in those discussions a primary generator is most normally a solution-driven idea. Quite simply a suggested form of solution is proposed and the implications of this are then explored. Schön's idea of framing is a rather looser notion and is often seen as more problem driven. In truth it is not entirely clear exactly what Schön meant by a 'frame'. The idea is none the less useful for its vagueness, and we

might note in passing that vague language is often helpful in the more sensitive periods of negotiations!

A frame however can be seen to be a sort of window on the world. In our case that world is the design situation. Looked at from some angles the situation looks difficult to resolve whereas from other viewpoints it might seem much less tricky. One way of thinking about this would be the 'video referee' now used in a number of sports such as rugby and cricket. A complex event has just occurred on the field and the referee or umpire was not able to tell in real time from his position what the correct decision should be about this. A so-called 'video referee' then watches video clips from several angles to help make the decision. Some of these angles may be relatively uninformative but sometimes one of them makes the whole situation much clearer and as a result the decision is easily made. In design conversations a frequently employed form of negotiating is to select a particular view of the situation in such a way that what appeared to be difficult becomes clearer or what appeared to involve conflict can be seen to be harmonious. In Ian Ritchie's conversation this was done through the idea of turning 'transparency' into 'panorama'. This slightly different way of seeing what was really required enabled a new design solution to emerge that then allowed the designers to reconcile conflicts.

It is highly likely that experienced designers will have their own ways of framing situations which they have used before and which have proved helpful in the past. We can see that the guiding principles we discussed in Chapter 10 may well offer sources of inspiration about such frames for experienced designers. Nigel Cross studied the British product designer Kenneth Grange who could be described as having a set of guiding principles about the importance of radical constraints or primary functions (Cross 2001a). His varied output is characterised by products that reflect in a very direct and modern way their main purpose, their usability and their construction. So Grange it seems would frame his problems through the eyes of the user. 'I start entirely from the point of view of, can I make the use of the thing better'. One of Grange's most influential and well-known designs was the Kodak Brownie Vecta camera. This was to be seen hanging around the neck of a whole generation of amateur snap-shot takers and at the time became quite iconic. Grange totally reversed the form into a vertical or portrait format rather than the more normal horizontal landscape format. This he did after realising that the vast majority of pictures that were going to be taken with this sort of equipment were of people. According to Cross, it was almost literally the case that he

saw the problem through the eyes of his users, and Cross describes this 'as though his ability is primarily perceptual'. Grange also gives us an insight into this process by telling Cross that 'you do have to ferret around . . . to find that which is then suddenly obvious to you'. Grange also refers to 'unlikely analogies' as being the secret of his process. It seems then that this is a process of turning the problem around, describing it in different ways, explaining it to other people, talking to the client, in fact any form of conversation that might reframe the situation until some alignment becomes obvious between what is desired and what can be realised. Such a moment is recognised frequently in the descriptions of creative designers.

Conversations as shared experience

We must also remember however that design is very often a team activity and so the way in which these ideas are shared by the team is likely to be important to us in developing our understanding of the process. The idea of conversation can help us again here too. Another characteristic of normal conversations is the extent to which they reinforce the idea of shared experience. Conversations at work in which colleagues discuss the programmes on television the previous evening or the football or hockey match played by their local teams are obvious examples. The way in which we like to reminisce and recall social occasions from our past offer other popular examples. In a normal everyday conversation one participant may comment on the weather that day. Such a comment only works if the other participants share the ideas about what makes pleasant or unpleasant weather. Imagine how unsustainable such incidental gossip would become if you were talking to an interplanetary visitor unfamiliar with earthly climates. It seems that teams gain social strength through shared experience and that such events and the conversations that surround them offer ways of establishing strong ties and bonds.

