Marking and making : a characterisation of sketching for typographic design

Thesis

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Marking and making

a characterisation of sketching for typographic design

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Marking and making a characterisation of sketching for typographic design

Abstract

This research rests on the premise that sketching in paper and pencil is crucial for typographic designers when designing documents. The aim has been to derive a characterisation of the salient aspects of sketching, through an ethnographically-oriented study of designers' use of paper and pencil. The people studied were professional typographic designers, but both the motivations for the research and the characterisation deriving from it relate to other design disciplines, notably industrial and engineering design and architecture. The goal was to identify the underlying functionality supported by sketching, in order to inform the design of future tools for document creation. The characterisation is presented as a framework, with seven main categories: visual characteristics of marks; basic semantic units of design; visual features of sketches; visual and tactile features of sheets of sketches; affordances of sketching; functionality required to support sketching; capacities of the traditional medium. The first four categories deal with the visual qualities of sketches, such as image quality within the line and recurring features in sketches such as different scale, closure, and degree of detail. The functions supported by sketching are suggested to be: interpretability, focus, comparison, simulation of experience, ideas capture and record making. The functionality identified as necessary to support sketching includes the appropriate speed of image generation, image emergence, image manipulation, and image capture and record making. Also necessary are high speed and ease of switching between all the strands mentioned above, and singularity of focus. The supportive capacities of the traditional medium include a rich vocabulary of marks, high image definition, and the *continuum-of-activity* through the *continuity-of-medium*, i.e. the natural progression from sketching on paper to making simulations out of paper. In recognition of the respective strengths of the traditional and electronic media, integration between the two is recommended for the design of optimal document creation systems.

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1 INTRODUCTION

The humanist, then, rejects authority. But he respects tradition. Not only does he respect it, he looks upon it as something real and objective which has to be studied and, if necessary, reinstated.

Erwin Panofsky
Meaning in the visual arts

1.1 Historical and current background

This dissertation explores the act of sketching by contemporary professional typographic designers in the early stages of designing documents, through their use of the traditional paper and pencil medium. The findings are summarised as a characterisation of sketching in this medium, with particular emphasis on the visual and tactile aspects of the sketches themselves.

Humans have been making drawings in a lasting medium for more than 20,000 years. The cave paintings of Altamira, Spain, for example, are among the oldest known and best preserved graphic objects made by our ancestors (Hogben 1949). The brush pencil, the precursor to the modern pencil, was in use in Egypt from 1800 BC (Petroski 1990). The earliest portable substrates used for drawing were baked clay bricks, sheets of metals (such as brass, copper, bronze and lead), strips of wood, bamboo, leaves, bark and papyrus. The Chinese are credited with being the first to make paper in a form recognisably similar to the modern product, from around 105 AD (Hunter 1957). So the act of drawing and the tools and materials we use today are rooted in activities from ancient times.

Drawing to support designing, that is, the use of sketching to capture and explore ideas, as opposed to drawing purely for pleasure or decoration, is also a long-established activity. On display in the Musée de l'Œuvre Notre Dame in Strasbourg are the intricate plans for Strasbourg cathedral, which date from the thirteenth to the fifteenth centuries. Leonardo da Vinci kept multiple sketchbooks, documenting his design ideas (for some excellent reproductions see Galluzzi [ed] 1987), while the nineteenth century American architect Frank Edbrooke is recorded as having used nearly two tons of paper for his plans for Denver's Brown Palace Hotel (Dunn 1989, 39). More recently, since around the first decade of the twentieth century, when typographic design became a recognisable activity distinct from the traditional printer's craft, paper and pencil has been the medium for designing in this profession too.

Given the history attached to drawing in the traditional medium, and the use of sketching for designing, the specialist activity of sketching for typographic design clearly merits careful study. In addition to the intrinsic value of understanding this activity, however, there is now another, more pressing reason for articulating sketching specifically for typographic design. In the early 1980s document production was revolutionised by desktop publishing. Certain electronic systems became almost immediately ubiquitous, through being relatively inexpensive and having an interface design oriented towards the non-computer-specialist. These factors opened up the world of document design and production to anyone with access to a personal computer linked to a laserprinter.

The appeal of such systems lies in their apparent promise of easy, cheaper, local production of documents with a high-quality appearance, previously

available only through the channels of specialised designers, printers and publishers. The true picture for the lay person is probably somewhat less ideal, since, for every hour a trained designer spends on a document's layout, the non-designer must spend at least that, if not more. Consequently, though a designer's, editor's, printer's and publisher's fees may not be explicitly charged to complete a job, the demand to perform these specialists' tasks will cost the layperson at least their equivalent in time. In addition, the results may not be satisfactory to the lay person even after considerable personal investment. Such hidden costs are hard to quantify, but are worth considering for their broader implications.

We may also speculate about the more subtle but pervasive consequences within society of such changes, which blur the distinction between professional and non-specialist activity. The scope of this dissertation precludes discussion of the relative merits and drawbacks of such social change, but these changes are important to note because electronic publishing systems have had such an impact that, whatever their actual or perceived advantages and disadvantages, they are now firmly established in our culture. They have made inescapable inroads into daily life for millions of office workers, as well as entering the work practice of specialised design professionals.

Therefore, because such systems now affect directly many more people than just the small core of professional document designers, there is an urgent need to assess the practice they are intended to support. By studying professional designers we learn about the intricacies of work practice at its most skilled. From the knowledge thus gained we may also extend research into lay users' practice and hence be better informed about

their needs. Thus, we will be in a more informed position to develop systems that answer the differing needs of both professional designers and lay users.

The primary goal of this research has been to identify the salient features of sketching in the early stages of designing documents, so that we may be accurately and adequately informed to build appropriate tools to support this activity. Despite their arguable advantages for document *production*, current electronic document production systems do not support sketching. Since sketching is tightly bound to the activity of designing, these systems are, therefore, not supporting the activity of document *design*.

The motivation for this research derived from the author's own experiences as a typographic designer. The primary research method has been looking, the primary research skill, seeing. Both these capacities arise from conventional training and practice as a designer, and they mean that the perspective brought to this research is somewhat different from that held by the social scientist, the cognitive psychologist or the systems engineer — the disciplines more commonly associated with studying human activity and building tools to support it.

There is a clear, if sparse, history of designers and craftspeople themselves offering articulations of their practice to others outside their professional reserve. Sturt's *The wheelwright's shop* (Sturt 1942) is the classic account, still valued today. In the typographic world, Moxon's *Mechanick exercises on the whole art of printing* (Moxon 1683/1962), Bradshaw's *Design* (Bradshaw 1964) and Williamson's *Book design* (Williamson 1983) provide accounts which describe and explain from the immediacy of personal professional experience. The research documented in this dissertation follows something

of this pattern, in that it includes active practitioners' own observations and speculations about their work.

The typographic designer designs alone. Social interactions the designer has with other designers, the client and others associated with document production (printers and binders, for example) will naturally have some influence on the designer's activities and decisions. But the major part of the designing is carried out by a single individual, who holds together all the strands of the emerging design, both in memory, and through notes and sketches.

1.2 What is typographic design?

Typographic design is the design of primarily textual documents. The typographic designer considers and makes choices to resolve both the layout of a document's 2-dimensional surface – the appearance of the text itself – and the 3-dimensional aspects of the whole physical artefact, whether it be a book, a tax form or a bus ticket.

In reaching a design for the layout of the 2-dimensional surface, the designer addresses the connection between the semantic content of the text and the appropriate graphic presentation for the text (Southall 1988). This involves decisions about the style and size of the type, interlinear spacing, text measure, margins, position and size of folios, running heads, footnotes, treatment of numbering of listed items, and so on. Each of these decisions has a bearing on all the others, and so each needs to be borne in mind while another is worked on. In resolving the appearance of the 2-dimensional surface the designer has only two things to work with: the spatial

relationships between the elements, and the typographic attributes of the elements (use of particular typeface and size, bold, italic, uppercase, etc.). The way in which the designer manipulates these possibilities, individually and together, is addressed in more detail in Chapter 4.

In addition to, and in association with, resolving the 2-dimensional aspects of the document, the designer derives a solution to the 3-dimensional requirements of the whole object. The properties of the 3-dimensional object both influence and reflect the visual presentation of the semantic content of the document, to form a coherent, pleasing and identifiable whole. The genre of a document (Waller 1987), which conforms to our culturally derived expectations, enables readers to recognise and therefore accurately parse a textual document, both by its surface appearance and by its 3-dimensional characteristics.

The exercise of typographic design is, therefore, a set of networked considerations, each of which must be treated and developed in association with all the others to evolve a complete solution. Although the practice may on the surface appear to be serial, and therefore easily divided into discrete pieces, this is more an artefact of the uninformed observer's perceptions than a true reflection of the whole practice, much of which is hidden from view. As with all design, the typographic designer makes, looks at and evaluates her design iteratively, though not necessarily in a set of easily identifiable, nor predictable, discrete steps.