Again this seems to have a parallel in design, most particularly in long-lived creative design teams. In the previous chapter we saw some examples of the work of the architect Richard MacCormac. As has been shown elsewhere his practice uses key shared concepts to progress their design ideas (Lawson 2004). Conversations with several members of the practice revealed popular words representing sophisticated sets of architectural ideas. For example the rather unusual word 'belvedere' being used widely in these conversations

suggested strongly that the ideas it represented were discussed by the members of the practice. This phenomenon of using simple words or phrases to represent complex sets of ideas that the members of a design practice understand seems particularly significant for creative teams. As we have seen, the design process often involves very fast and intense periods of idea creation. The conversations that go on at these stages must therefore be very high level and rapid too. It simply would not work if every major concept raised in the conversation had to be explained.

The conversation with the drawing

We have already discussed the relative advantages of words and images in designing. However there can be no doubt that the drawing process is generally central to most design processes. In an earlier edition of *How Designers Think* I developed a model of the kinds of drawings that designers use which was based on an earlier taxonomy first suggested by Fraser and Henmi (1994). In fact that model has since been taken rather further and become more elaborate as research has suggested its initial inadequacies. It will not be presented here in its entirety since the reader can find it in *What Designers Know* (Lawson 2004). What is important for our consideration here however is not the whole model but those kinds of drawings with which, as Schön put it, designers have conversations. Technically this is possible with any kind of drawing. Indeed it is possible too with text. When I write this book I do not know in advance every detail of what I am going to say. I have a rough idea, some major themes and an overall structure. As the text begins to emerge on the word processor I may from time to time, and indeed I do, change my mind. In a sense then my own words speak back to me, as if I were talking to myself, and when I hear them I may feel the need to make adjustments. This is what Schön described as 'reflection in action'. I am sure a musical composer must go through a similar process of writing, listening and revising. Perhaps the process is more noticeable in a drawn medium which is not linear and sequential as the text and the score are. The order in which a viewer gets information from a drawing is not determined by the author. Even the order in which we draw is less predictable and structured. When designers are producing drawings entirely for their own benefit as opposed to presenting information to others, this reflective process is almost the whole point of the drawing.

It is these design drawings, sketches, scribbles, diagrams and the like that most offer this conversational potential. This was perhaps most eloquently described to me by the great architect/engineer Santiago Calatrava (Lawson 1994).

> To start with you see the thing in your mind and it doesn't exist on paper and then you start making simple sketches and organising things and then you start doing layer after layer . . . it is very much a dialogue.

A particularly charming example of the designer having such a conversation with a drawing was first shown to me some years ago by Steven Groak who had heard the Italian architect Carlo Scarpa describing how he designed a handrail detail for his wonderful Castelvecchio Museum in Verona. Scarpa worked over several years in the building itself, designing and drawing as construction work proceeded. This process has been lovingly researched by Richard Murphy and is beautifully documented in his excellent book (Murphy 1990). Scarpa's work is notable for the way he has designed around the methods of construction employed by the craftsmen who built the work. So as Scarpa was drawing we may assume that he was also imagining the process of construction and Groak's account of his description of the process confirms this.

In the example shown here Scarpa is designing a balustrade for one of the galleries that leap across the spaces of the Castelvecchio (Fig. 15.3). He is drawing the junction between the handrail and the
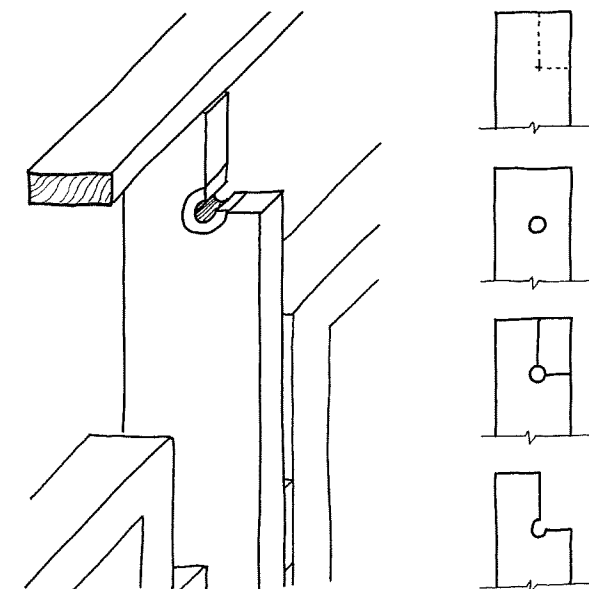

Figure 15.3
A reconstruction after that by Steven Groak of how Carlo Scarpa developed a detail through drawing the construction process

vertical posts which will support it. The width of the handrail is narrower than the posts which are needed to support the balustrade. Almost certainly this is an example of Scarpa resolving the size of a rail which fits comfortably in the hand with the structural depth of the post. However the transition is, typically for Scarpa, very carefully detailed. It is characteristic of Scarpa that such a problem would not be dismissed, or even concealed, and that junctions of these kinds were often clearly articulated. Groak explains how Scarpa achieved this kind of detail by drawing (Groak 1992):

> In drawing the lines to show where the cut edges would be, he encountered the familiar problem of the draughtsman: how do the lines cross? Do they overlap? Or stop at a point? Scarpa realised that the carpenter would face an analogous problem in cutting the piece of timber (although in fact it is not a complicated task for a skilled craftsman). Eventually he decided that the carpenter should drill a small hole at the intersection of the lines, so that the saw would change tone when it then hit the void and produce a clean cut with no overrun. To complete the detail, he then designed it to have a small brass disk inserted in the circular notch left behind . . .

One can see in this sequence of drawings how Scarpa first draws the lines, then sees the problem and finally solves it. Thus the drawing appears to talk back to the designer enabling a problem to be discovered and a solution created.

However there remains the danger which we saw in Chapter 13 of falling into the 'icon trap'. That is to say the drawing begins to dominate the conversation, sets the agenda and ultimately becomes the designed object replacing the original objective. This trap seems at its most dangerous the further designers are away from the process of making. When a design is highly unlikely to be realised then the drawing inevitably becomes more potent. Sadly this is the case for the vast majority of design projects completed by students during their education. No wonder then that students can develop a conversational style with their drawing that is not entirely constructive.

This is then a matter of the balance of power in the conversation. Herman Hertzberger expressed a concern about allowing the balance to go too far in favour of the drawing (Lawson 1994).

> A very crucial question is whether the pencil works after the brain or before. In fact what should be is that you have an idea, you think and then you score by means of words or drawing what you think. But it could also be the other way round that while drawing, your pencil, your hand is finding something, but I think that's a dangerous way. It's good for an artist but it's nonsense for an architect.

One can sympathise with Hertzberger's view here that the design drawing is not in itself an end product in the way a piece of art is. On the other hand research evidence suggests that designers, just like artists, do get inspiration and ideas from their drawings that they did not imagine in advance. Schön and Wiggins (1992) have described this as 'unexpected discovery' and it does appear to be a significant influence in the design process. Suwa and Twersky have studied the way designers work with drawings in a more controlled setting. Their work clearly suggests that designers respond to the geometric properties of drawings as they develop them and from this may 'see' other ideas than those that were in their mind before they began the drawing (Suwa and Twersky 1997). The Scarpa drawing already described here offers an excellent example of this phenomenon. In particular what this research suggests is that these design drawings tend to be of solution features rather than problem states. However it is the formal and figural properties of their own drawings that designers appear to attend to. The work shows that a high level of activity involving such considerations often follows the act of drawing. The drawings then are primarily images of the materiality of what might be, while the designer may also be considering the more abstract sets of needs and wishes. But since the drawings do not actually have to be constructed or manufactured the material constraints on them can be relaxed or tightened at will. It seems then that the drawing does indeed offer the potential to be a 'perceptual interface', as Schön and Wiggins describe it, between function and form (Schön and Wiggins 1992). Goldschmidt has also described this process in conversational terms by calling it the 'dialectics of sketching' (Goldschmidt 1991). She points out how sketches enable a dialogue between 'seeing that' and 'seeing as'. For her 'seeing that' is a way of summarising the process of reflective criticism and 'seeing as' represents the process of making analogies and reinterpretations. In fact it is one of the most flexible and powerful tools for conducting the conversation of negotiation between what is desired and what can be realised.