The typographic designer's aim is to create a design that functions well. This means both making the message content accessible to the reader and creating an appearance that is aesthetically pleasing. The former is the

designer's primary motivation, but the latter is important as well, since a document that is visually jarring is harder to read and could therefore be judged to have failed in its functional aspect.

For the purposes of this research, the term typographic design has been used to refer only to the design of documents whose final form will be paper-based. The design of purely electronic documents is not addressed, as this constitutes at least another thesis in its own right. It is likely that aspects of one relate to the other, both in terms of design and use, but these connections merit deeper consideration than the confines of this dissertation allow.

1.2.1 The role of context in typographic design

There are several aspects of context that play a crucial role in typographic designing, each of which influences the emerging design. One kind of context is the physical context or environment in which the designing takes place. The designer's own workspace is a customised environment fit for the myriad operations the designer carries out. This customisation includes acquisition of particular tools for particular tasks, and personalisation of the physical space. This takes the form of collected and self-made artefacts being hung on the walls and left around on available work surfaces. These artefacts all provide visual stimulus, which may be consciously sought or simply present on the periphery of the designer's attention. Black has observed of designers she studied (Black 1990, 286):

> It is common for designers to pin up part-finished drafts around the area in which they are working so that they are open to their own reflections (even at times when attention is not specifically directed to them) and to responses from colleagues.

Tang observed of designers he studied that, even when they were transferred to an alien, otherwise sterile laboratory setting, they tailored their workspace, including bringing their own writing and drawing instruments to the session (Tang 1989). So this kind of physical context is actively created by the designer seeking visual prompts, communication with neighbouring designers, and a congenial, functional workplace.

A second kind of context is the more nebulous, but equally important one that may be termed the design constraint context. This is shaped by factors such as the budget, the intended audience, the appropriate document genre and the production technology. These factors have to be uncovered by the designer, and the careful investigation needed to establish them is an integral part of the design process. Potter observes the importance of the designer and client negotiating the brief until an agreement is reached between them (Potter 1980). This negotiation may continue throughout the designing stages, prompted by the client's responses to the emerging designs: critical information may not be initially forthcoming, and navigating the evolution of the brief is a necessary design skill. There is also skill in knowing when to press clients for information they may be surprised at being asked for, or even, for reasons of their own, unwilling to give. Lera points to the potentially serious consequences when the negotiation aspect of design fails (Lera 1983). This context provides the criteria for a successful design, and some of the factors that emerge from this negotiation are significant enough to be considered as contexts in their own right.

So, a third kind of context is the one for which the document is intended, meaning the anticipated audience and the physical environment in which it will be used. Three examples that illustrate these issues are: a school text

book for eleven year olds, which needs to strike a balance between being appealing and authoritative, which will be used spread flat on a desk, and which must be robust enough to withstand travel but light enough to be easily portable; a company annual report, meant to convey an impression of success and financial security to the share-holders, but probably not destined for the archives; a social security benefit application form, often filled in by people with low literacy skills, and which, once completed, will be posted and subsequently filed, and so must conform in size to postal regulations and standard filing systems.

A fourth kind of context is that of production, which refers to the technical means by which the document will be produced. This may be dictated by factors such as availability and budget, and will in turn have an impact on aspects of the design. For example, one is well-advised to avoid using high contrast fonts, such as Bodoni, at small sizes if the production mechanism will be silkscreen, because the thins are likely to disintegrate and make the type both unsightly and hard to read.

Fifth is the context of the designer's own experience and memory. Once trained, the designer's eye never rests: her memory, both of designs she has created, and of objects created by others she has seen and handled, serves as an information source when embarking on a new design.

1.2.2 Gathering information and embarking on design

Gathering information about the practical constraints and expected usage of the design — the second, third and fourth kinds of context described in the previous subsection — is an inherent part of designing, since these factors

influence aspects of the design (Hewson 1989). For example, a leaflet about social security benefits aimed at pensioners should be set in type large enough for easy reading by people with eye defects common in that age group. That fact itself may prompt the designer to seek more information, for example, looking at previous, similar publications, reading appropriate standards, and consulting elderly people to gain their point of view.

The converse to the information-gathering exercise is embarking on designing without complete information. Some considerable design skill lies in knowing how much you have to know to begin, and in being able to create a convincing first pass without all the information that will be necessary to complete the design. So the designer often begins designing with incomplete knowledge of both the semantic and illustrative content, but with an understanding of the flavour of the content.

All these issues imply that the typographic designer needs to be able to remain uncommitted through the early stages of design. One of the ways designers are able to remain uncommitted is through sketching.

1.3 What is sketching?

In the context of design, sketching is the making of 2-dimensional representations that both reflect and stimulate design ideas in the designer's mind. These ideas are often only partially formed whilst still in mind, and the externalisation enables the designer both to see an instantiation of the idea, and hence to develop it. The sketches are a diagrammatic shorthand, possessing only the essential aspects of the idea they embody. A natural extension of sketching in typographic design is the

making of 3-dimensional representations or mock-ups, known as *dummies*. These may be blank dummies, which have no marks on them, and simply consist of, for example, the particular kind of stock the designer is contemplating, folded in the manner anticipated. These mock-ups allow the designer to consider the physical, handling properties of the emerging document in isolation from the typographic aspects. Or the dummies may include the images, and hence enable the designer to experience, and therefore evaluate, the totality of the design solution, as it will be experienced by the end user.

For the purposes of this research, the focus has been on sketching in the early stages of designing, in which the activity is a highly personal, not to say private, act. In each instance the sketches studied were made by the designer for the designer, and were not primarily intended as communicative artefacts for other designers, clients or other artisans involved in the production of the document. Nevertheless, as is shown later in the thesis, one designer's sketches are frequently understandable by other designers, even though they are not made for this purpose. Certain kinds of drawings, or layouts (Tschichold/McLean 1991), and other, more highly finished representations, known as *visuals*, intended as communicative artefacts are also made by designers and play a vital role in the whole process of document design and production, but the study of these artefacts falls outside the scope of this research. For a consideration of the broader role of drawing, including the social and communicative aspects of sketches, in the related field of graphic design, see Schenk (1991).

1.3.1 The function and functionality of sketching in typographic design

The function of sketching is twofold: first, to capture and make visible a designer's ideas while they are still at a very early stage; second, to enable the designer to explore, develop and hence eventually resolve or abandon a design idea, through the manipulation of images that represent the essential aspects of the design. Therefore, the visual characteristics of sketches must be such that they convey enough of the right kind of detail about the design idea for the designer to be able to evaluate the idea via the sketch.

The functionality of sketching (that is, the way it enables the function to work) is achieved through a shorthand of marks, whose visual qualities are complex and subtly interlinked. That the marks are a shorthand enables the sketches to be made at high speed to match the speed of the designer's thinking. The richness of their visual qualities enables them to capture and convey the essential aspects of the design idea being addressed at the time the sketch is executed.

The sketches can be thought of as an instantiation of the designer's embryonic ideas, which enable the designer to engage in informed decision-making, on the basis of the visual feedback the sketches provide. The criteria applied in the evaluation are closely, though not exclusively, linked to the visual experience of the simulation. This is true of both the 2-dimensional representations, and the 3-dimensional simulations.

The designer sketches and, looking at the emerging sketch, changes the sketch or switches to making another sketch. Making and evaluating are

the defining aspects of designing (Cross 1982). Typographic designers make and evaluate: they make representations in 2 dimensions of both the 2-dimensional and 3-dimensional aspects of documents. In looking at and handling these representations they evaluate the design idea. Through altering the representation they manipulate the design idea, and in seeking to refine the idea, they change the representation. The eye sees, the brain assesses, the hand alters.

1.3.2 The visual channel

As Schön and Wiggins have observed, designing is crucially dependent on seeing (Schön and Wiggins 1992). Because the designer is engaged in contemplating visual representations in order to make decisions about visual phenomena based on primarily visual criteria (though, clearly, in conjunction with reasoning), it naturally follows that the characteristics and qualities of the visual representations are of crucial importance. This in turn implies that the characteristics and qualities of the medium used to create and display the visual representations are also of crucial importance.

Rough pencil sketches on paper contain a striking complexity of interlinked visual characteristics that combine to give them their informal, 'sketchy' quality. Paradoxically, such sketches contain considerable visual subtlety, which rests on the definition possible in the paper and pencil medium. That is to say, the very sketchiness of such marks requires a higher resolution to do justice to conveying them than is necessary for more formal marks such as straight lines. So, it is important not to confuse informality of marks with crudity of marks.

In contrast to the paper medium, freehand sketches made directly onto current ubiquitous digital displays are confined to the visual refinement possible within the resolution of the display. Such sketches are both informal and crude. The obvious shortcomings of current display devices may be dismissed as a merely transient and therefore irrelevant phenomenon, which will be eliminated by the inexorable improvement of display devices. However, it is worthwhile pinpointing the particular weaknesses of current display devices, since that enables us to recognise some of the ways in which current systems lack essential features, and therefore to contemplate ways in which these weaknesses may be addressed and the systems improved.