Conversations with computers

In the first edition of this book I included a whole chapter on designing with computers. At that time using computers in design was relatively innovatory at least in practice if not in theory. Now there are many books on the subject of computer-aided design

and there is hardly a design studio where computers have not replaced at least some of the drawing boards. This is not a book about computer-aided design any more than it is a book about drawing. For these reasons it no longer seems appropriate to continue to devote a special chapter here to what is a major subject in its own right. We are however interested here in how designers interact with computers as part of a design process. There are several questions here. Those questions are not so much about what computers can do as what they cannot do. They are not so much about what happens inside the computer but how we converse with it.

Amongst the most fundamental questions we can ask here are: what knowledge do designers exchange with computers, for what reasons and how? They are also really beyond the scope of this book as I have discussed them more thoroughly in *What Designers Know* (Lawson 2004). However a brief discussion of how we converse with computers is useful in the context of seeing design as conversation. In fact much of what is called computer-aided design is in reality computer-aided drawing. Even this does not interest us here as this kind of drawing is most often for presentational purposes rather than as part of the design process itself.

Computers so far cannot design in anything like the sense that we use the verb in this book. They may be able to solve well-constrained problems, but they cannot design in any of the fields we are discussing here. So if computers appear in the design studio, other than as rather smart drawing boards, their purpose must be to aid design. If this is the case then we must assume that the greatest responsibility and certainly the final say will rest with the human designer. Again logically this tells us that the human designer will necessarily be in a conversational relationship with the computer. In fact the designer is going to have to describe the design state and then interpret some modification of it as suggested by the computer.

In general, designers seem to find this experience of using computers a frustrating one. Many well-known and successful designers have articulated their opposition to using computers in their design process. Santiago Calatrava, although using computers for structural design packages such as finite element modelling, prefers to use real physical models to computer-based ones (Lawson 1994). Others rely on computers but leave specialist staff to interact with them. The amazing work of Frank Gehry relies heavily on a great deal of computer technology for its realisation but Gehry himself prefers not even to see the screens of the computers (Lindsey

2001). Gehry is thus lucky to be able to have conversations with the members of his staff led by Jim Glymph who look after all the technology and effectively hide it from him.

Of course the computer can save designers huge amounts of time in the way my computer did for me when I was writing this book. I well remember that the first book I ever wrote had to be done on an old fashioned typewriter. It was a painfully slow process that invited no reflection or interaction. There was no easy way to make simple changes, you just had to type it all again. So of course the editing and interacting capability of computers helps designers to make images. But even here designers often describe it as rather a remote process. As Nigel Cross rather disappointedly asks (Cross 2001b):

> Why isn't using a CAD system a more enjoyable, and perhaps, also more intellectually demanding experience than it has turned out to be?

So what is the problem here? The answer to this simple question is actually rather complex and much of it beyond the scope of this book and certainly this chapter. I attempt some of the answers in *What Designers Know*. Here we should continue to concentrate on this conversational view of design. A real problem with much computer software in general and much CAD software in particular is the way in which the conversation has to be on the computer's terms rather than the human designer's terms. There are several reasons for this. Often the capabilities of the software to perform a multitude of clever tricks, most of which most users will never even bother with, means that the whole system becomes extremely complex to understand. Again my word processing software offers a good example. I have been writing with this system for many decades now but I have never read the manual or gone on any training courses because I am just too busy. As a result I am aware that there are many menu commands and features that I do not use. I can even see that some of them might be useful but only on rare occasions. I know that the opportunities to exploit these features will be so few and far between that even if I learn them I will have forgotten them by the time the next chance to make use of them arrives. So it is with computer-aided design systems but even more dramatically so.

CAD systems suffer from a much worse problem compared with word processors. Putting the text into a word processor is generally an obvious and straightforward task that does not require attention and therefore does not distract me from thinking about what I am

actually trying to say. This is not the case with CAD systems. Even simple graphics systems have their own way in which you must enter information. A relatively simple task such as drawing a closed polygon or constructing an arc requires some knowledge about the system itself. A more sophisticated task involving the description of three-dimensional form is an altogether more demanding affair. If the geometry becomes irregular and in particular if it becomes curved and irregular then the whole process is likely to require highly specialist knowledge. No wonder Frank Gehry exploits his luxurious circumstances and has staff who manipulate this knowledge for him.