1.3.3 The kinaesthetic channel

The visual channel, however, is not the only one the typographic designer uses in creating and evaluating design solutions. The kinaesthetic channel is critical too, in terms of creating and evaluating the artefact-being-designed as a whole. Reflecting on the importance of the kinaesthetic dimension, Schön states (Schön 1988, 182):

> I ... treat designing not primarily as a form of 'problem-solving', 'information processing', or 'search', but as a kind of *making*. On this view, design knowledge and reasoning are expressed in designers' transactions with materials, artifacts made, conditions under which they are made, and manner of making.
> (*original emphasis*)

And Arnheim has observed (Arnheim 1970, vi-vii):

> ... how widely human beings and animals explore and comprehend by acting and handling rather than by mere contemplation.

Every document is a 3-dimensional object, whose physical characteristics must be resolved by the designer. In order to explore and resolve these characteristics, the designer creates 3-dimensional simulations of the document. These enable the designer to handle the physical realisation of the document, and hence perceive what the end-user's experience will be of these aspects of the document. For example: how do the pages of a booklet made of *this* paper lie when the booklet is opened? How does the feel of *this* paper compare to *this*, in terms of conveying connotations of luxury or thrift? What is the visual impact of *this* page layout, when the reader turns over from the previous page?

As the last question suggests, the visual and kinaesthetic are tightly coupled, both in the designing of a document and in its use. The well-designed document affords reading with no irritating visual features or intrusive physical attributes.

Issues about the kinaesthetic qualities of the *tools* used to create the designs is an equally important and related but separate topic, which lies largely outside the confines of this thesis. In Chapter 7 there is further discussion of both these issues, with reference to some current electronic tools which are beginning to address the kinaesthetic channel, and to the connection between the visual and kinaesthetic dimensions.

1.4 What is the place of electronic technology in sketching for typographic design?

Current electronic technology relating to document creation falls into two categories. One is the office standard document production systems, which

primarily facilitate the implementation of designs. These systems provide word-processing and page formatting capabilities, and incorporate printing facilities. These tools essentially support typesetting and printing, but they offer no sketching, nor, therefore, designing, facilities. The other category contains electronic drawing tools which have not been explicitly applied to document design, nor yet incorporated into document production systems. These tools range from large, multi-user installations to jotter-sized, portable digital assistants (PDA's). They commonly use a stylus device for input, rather than a mouse or keyboard.

1.4.1 How do current electronic document production tools and drawing tools fall short as design tools?

Electronic document production tools are useful as repositories for specifications which may be used to produce multiple copies of a document repeatedly and indefinitely. These specifications may also be altered with ease. However, in comparison with the paper and pencil medium, their input devices are less sophisticated than conventional mark-making tools, and in using the tool the designer's physical and mental focus is dispersed between different surfaces and different places on those surfaces. Current electronic drawing tools have limited display capacity, and limited kinaesthetic properties, in comparison with traditional mark-making tools. Each of these issues is treated in more detail in Chapter 7.

1.4.2 Promising developments for future electronic design tools

By coincidence, during the course of this research technological interest and development have swung round to focus on pen-based input and drawing

tools. There is a recognition that 'natural' ways of interacting with computers, such as stylus input devices for drawing and informal writing that exploit more fully than mice and keyboards our motor-sensory skills, facilitate our use of electronic tools (Buxton 1989, Wolf 1992). Conversely, there is increasing realisation that new tools that honour established working methods can enhance our working practice.

As interest has focused on electronic drawing tools, so the need for improvement in both the display and input aspects of systems has been recognised. In describing computer-based tools for architects ten years ago, Greenberg pinpointed their limitations, observing (Greenberg 1984, 150):

> They are not really *design* systems. They can help in the production process, but available tools are simply not flexible enough to use for preliminary design and testing of alternative strategies. Nor is the output realistic enough to permit [a]esthetic or design evaluations. (*original emphasis*)

Lakin *et al*, recognising the importance of flexibility, have developed vmacs, a prototype electronic design notebook, designed to offer freedom and agility equivalent to paper (Lakin *et al* 1989). The authors claim this system enables the designer to write and draw whatever they wish, and to switch quickly and easily between text and graphics.

These developments demonstrate a deepening understanding of the design process on the part of software designers. In addition, there have been relevant developments in display media (such as flat panel, high resolution displays), and in input media (with cordless, pressure-sensitive stylus devices), alongside a growing recognition of the value of paper and pencil itself as a medium to be integrated with electronic media, rather than supplanted by it. All these developments could be successfully combined in

designing genuinely effective design tools, which could be valuable in numerous design disciplines, not just typographic design.

The implications of the findings from this research for the development of future document creation tools are treated in more detail in Chapter 7.

1.5 The research focus

The research documented here consists of a detailed examination of sketching for design, explored through several approaches. The focus of this research has been to characterise the activity of sketching and the use of the traditional paper and pencil medium by professional typographic designers in the early stages of document design. A major concern has been to develop an appropriate and detailed vocabulary to describe sketching. Although the focus of the research was somewhat esoteric, centring on typographic design, the findings of the research have much broader applicability, radiating out to the design of tools to support sketching in other design disciplines, and even to general purpose drawing tools for lay users.

This thesis provides a cross-sectional account of sketching activity and products of that activity, to show the multiple strands of sketching, and the ways in which they interconnect with one another. The characterisation of sketching highlights the kinds of activities designers engage in — focusing on parts and then on the whole design, switching between levels of detail and precision, capturing and exploring ideas while withholding commitment to them, simulating artefacts — and the qualities of the sketching medium that enable designers to do these things.

This thesis does not attempt to provide an account of the design process in the temporal sense: it is not an account of the sequence in which designers perform these acts, nor does it attempt to identify percentages of time spent on each part of designing. However, the findings from this research are connected to design process research by being a natural precursor to an investigation of temporal process, since we need to have a much clearer understanding of the intertwined strands of sketching before we can provide a coherent account of the way in which they are performed. This is one obvious direction for future research, and is considered alongside other possibilities in section 8.3, Chapter 8.

In addition, during the research it has become clear that the premises about sketching for design that prompted this research are shared by practitioners in, and observers of, other design domains as well. From the literature of graphic design, architecture, industrial and engineering design the same issues seem to be pertinent: sketching in the early stages is important; we do not yet understand it; and current electronic tools do not support it, in ways that are essential for the creative phase. There is a further deduction from these premises, which has rarely been expressed by practitioners, but is a concern for those engaged in toolbuilding: because, so far, we have only had a partially formed understanding of sketching we have not, to date, been in a position to build genuinely useful tools for this crucial part of designing. The applicability of the findings from this research to other design domains and their implications for tool-building are considered in more detail in Chapter 7.

1.6 About the methodological approach

Since the motivation for this research arose from actual experience of current document production systems, and the intention was to identify what designers actually do in real circumstances, it is clear why the ethnographically-oriented approach was appealing. This approach recognises and respects established practice, and it honours the contribution made by the worker's physical environment. In Suchman's terminology the activity is situated in a particular context, and the context is recognised as integral to the activity (Suchman 1987).

This research was motivated by the author's experiences as a practising typographic designer, using contemporary electronic systems for designing and producing documents. Initial frustration gave way to puzzlement at the deficiencies of these systems as design tools. Early experiences suggested that the deficiencies derived more from a lack of understanding of the activity the systems were supposed to support, than from shortcomings intrinsic to the electronic medium itself. This lack of understanding manifested itself in electronic tools that lacked *readiness-to-hand*, in Heidegger's term (Winograd and Flores 1987, 36). Moreover, Heidegger's term refers to tools which are at least ready-to-hand as long as the tools do not break down. By contrast, contemporary tools have been *designed* to function in ways that run counter to traditional practice, obliging the designer to work with unfamiliar primitives, in an alien and unhelpful sequence. In other words, they lack readiness-to-hand even in their supposed working state. It is not apparent that this is an inevitable trade-off for the acknowledged advantages of such systems. Rather, it seems more likely that the deficiencies are inadvertent reifications of partial

understanding than informed decisions based on a consideration of all the pertinent issues.

This state of affairs reflects, in part, the paucity of explicit accounts of typographic design, which a systems designer might reasonably be expected to consult in developing a tool to support typographic design. Such accounts are rare because the skills and knowledge typographic designers possess are acquired experientially, and, once acquired, remain tacit. Even the accounts that do exist (for example Morison 1936, McLean 1980 and Hochuli 1990) are not readily accessible to the non-typographic designer. They are written more as explanatory texts to people already engaged in becoming designers than as exhaustive accounts for teaching everything to the complete novice. Consequently they take for granted a certain amount of related knowledge — the very knowledge, in fact, of which the complete novice is seeking a description.

Until the advent of ubiquitous electronic document production technology, there was little need for an explicit account, as those who wished to acquire this knowledge were a self-selecting minority, most likely intending to practise as designers. They were therefore willing and able to invest the time required to take the conventional path to this knowledge. Recent technological developments, however, make a description that is accessible to the non-typographic designer a necessity to aid the system designer's comprehension of document design and production. An explicit account of this kind both frames the activity in a form accessible to the systems designer, and, potentially, acts as a channel to facilitate communication between the engineer and the typographic designer in a collaborative endeavour to build an effective tool.

It is clear that a constructive approach to ensure a better chance of the new generation of systems being more effective is by grounding their development in the results of a careful investigation of designers' established practice. While it is obvious that the electronic medium offers novel dimensions that have no parallel in the traditional medium, and from which we may therefore profit by exploiting them inventively, it is also clear that there is value in incorporating the best from the past in developing future tools. This respect for tradition need not be synonymous with constraining and blinkered conservatism, but in fact may enable us to push forward to better effect our use of the new technology. For, as Beatrice Warde wrote (Warde 1964, 13):

> The verb *trado* never meant I worship the Past. A tradition, to be worthy of the name, must be a *carrying forward* of some freight of hard-won knowledge that is too valuable to be jettisoned.
> (*original emphasis*)

The issue of what constitutes relevant knowledge in the transfer from one stage of development to another is certainly open to debate. It is particularly important to clarify this issue when we have the opportunity of altering practice, supposedly by streamlining it, by removing apparently redundant techniques. There is a great temptation to excise seemingly unnecessary and time-consuming practices, whose worth is hard to determine. But the deliberate design of tools intended to oblige such alterations in practice should be exercised with caution, lest a subtly valuable piece of the work be made more difficult, or worse still, impossible, through the removal of the channels enabling that work. Changes in working practice obliged by tool design should be clearly advantageous to

the practitioner, and preferably reduce the pre-existing tedious aspects of the job without adding new ones.

However, even approaching the task of articulating a traditional practice in a respectful manner raises challenges, as Winograd and Flores observe (Winograd and Flores 1987, 7):

> In trying to understand a tradition, the first thing we must become aware of is how it is concealed by its obviousness.

This is particularly true of practices which have not previously been articulated, and which are acquired by experiential means.

The research approach has been to start with the physical products of the activity, and to work outwards from them. The sketches have been looked at with a designer's eye, as well as contemplated with a researcher's mind, thus using an aspect of design skill in investigating the products of designing. From this careful perusal of sketches, visual and tactile features of sketches have been identified. In addition, suggestions are made as to the functions the features play in supporting the designer's cognitive activity.

Thus, the objects of study have been real artefacts, made by professional designers, working on real jobs, in the way and place to which they are accustomed. Professional designers were consulted, without constraints on what they spoke about (Davies and Talbot 1987). Designers were watched at work on real jobs in their own studios and, though the observation was intrusive to an extent (as all observations must be, by simple virtue of the presence of some recording equipment at least), the work itself was not artificially constrained, as would be the case in a laboratory-based experimental setting. Then, for the purposes of evaluating the initial characterisation derived from the first three studies, professional designers

were again consulted and interviewed about the characterisation in such a way that they were as little constrained as possible in responding to the structured part of the interview, and had free reign in the way they responded to the unstructured part of the interview.

The subject of interest was the sketching practice and products of professional typographic designers. Therefore professional designers were enrolled as participants. Experts are by definition a rare and consequently precious resource, not least because the time they grant for interviews is effectively time taken away from their earning (all the designers interviewed for this research work freelance). So, while the ethnographically-oriented approach was already the appealing option, for reasons specified above, these additional factors make this approach appropriate as well as appealing, since this approach embraces a greater depth of detailed study of fewer individuals' work.

1.7 Guide to the thesis

The rest of this dissertation is ordered as follows.

Chapter 2 summarises previous studies of sketching from a variety of disciplines, observing both how few and how limited are the descriptions of sketching predating the research documented here.

Chapter 3 describes the research methodology adopted for the first three, exploratory, studies, noting how the methodology was developed in response to the accumulating findings.

In Chapter 4 the initial characterisation of sketching for typographic design, derived from the findings of the first three studies, is presented, and illustrated with reproductions of the sketches collected from studies 2 and 3.

Chapter 5 describes the fourth study, in which the initial characterisation was evaluated, relating the method used, the results gained and the analysis derived from the results.

Chapter 6 contains the refined characterisation of sketching, which is a distillation of the initial characterisation and the results of the evaluation study.

Chapter 7 sets out the implications from these research findings for the design of future tools for document creation, observing the complementary characteristics of the traditional and electronic media.

Chapter 8 summarises the findings from the research. The chapter concludes with a list of directions for further research, both for developing the theoretical framework of the refined characterisation, and for applying the findings of the research to the development of future tools for document creation.

2 EXISTING STUDIES OF SKETCHING FOR DESIGN

Gregory wondered if this was what being old meant: everything
you wanted to say required a context. If you gave the full context,
people thought you a rambling old fool. If you didn't give the context,
people thought you a laconic old fool.

Julian Barnes
Staring at the sun

2.1 Introduction

The amount of research focusing on sketching for design *per se* is modest: the amount dealing with sketching in typographic design is virtually non-existent. The majority of studies which deal with sketching have tended to concentrate on the process of design, casting sketching as a means to an end — the window through which the process of design may be perceived — rather than as the central subject in its own right. Consequently, observations about sketching are mostly to be found embedded either in works intended to shed light on the cognitive processes in one of a variety of design disciplines, or in envisionments outlining the requirements for new tools to practise design. Although the treatment of sketching is therefore somewhat limited, some of the observations that have been made contribute to a basis from which a fuller investigation into sketching may be directed.

In this chapter, studies from diverse disciplines are reviewed, providing the context for this research. The discussion highlights what has been observed about sketching, what implications for the design of future tools to support the creative part of the design process have been derived, and it touches briefly on which research methodologies have been employed to investigate

sketching. Issues regarding the relative merits of different research methodologies for this subject area are treated in greater detail in Chapters 3 and 5. The observations about sketching form the background to the central work of this dissertation, appearing in Chapters 4, 5 and 6. The implications for the design of future tools to support designing are revisited in Chapter 7.

2.2 Sketching as a medium for design

In works whose primary focus is an investigation of the design process, there is a common assumption that sketching happens as an integral part of the creative process. In fact, numerous authors argue that sketching is crucial to supporting creativity (Lakin *et al.* 1989, Radcliffe and Lee 1990, Ullman *et al.* 1990). Sketching activity is observed, and in some instances an analysis of the kinds of marks produced in sketching is offered. In a few instances the authors speculate on the functionality afforded by sketching. In this section the studies in which the marks are analysed are considered, and the respective classifications offered by their authors are compared.

2.2.1 Sketching as distinct from writing

In the course of researching the use of drawing surfaces in collaborative settings, Bly observes that designers mix and switch freely between two kinds of actions, namely, *drawing* and *writing*, which result in *graphic marks* and *alphanumeric marks* respectively (Bly 1988). Subsequent related studies she conducted with Minneman confirm this use of mixed visible languages (Bly and Minneman 1990, Minneman and Bly 1990).

Accordingly, they conclude that a tool to support shared drawing must enable the designers to switch freely between drawing and writing.

Tang studied design teams using shared workspaces to work on software design, curriculum design and industrial design (Tang 1989). He observes similar distinctions between writing and drawing, but refers to them as *list actions* and *draw actions*, and deals with their respective natures in more detail than Bly and Minneman. In Tang's terms, list actions result in *alphanumeric text* whose spatial location on the work surface is not deemed of major significance. Draw actions result in *graphic marks*, typically two-dimensional sketches. Where Tang considers textual annotation to be specifically spatially located, he classifies it as the result of a draw action. He admits to this distinction seeming somewhat arbitrary and being difficult to make, but justifies it on the basis of the implications it has for the design of workspace tools. So, for example, he observes that 'pure text' could be generated by one kind of tool such as a typewriter, whereas text deliberately integrated with graphic marks would need a tool with more complex capabilities, such as a text-graphics processor.

Tang's distinction between alphanumeric text and graphic marks, and his observation that they are sometimes deliberately mixed seems more germane and easier to defend than his argument for different tools according to whether or not they are combined. Precisely because designers mix these visible languages, in ways that are hard to predict, it seems more constructive to make that joint capability an integral feature of a tool, rather than conceiving of separate tools for activities which the designer may not explicitly distinguish between.

2.2.2 Classifications of writing and sketching

Radcliffe and Lee, studying novice mechanical engineers working alone, also observe the mix of visible languages, stating that sketches are 'frequently complemented by notes or other written explanation' (Radcliffe and Lee 1990, 147). They draw the rather curious conclusion from one of their experiments that the subjects' extensive use of annotations 'may have reflected an apparent lack of confidence in their sketching ability or perhaps their inability to clarify their ideas' (p. 148). Without illustrative examples of the sketches themselves, it is difficult to determine whether this is a legitimate observation, or whether the annotations are in fact appropriate accompaniments to the sketches, as recognised in other studies.

Radcliffe and Lee classify their subjects' sketches into three types, *functional*, *geometric* and *pictorial*, and define them as follows (pp. 148-9):

- *Functional sketches* express the working principle of the functional relationship between two or more elements in a design concept. This kind of sketch is not drawn to scale, and the individual elements may be represented symbolically.
- *Geometric sketches* are drawn to scale, and delineate the dimensional relationships between the elements. Only the essential geometric information, the outline of the elements, is included.
- *Pictorial sketches* depict the elements in three dimensions to provide an overall view of the object. These sketches integrate the information from the functional and geometric sketches.