But even this is not the whole story of the frustration designers have in their conversation with computers. When we talk to other designers, they understand not just the shapes and forms but also the materials, systems and components that the drawings represent. In the case of architecture in particular, designers understand that actually it is what is not drawn that is really important, for architects are really manipulating space. Computers have little or none of this knowledge and are thus generally rather dumb in the conversation. They can perform some clever tricks such as viewing the objects from an infinite variety of angles and rendering them under natural or artificial lighting conditions but here they are really acting as little more than smart drawing boards. If we want to discuss with a computer how well a design might work in some functional or technical way then the computer needs knowledge not just about geometry but about what the graphical elements actually represent. So far this has turned out to be remarkably difficult to achieve reliably and efficiently.

Of course all sorts of research work has been done, and continues to be done to counter all these conversational problems of computers. Some argue that it is simply a matter of time. Once we have big enough and powerful enough computers and we have worked out all the clever algorithms needed, they will talk to us just like another human being, or so this argument goes. Essentially this is the argument behind the whole Artificial Intelligence movement. So successful has this movement been in a relatively short time that the argument appears quite convincing and of course it is remarkably seductive. It is not long ago that the opponents of this movement were saying that although we could write clever little chess playing programs, computers would never beat the grand masters. Well now they can and they have. We already have handwriting recognition and voice recognition and some limited natural language translators. So surely computers

that can converse with us meaningfully about design cannot be so far away?

However there is another school of thought (Dreyfus 1992). Such a view holds that there is something quite different about some kinds of human cognition that simply cannot be reduced to the kinds of simple representation needed to put information into computers. This view claims that although we have crude natural language translators, it will never be possible to instruct a computer to translate sensitively and as accurately as people can. Such a view holds that the act of designing as we have discussed it here is probably even more uncodable. Designing is not just an extension of complex problem solving or of playing chess. It involves some cognition that is fundamentally different from those kinds of activities. It is probably one of the main reasons why designers find it so difficult to explain what they do and to discuss their ideas with their clients and users. It is to do with the fact that there is no text book for design students and there are no overarching theories that designers rely upon to practise. It is to do with the apparent lack of boundaries around the knowledge that may be useful when designing even the simplest of objects. Above all it is to do with the curious and beautiful relation between design problems and their solutions. Quite simply it is what this book is all about.

So in terms of our conversational view of design, certainly at least for now, and probably for the foreseeable future, we need an interpreter before we can talk to the computer. This is hardly the direct creative conversation that we have been discussing in this chapter. Our point here is not to attempt an answer to this or any of the other multitudes of problems of using computers in design. That argument belongs elsewhere. Our interest here is the further evidence that this frustration with computers provides of the very natural, conversational and immediate way in which designers think.

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16

Towards a model of designing

The kinds of knowledge that may enter into a design solution are practically limitless

Goel and Pirolli, *The Structure of Design Problem Spaces*

You think philosophy is difficult enough, but I tell you it is nothing to the difficulty of being a good architect.

Wittgenstein, *Conversation with M.O'C Drury 1930*

This book has relied upon a great deal of research to develop its arguments. Some of the data behind those arguments are the author's but much were collected by others. A brief look back through the book will show that a tremendously wide range of research methodology has been used in design research. It is possible to classify all these approaches.

Ways of investigating design

When the first edition of this book was written in 1980 there was relatively little empirical research into the design process. Most of what had by then been written about designing was based not on gathered evidence but on introspection. A number of designers had simply sat down and reflected on their own practice and what they thought must be happening. Thus many early writers described not a design process they had observed, but one they believed logically must take place. Perhaps some, whose work was then known as 'design methods', even described a process they thought ought to happen. Examples of this sort of work are found in Chapter 3 and would include attempted definitions of design