These categories are fairly broad, and while sufficient for Radcliffe and Lee's purposes, only point towards the details that constitute sketches, rather than delineating them explicitly. They do not analyse in detail or subdivide the category of written annotations.

Ullman *et al.* observed designing by mechanical engineers working alone. They recognise the distinction between drawing and writing and, in categorising the marks-on-paper their subjects made, divide them into *draw* marks and *support* marks (Ullman *et al.* 1990). They further subdivide these two categories into *sketch* and *draft* marks, and *text*, *dimension*, and *calculate* marks, respectively. Their definitions are (p. 269):

- *Sketch* — drawings of features made freehand.
- *Draft* — drawings made with mechanical devices.
- *Text* — letters, words or numbers that are not part of a calculation or a dimension on a drawing.
- *Dimension* — dimension or dimension lines on a drawing (sketch or draft).
- *Calculate* — equations and answers to calculations.

This classification appears to place considerable emphasis on the textual annotations, by virtue of three distinct categories being identified (*text*, *dimension*, *calculate*). By contrast, there is only a single category, *sketch*, to encompass all the freehand graphic marks made.

Radcliffe and Lee describe their own classification as complementary to Ullman *et al.*'s, since, they claim, their subdivision of sketches into three types can be incorporated into Ullman *et al.*'s single sketch category. They also assert that their form of analysis integrates with Ullman *et al.*'s support marks. This is a plausible claim, although they do not identify in detail instances of support marks in their own data, which would provide a more convincing demonstration of the compatibility between the two classification schemes.

Ballay, studying industrial designers working individually on an experimental task, observes that experienced designers mix drawing with

other types of external representations (Ballay 1987). He classifies the representations his designers used into seven categories, defined as follows (pp. 70-1):

- *Notations* — words, numbers, letters and related symbols.
- *Matrices* — two-dimensional grids of information constructed to help the designer choose which alternative parts to work with.
- *Orthographic projections* — views perpendicular to the principal cartesian planes.
- *Perspective drawings* — graphic conventions which imply a spatial view of objects.
- *Dimensions* — representation which combines symbolic and graphic components.
- *Solid models* — three-dimensional materials.
- *Procedural representations* — encoded action scenarios.

Ballay does not state directly which of these categories refer to sketching. However, he does state (p. 72):

> The external artefacts of the design process ... appear as a chain of representations, the majority of which are sketches.

The implication of this statement is that he considers most if not all of his categories of representations to be manifested as, or in, sketches, except those which clearly cannot exist as sketches — namely, *procedural representations* and *solid models*. Therefore, we may legitimately deduce that all the categories, except these two, together form his analysis of the constituents of his subjects' sketches. As with Radcliffe and Lee, Ballay's categories dealing specifically with sketches do not delineate the details which constitute sketches.

2.2.3 Comparing classifications

Viewing Ballay's classification in this way, it is possible to draw some comparisons between this scheme and those of Radcliffe and Lee, and Ullman *et al.*, although the mapping is neither comprehensive nor one-to-one. Ballay's category *notations* correlates to Ullman *et al.*'s *support* marks, without the finer detail provided by Ullman *et al.*'s subdivisions. Unlike Ullman *et al.*, Ballay does not state explicitly how notations, in his usage, relate to his other kinds of representations: for example, whether they are clearly separate from, or an integral part of, *drawings*. By his own definition, *matrices* must contain notations, but the implication is that notations occur separately from matrices as well.

Orthographic projections and *perspective drawings* correspond to Ullman *et al.*'s *draw* marks, but since Ballay does not elaborate on whether they are drawn freehand or with instruments, and no visual examples are provided to enable the reader to gauge how they were made, a more refined parallel between these categories and Ullman *et al.*'s sketch and draft marks cannot be drawn. In fact, throughout his article, Ballay appears to use the terms drawing and sketching interchangeably. Ullman *et al.*'s distinction between the terms (using sketching as a subset of drawing) is useful in affording greater clarity, and is intuitively appealing.

Ballay's term *orthographic projections* has something in common with Radcliffe and Lee's category geometric sketches, and his term *perspective drawings* may be loosely compared to their term pictorial sketches. But once again it is difficult to make these comparisons with confidence, since no visual examples from Ballay's categories are provided.

Ballay's category *dimensions* is hard to place. Since he does not define or illustrate his use of the terms 'symbolic' and 'graphic', it is not clear what kind of image he places in this category. Apart from this lack of clarity, the term dimensions seems inappropriate for the concept it is intended to represent. This is particularly emphasised if we compare Ballay's use of the term with Ullman *et al.*'s. Once again, as with the terms *draw* and *sketch*, Ullman *et al.* use the term *dimension* ('dimension or dimension lines on a drawing') in a more precise and apposite way.

Although Ballay's categories *procedural representations* and *solid models* do not correspond directly to sketching, they are a natural extension of 2-dimensional representations of 3-dimensional objects.

While Ballay's classification scheme suffers from some shortcomings, he nevertheless offers some valuable insight into what he calls variables or dimensions of sketching. His variables are (p. 75):

- *Inclusion* — the amount of information that is represented in a sketch. It can be thought of as the level of detail or as the 'grain size' of the information in the sketch.
- *Coherence* — the degree to which different pieces of information agree with or support [one] another. It reflects whether the partial solutions to sub-problems have been reconciled to one another.
- *Precision* — the dimensional refinement with which an intended configuration is represented. This is the most commonly understood of the dimensions.

Ballay's categories and variables are considered again in Chapter 4, and compared to those of the initial characterisation set out in that chapter.

2.2.4 The functionality of sketching

Ballay asserts that the designer chooses a combination of mode of representation, and levels of inclusion, coherence and precision. He interprets the functionality of these last three variables as follows (1987, 80):

> Through *ex*clusion, *in*coherence, and *im*precision, the designers provide their sketches with enough ambiguity so they can take advantage of inventive opportunities right up to the end of the process.

This theme of valuable ambiguity is linked to the bi-directional nature of sketching first mentioned in the Introduction (p. 10), described by Ballay thus (p. 71):

> We have observed that designers do not know many details about what they are going to sketch until part of the sketch is made: 'knowing' is in the observing of the external sketch.

The strong implication here is that the sketch provides the designer with visual feedback of a certain kind that both encapsulates and displays just enough of the idea as is appropriate for the given stage in the design. If we accept this premise, it follows that the visual characteristics of the images are powerfully influential, prompting further ideas, resulting in further sketches, and so on, and therefore deserve careful consideration in designing systems to support sketching. This issue is among those that are treated in detail in the following section.

2.3 Desirable characteristics for tools to support sketching

Based on the observations made in their respective studies, various authors point towards the implications for electronic tools to support the

creative aspect of the design process. These are sometimes expressed explicitly as support for sketching, sometimes only implicitly, but the consensus of desirable characteristics is striking.

2.3.1 Lack of computational support for sketching

Of the authors cited here, Ullman *et al.* express most forcefully the need for sketching to be supported by electronic tools for designing (Ullman *et al.*, 1990). They refer specifically to CAD tools, by which they mean 'interactive computer graphics to help solve a mechanical design problem' (p. 264), but their assertions may equally be applied to tools for other design domains. They claim (p. 264):

> CAD systems do not support sketching in any meaningful way

and later assert (p. 273):

> CAD systems must allow for sketching.

They cite three reasons for this (p. 273):

> First, it [*sketching*] is a rapid representation method. Rubber banding and select methods traditional to CAD systems are simply not fast enough. Second, the additional cognitive load to implement current systems is detrimental to the design process. Icon and Menu selecting add an unneeded step to creating an image. Third, in conceptual design in particular, it is not necessary that all graphical representation be as refined as that demanded by current CAD systems.

These three issues are considered in detail in the following three subsections, in a reordered sequence. The first issue, addressed in 2.3.2, has been expanded to include multiple representations; the second, cast as the naturalness of the tool, is considered in 2.3.4; and the third, appropriateness of the image quality, is dealt with in 2.3.3.

2.3.2 Value of multiple representations and facile switching between them

As noted in subsection 2.2.2, a number of authors observe that designers use different kinds of representations and switch rapidly and freely among them. Another example is Eastman, speaking of industrial designers, architects and engineers, who states (Eastman 1970, 30):

> One of the strengths of the human problem-solver is his ability to use several representations — words, numbers, flow diagrams, plans, sections, perspectives — to represent, compare and manipulate information.

He goes on to infer (p. 30):

> It would seem that any man-machine system to aid the designer must recognise his reliance on multiple representations. ... it must allow a designer to work back and forth between representations.

Ballay echoes Eastman's concern with multiple representations (Ballay 1987, 80):

> It seems clear that the more kinds of representations a designer can use, the better able he is to work through complex problems.

Bly reiterates these observations and continues (Bly 1988, 255):

> It's interesting to note that few, if any, existing computer-supported sketching tools allow such rapid transitions. This limitation could be a detriment to computer-supported design sessions.

Similarly, Tang concludes (Tang 1989, 98):

> Tools should allow fluent mixtures of actions and functions. Conventional computer tools tend to separate actions into different modes (e.g. text from graphics). However, the naturally occurring activity observed does not exhibit such segregation. Intermixing listing with drawing and drawing with gesturing was commonly observed. Workspace tools should allow full integration of listing, drawing and gesturing, as well as storing information, expressing ideas and mediating interaction.

Aside from the relative ease with which the designer may switch from one representation to another, some observations are offered about the rapidity with which the individual representations are made. Ullman *et al.* state, almost in passing (Ullman *et al.* 1990, 271):

> ... with the average length of these sketching actions at eight seconds, the use of instruments could have slowed the drawing action to the point that the cognitive problem solving would be impaired.

The implications for the design of tools regarding the speed of image generation and manipulation are considered again in the next subsection.

2.3.3 The importance of image quality in sketching

Ullman *et al.*'s claim that 'it is not necessary that all graphical representation be as refined as that demanded by current CAD systems' (Ullman *et al.* 1990, 273) is something of an understatement, since the essence of sketching is that the image is not visually refined, but is rough in particular ways. Greenberg makes a similar observation relating to all three of Ullman *et al.*'s points about the importance of sketching (Greenberg 1984, 152):

> At the preliminary design stage speed and flexibility are far more important than image quality.

This may be more accurately rephrased as 'at the preliminary stage speed and flexibility are far more important than absolute detail, but the quality of the image is very important, in that it should have just the right *amount* of detail at just the right *level* of precision for the given stage of the process'.

It is a nice irony that Greenberg makes his statement about the video display of a computer system, whose image quality is crude, in terms of size

and resolution, by the standards of such displays, and yet, inevitably, manifests the characteristics of such displays. These characteristics, paradoxically, cause the image to be much more finished in appearance than their paper-based counterparts even when they are displayed in relatively crude resolution. In fact, it is *particularly* images displayed in crude resolution that have the deadening uniformity characteristic of this type of display, that is so far removed from the lively roughness of paper-based sketches, since the coarse grain of low resolution CRT displays cannot do justice to the subtlety of such images.

Black speculates that the characteristics of CRT displays contribute to the image having an authority inappropriate to the early design stages (Black 1990). This can curtail the designer's explorations of alternative solutions if the designer is beguiled by the finishedness of the image that is simply an artefact of the display device, rather than a reflection of a fully-explored solution.

In observing the part played by representations in sketching, Akin refers to the dimension of abstraction (Akin 1978, 80):

> Abstract representations used in sketching ... help focus the attention of the designer to specific aspects of the problem as needed.

The nature and role of abstraction in sketching is considered in detail by Fish and Scrivener, who describe the marks in paper sketching as possessing 'tolerances and indeterminacies ... that can amplify the ... ability to perceive or imagine many options' (Fish and Scrivener 1990, 117). Although they are specifically describing artists' rather than designers' sketching, the phenomenon of abstraction is common to both. Fish and Scrivener continue (p. 117):

> Computer systems that fail to represent in their data storage the implicit structure or categorical meaning of an image may force the artist to provide precise or detailed information too early in the creative process. This can lead to premature decisions that are harmful to invention because they limit the ability to discover unexpected or original solutions.

This reiterates Black's speculations quoted above and connects to Ballay's considerations of his categories inclusion, coherence and precision (Ballay 1987, 80):

> Systems which force a designer to make an early decision about the inclusion, coherence or precision of information will be counterproductive. They will tend to close down a designer's inventiveness too early in the design process.

One of Ballay's conclusions for a desirable computer-based design system is (p. 81):

> In graphics applications, the primary information is the image itself; image manipulation must be direct and intuitive.

This links to a claim made by the type designer Charles Bigelow (quoted in Southall 1988, 176):

> ... the designer thinks *with* images not *about* images.
> (*emphasis added*)

This statement emphasises the importance of visual feedback for the designer, a theme already alluded to and that is taken up again and treated in more detail in Chapter 4. The last four quotations also illustrate the close connection between image quality and ease of image manipulation, which leads us to the consideration of naturalness in tool use.

2.3.4 'Naturalness' of the interface

The notion of what constitutes 'naturalness' is a moot point, and is the subject of significant debate in other branches of systems-related research. In this context, the term naturalness is used to describe both the ease with which the designer interacts with the tool, and the results gained from using the tool, namely the visual images.

Two of the conclusions drawn by Bly and Minneman about what characteristics tools for supporting collaborative design should possess are (Bly and Minneman 1990, 186):

1 Designers must be able to switch quickly among drawing, writing and gesturing.

2 The tool should be as 'natural' as possible (e.g. a familiar writing/drawing instrument, marks appearing at the point of input etc.).

To this end they (p. 186):

> decided on a system in which the user writes on the same surface where the marks appear, the surface is positioned horizontally, and the writing tool is like a pen.

In their later paper they make further observations about the desirability of rapid switching between writing and drawing, implying the 'naturalness' of this facility (Minneman and Bly 1990, 3):

> ... it was clear from our observational work that participants moved frequently and fluidly between manual writing, drawing and gesturing. These observations indicated that we could expect problems with any system requiring users to make time-consuming and distracting mode selections to achieve these different drawing surface actions.

Even in situations where the user remains within one mode, similar problems may be encountered, as Bleser *et al.* observe (Bleser *et al.* 1988). They recognise two kinds of discontinuity inherent in traditional paint

programs. These are equally true of most current sketch and draw programs (p. 76):

> First is a physical discontinuity: stopping the act of drawing and making a brush selection using a different physical device, or using the same device to point at a menu selection. A second discontinuity is the cognitive one involved with deciphering the menu contents and making a selection.

They go on to assert (p. 76):

> Although the second may be minimized by using iconic menus, these interruptions of the drawing act make it difficult or impossible for the artist to maintain the continuous control over his or her medium that is required.

Echoing this theme, Lakin *et al.* compare the designer to the musician, describing both as performers, and equating their respective requirements of their tools (Lakin *et al.* 1989, 24):

> Musical performers demand that their instrument be able to respond immediately in support of their every improvisational whim. Likewise, designers during conception are text-graphic performers and demand similar agility from their instrument.

They conclude that the traditional medium of paper fulfils the performance criterion, both in terms of its ease of use (i.e. no disjunction of the type described by Bleser *et al.*) and in terms of its richness of mark-making possibilities.

Ballay posits four desirable characteristics for a computer-based design system, all of which relate to the notion of 'naturalness' (Ballay 1987, 81):

1. Users should feel like they are working on the representation, not on the computer.
2. In graphics applications, the primary information is the image itself; image manipulation must be direct and intuitive.
3. Solid models assist cognitive aspects of spatial problem solving; computer-aided design systems need a surrogate for solid models.

4 A model's system of spatial references should be natural to the task; co-ordinates are appropriate for specifications but not for ideation.

Krauss and Myer, writing about computer systems as tools for design, proposed desirable characteristics for effective tools. Two of their proposals for a system to aid building design are (Krauss and Myer 1970, 20):

1 The system should permit the designer to select the scale at which he is to operate; to consider part or whole, or the broader context of the project; and to proceed with operations in the order he judges best. It must allow for variables to be investigated in any order.

2 The system should permit the treatment of a large number of variables, most of which become known only after the problem-solving process has begun, many of which are not susceptible to either numerical or discursive definition, and many of which can find definition only in visible form.

The issues in the first conclusion relate to the freedom of choice and flexibility in the designer's working practice, implicitly acknowledging that the designer needs the freedom to switch between kinds of representation, including partial representations, at will. Krauss and Myer's observation about considering parts of the design relates to Ballay's variable *coherence*. While Ballay does not state explicitly that designers work on details, or parts of the design taken out of context, this way of working is implied in his definition of coherence ('it reflects whether the partial solutions to sub-problems have been reconciled to one another' p. 75).

The second conclusion underlines the importance of the image quality, since visible form is the only channel through which many of the issues can be addressed.

2.4 Conclusion

As this chapter shows, the analyses of sketching for design to date are few, and those that do exist are not highly detailed. There is no common breakdown of the constituents of sketching, nor any standardised vocabulary by which they are described. Since the emphasis in previous research into sketching has been on the design process it supports, it comes as no surprise that the dominant theme in earlier research has been the identification of designers' actions and the sequence in which they occur. This is a valid and useful angle of research, but seems to be somewhat premature. Without a more comprehensive account of the constituents of sketching, and an adequate vocabulary to facilitate reference to them, it is hard to hold a meaningful discussion of the process in which they play a major part.

The central goal of this research, therefore, has been to derive a more detailed characterisation of sketching, described by a more comprehensive vocabulary than previous accounts have offered.

3 RESEARCH METHODOLOGY

The more you *look* the more you *see*.

Robert M Pirsig
Zen and the art of motorcycle maintenance

3.1 Overview of studies

As described in section 1.6 of the Introduction, the approach adopted throughout this research has been ethnographically-oriented, in order to take advantage of the participants' richness of experience, working methods and familiar environments. This approach, which values the detailed study of few participants, in contrast to statistical analysis which demands high numbers of subjects, was also appropriate given the financial constraints involved for the participants. All except one were freelance designers, so their time, given freely, involved lost income for themselves. Nevertheless, once enrolled, all the designers participated with enthusiasm.

The aim of the studies was to explore sketching by professional typographic designers using paper and pencil, and hence to move towards an understanding of the underlying functionality of sketching as it has traditionally been practised. As there is no established procedure for investigating sketching, part of the research involved developing appropriate research methods as the research progressed. The first three studies were exploratory and the different methods used in them are described in this chapter. The findings from them were used to develop the initial characterisation of sketching presented in Chapter 4.

The fourth study was designed to evaluate the initial characterisation derived from the first three studies. Since the fourth study was different in kind from the first three, the methodology used for it is not described in this chapter, but is to be found in section 5.2 in Chapter 5, which contains the results from and discussion about that study.

3.1.1 Procedures

The four studies conducted comprised three exploratory studies and an evaluation study, and are summarised in Table 3.1.

Table 3.1 Summary of studies

Study	Participants	Type of study	Data collected
1 (Investigation)	6	Open-ended interview	Audio
2 (Investigation)	2	*In situ* observation	Sketches, audio and video
3 (Investigation)	1	Focused retrospective interview	Sketches and audio
4 (Evaluation)	4	Unstructured and structured interview	Sketches and audio

The first set of interviews was open-ended to yield rich data from which more focused studies could be derived. This flexibility was important in allowing the designers and the researcher to explore themes arising naturally during the interviews, without being constrained before the important issues were identified. From this data important issues began to emerge, which helped to shape the subsequent studies. The second study

was conducted to gain real-time data showing how designers perform sketching, to enable closer examination of the issues raised in the first study, and to gather actual sketches. From these two studies it became clear that the sketches themselves were the main source of data for investigating the issues of interest. The third study, therefore, was used to gain a much more detailed account by one designer of both his own and his colleagues' sketches. The second and third studies provided triangulation with the first study. The fourth study was designed both to yield more data, in the form of insights from designers and additional sketches, and to test the findings derived from the first three studies.

The initial analysis of the transcripts and videotapes addressed three broad questions, namely:

1 What themes about sketching recurred within an interview/session?

2 What themes were common across the collective interviews/sessions?

3 What issues were mentioned rarely, but seemed relevant to sketching and potentially important?

The common issues of interest and rare insights that began to emerge drove both the next stage of research, and consequent iterative analysis of the accumulating data.

An analogous set of questions was prompted by the issues that emerged from the analysis of the transcripts and videotapes, which were then used in the analysis of the sketches:

1 What features recur within one designer's set of sketches?

2 What features recur across the whole set of sketches?

3 What features occur rarely, and what might their importance be?

As with the transcripts and videotapes, the sketches were analysed iteratively as the collection grew. With all the types of data the guiding principle was that as the issues began to crystallise, the questions became more specific, enabling clarification and confirmation of the issues. Ultimately, the refined characterisation itself reflects the most specific questions asked of the data.

3.1.2 Participants

All the participants were professional typographic designers, ranging from recent graduates to a practitioner with fifty years of experience. Their professional backgrounds were varied, some having received a recognised specialist typographic training, others having arrived at typographic design by an alternative route, but all were practising typographic design at the time they were interviewed or observed. Each designer only participated once, with the exception of one who was videotaped twice during the second study. Nine of the thirteen designers were already known to the researcher through her own training and practice as a professional typographic designer; the others were recommended to the researcher by other designers on the basis of their current work.

The participants have been given fictitious names which reflect their gender but preserve their anonymity, and provide an easy form of reference throughout the dissertation.

3.1.3 Data collected

The sketches collected during the research form the core of the data. The audio and video records of designers discussing and performing sketching provide additional material that was analysed in conjunction with the sketches. The sketches were collected from the second, third and fourth studies and were made by ten designers in all. The sketches are contained in Appendix 4, presented in numbered sequence, according to the interview or session to which they relate. With a few exceptions marked in the list of sketches at the front of Appendix 4, they are shown as close to their original dimensions as first-generation samesize photocopying allows. In the main body of the thesis whole sketches or sheets of sketches are sometimes shown reduced in size, and colour originals are reproduced in monochrome. All the figures give a reference to the relevant sheet from which the sketch shown is taken, and state the reduction, if any, of the image from the original size. Appendix 4 is the source reference, therefore, from which the reader may check the details of the originals.

The sketches are labelled with the designer's initial and a sketch number, e.g., Alan's first sketch is A1. Where the designer created sketches relating to more than one job, the labelling includes the designer's initial, the alphabetical listing of the designer's job, and the sketch number, e.g., Don's first sketch from his first job is Da1.

All the sketches that the designers offered to the researcher were collected, and, as far as possible, all the sketches produced during the observed sessions were retained at the end of the session. In two cases (Alan and Don) the designers offered sketches relating to the same or similar jobs

made by their colleagues as well. These were also collected and labelled in the same way as the sketches of the designers who were directly interviewed or observed at work. These sketches are included in Appendix 4.

In the cases where the researcher was present at their production and could therefore track their emergence, the sketches are numbered according to the order in which they were made. In the other cases, the numbering is a best guess at the order in which the sketches were made.

3.2 Study 1: Preliminary interviews

The first study consisted of open-ended interviews of professional typographic designers. The goal of the interviews was to develop an initial picture of the role of sketching and to identify issues to be studied in greater depth in subsequent studies. Six open-ended interview were conducted, some of which included post-hoc descriptions of real jobs.

3.2.1 Participants

Six participants, selected for their range in age, experience and training were interviewed. All were typographic designers, but they had reached the profession via different routes:

Sue: twenty years' experience in magazine design, and teaching typography and graphic design

Pete: fifty years' experience, specialising in book design

Tom: twenty five years' experience in magazine, book and graphic design

Rod: twenty years' experience in information design

Matt: recently graduated in typographic design

Neil: recently graduated in typographic design.

3.2.2 Procedure

Before the interview the researcher explained that she was conducting a study into the use of sketching by typographic designers in the early stages of design jobs. At the interview the participants were asked to describe what occurred in their own sketching and to discuss what they consider important, both about sketching and the tools they use for sketching. Each participant was interviewed in his or her own design studio, enabling the designer to have to hand current or previous work to illustrate points made during the interview. Each designer was asked to say how s/he begins a design job. If the topic of sketching arose spontaneously the designer was encouraged to speak about it in detail, prompted by a question like:

> What do you feel you get from sketching?

If after some time the topic had not arisen, the designer was specifically asked whether his or her working practice included sketching, and if so, in what ways it featured, prompted by a question like:

> Is there any point in the process of designing a document where you sketch on paper?

The designers were also asked explicitly about their use of tools, and their preferences in working on the early stages of a design job.

At each interview an audiotape recorder was placed on a table near where the designer was sitting, and was carried about by the interviewer if the designer moved around the studio to make reference to a piece of work or tool elsewhere. Each interview lasted between thirty minutes and two hours. The interviews were conducted over a six month period, with the second and third interviews taking place two months after the initial

interview, and the last three interviews four months after the second and third interviews.

3.2.3 Data collected

All the interviews were recorded on audiotape and transcribed in full.

3.3 Study 2: Observation of *in situ* design sessions

The second study was a series of observed *in situ* design sessions, which were intended to provide audio-visual, temporal records of designers engaged in the early stages of real jobs, in the natural setting of their own studios. The goal of this study was to gain firsthand insight into, and records of, designers actually sketching, and to collect sketches made in as naturalistic an environment as possible. Three sessions, each featuring one designer, were observed.

3.3.1 Participants

Observational studies were made of two participants, one of whom was recorded on two separate occasions. Although the number of participants is clearly too small to be comprehensively representative, the designers were selected to cover different ages, training and years of experience, on the basis that these factors might contribute to different preferences and sketching habits. The participants were as follows:

Carl: ten years' experience in typographic design
Alan: thirty years' experience in typographic and graphic design.
Carl was recorded twice.

3.3.2 Procedure

The participants were telephoned to ascertain when they were next embarking on a new job. The researcher described the proposed plan, to observe the designer at work on a real job in the designer's own studio, and gained the participants' agreement to being recorded on videotape. The participants were asked to inform the researcher in advance when they were about to begin a new job, so that the earliest stages could be observed.

In each session the designer worked in his own studio, thus making use of the familiar, tailored workplace. The studios shared common features such as large tabletops and planchest surfaces, a drawing board, a light table, areas for cutting and gluing paper, drawers for storing paper and archived work, a telephone, a fax machine, and natural light. Carl also had an Apple Macintosh II™ with 13-inch colour display and an Apple LaserWriter™ printer in his studio.

The participants worked on jobs for their own clients, so the jobs were self-selected. Each participant described the job orally at the beginning of each session. Carl worked on a catalogue for an art exhibition in his first session, and on a letterhead for a publishing company in his second session, and Alan worked on a biennial review for a museum.

Each session was recorded on videotape from two views simultaneously. Two 8mm camcorders were sited on tripods, one showing a close-up view of the participant's drawing board or table where the participant sketched, the other providing a view of the whole studio, capturing the participant's movements around the studio. The researcher remained in the room

throughout the sessions and occasionally asked the designer what he was doing. Each session lasted between one and two hours.

3.3.3 Data collected

The sessions were recorded on videotapes which were transcribed in full. The sketched products of Alan's session and Carl's second session were collected. Later, Alan contributed a series of sketches his colleague, Bill, had made relating to the review, and Carl gave the researcher photocopies of sketches he had made in his sketchbook for the letterhead design before the videotaped session. The tapes, transcripts and sketches from this study were analysed in conjunction with one another and with the data from the first study. Reproductions of the 25 sheets of sketches collected from this study can be found in Appendix 4, labelled A1 to A5 (Alan's sketches), B1 to B5 (Bill's sketches) and Ca1 to Cb14 (Carl's sketches). Sketches B1 to B5, Ca1 and Cb1 to Cb7 were supplied after the videotaped sessions.

3.4 Study 3: In-depth retrospective account

The third study was originally conceived as another open-ended interview. The participant brought a collection of his own and his colleagues' sketches to the interview and used them in discussing sketching. From this interview a more detailed account was gained from one designer of his perceptions of sketching, through a retrospective contemplation of particular sketches and the jobs they represented. This study also yielded further sketch data.

3.4.1 Participant

This participant was selected because of his experience; he holds a senior position at a major book publishing house:

Don: twenty years' experience in book design.

3.4.2 Procedure

In arranging the interview the participant offered to bring a collection of his own and his colleagues' sketches. In the interview the participant used the sketches as a reference tool to address issues about the nature of sketching and tools for sketching. He spoke, largely unprompted, about how the sketches related to the development of the ideas they represented. The researcher occasionally asked questions about the sketches to prompt more detailed descriptions from the participant.

The assessment was recorded on audiotape, with the tape-recorder placed between the participant and researcher, who sat opposite one another. The interview lasted an hour.

3.4.3 Data collected

The interview was recorded on audiotape and transcribed in full. The sketches Don brought to the interview and discussed were retained and analysed in conjunction with the transcript from this study, and with the data collected from the previous studies.

The sketches related to nine jobs. Don had made the sketches for seven of them, and his colleagues Eric and Frank had made the sketches for one job

each. Reproductions of these 16 sheets of sketches are contained in Appendix 4, labelled Da1 to Dg1 (Don's sketches), E1 (Eric's sketch) and F1 (Frank's sketch).

3.5 Evolution of the research methodology

In this section the kind of data gathered from each of the first three studies is briefly summarised, and the cumulative development of the methodology adopted is described.

3.5.1 General assessment of the first three studies

The first study was intended to allow the designers to speak in as unconstrained a way as possible, consistent with eliciting observations from them about the general topic of sketching. The transcripts from the open-ended interviews of the first study were examined for potentially important issues that arose during each interview. This examination also enabled identification of common themes occurring across the designers' interviews, and of any repetition of the same themes within a given designer's interview. This analysis suggested that examining actual sketches, and watching the process of making them, could illuminate some issues further, and this lead to the *in situ* observation study.

Since one of the aims of the research as a whole was to gain data from as naturalistic a setting as possible, for the second study the designers were observed and videotaped in their own studios while they worked on real jobs. Successful positioning of the cameras presented some interesting challenges, since designers' studios are not primarily designed to facilitate

videotape capture of working practice. However, as observed in section 1.2.1 of Chapter 1, the designer's workplace forms an integral part of their working practice, so their natural working environment was chosen in preference to the laboratory environment, which is easier for the researcher to manipulate, but less faithful to genuine work practice.

These sessions of the second study yielded videotape footage of designers in action, accompanied by their commentary about sketching, but ultimately yielded only a few sketches made during the actual sessions. From watching the videotapes, analysing the transcripts from both studies for issues of interest, and examining the few sketches arising from the videotaped sessions, it became clear that the actual sketches were the most important data source for investigating the issues about sketching of interest to the researcher. The additional sketches given to the researcher by the participants after these sessions confirmed their centrality. Contemplation of these sketches also suggested that, while observing their making provided useful data in developing an understanding of sketching activity, it was not necessary to watch them being made to be able to recognise and categorise their static visual aspects. Hence, the third study was used to focus closely on specific, pre-existing sketches. This study provided more sketch data and additional insights from another designer, including more detailed discussion of particular sketches than had occurred in the previous studies.

3.5.2 Open-ended interviewing: discussing an activity in the abstract

The value of the open-ended interviews was two-fold: they provided a way into a subject area that has no well-established research methodology and

they yielded initial data in the form of transcripts that could be examined in detail afterwards. The close study of the transcripts enabled both a developing understanding of the crucial issues about sketching, and a related gradual refinement of research methods to explore those issues more fully. The main disadvantages of this form of interviewing as a research method were that it did not generate any sketch data, nor did it show the designers actively engaged in sketching. These discussions were, therefore, at one remove from the activity and products of central interest, and from contemplating the transcripts it became clear that actual sketches would be a valuable data source. So the next study was conceived as a way for the researcher to gather more direct, observed data of designers actively sketching, and to collect the sketches made during the observed sessions.

3.5.3 Videotape recording: pros and cons for recording spontaneous activity

The perceived value of videotaping designers at work on real jobs in their own studios was the anticipation of capturing naturalistic activity and to an extent this was achieved. However, it became clear from the second study that attempting to capture the sketching process on videotape and collecting sketches made during the observation, while resulting in some valuable data, had several drawbacks.

First, creative ideas come spontaneously, so the designers jotted them down as sketches at times outside the recorded session, even when they had agreed in good faith to embark on the particular job at a given time when the recording would take place. Good ideas are too important and fleeting to

postpone recording until the 'right' time to sketch. As Carl, a participant in the second study, astutely observed:

> I don't know the experience you've with the others, it is, er — but it's very hard to find somebody sketching for you in front of the camera, because it's such a direct and, er — it's like scratching my head, and I can't do that — just do that when it comes, and it's very hard for you to wait for that.

He went on to say of his own approach:

> I do them on the train, or in the tube — just whenever I think about it, so that's — it's very hard for me to sit down and say, 'well, now I start sketching' — do them in bed, even.

Some of these sketches made outside the recorded or observed sessions were preserved by the designers and later given to the researcher. For example, see sheet Ca1, Appendix 4, for the archetypal 'back-of-the-envelope' sketches (in this case on the front and back of business cards). The aspect of ideas coming unbidden, and hence the sketches they embody being made spontaneously, threw a new light on the attempt at the naturalistic data-gathering approach. Obliging the designer to wait until a particular moment to 'have an idea' and sketch accordingly began to seem more constraining than was originally apparent.

A second constraint in the recording environment was asking the designers to work within a fixed physical area on the table or drawing board they used, to ensure capture of a close-up view of their sketching. This conflicted with their need and natural inclination to handle the emerging artefact, by folding, turning and flicking through it in mid air above the table, for example. Orienting the video camera to capture on film a close-up image that showed the amount of detail in the imagery being created was one challenge: tracking unfolding events by moving the camera around on the

tripod and manually changing the focus to capture in detail the execution of a sketch about five centimetres square in one instant, to the folding and tearing of the whole sheet in the next, was another. The speed in the designer's switching between such activities and the different focusing requirements to capture the different activities made it difficult to match the camera focusing appropriately to the immediate activity. In each videotaped session there was a second camera placed a metre or so away from the designer, intended to capture broader movements the designer made around the studio, including using other pieces of equipment away from the drawing board. This camera therefore recorded something of the physical manipulations the designer made with the emerging artefact. However, although this view could provide a useful complementary record of the designer's physical movements, it could not capture the richness of detail that only the close-up camera could provide. Consequently the conflicting requirements of the close-up view remained.

A third drawback to this kind of study that emerged was that, since the sketches made during the observed session related to real jobs, which the designers needed for subsequent reference, they were reluctant to relinquish the sketch material immediately after the session. Unfortunately, despite being asked to preserve the material for later collection, Carl threw away his sketches from his first session before the researcher returned to pick them up. Since Carl had been quite prolific in his sketch output during that session, he was observed and recorded for a second session, and produced a valuable collection of material that was preserved.

3.5.4 The value of sketches to designer and researcher

The experience with Carl echoed indications from other designers that they are strongly attached to their sketches for a time immediately after their execution, but when a certain threshold is reached the sketches cease to have any importance for the designer and are then disposed of. This attitude was echoed in statements from other designers interviewed during this research, who spoke of their sketches in rather dismissive and apologetic terms ('I'm just playing', 'there's not much here'). There is a prestigious and perhaps surprising precedent for this. Michelangelo is said to have destroyed many of his preliminary sketches because he did not want posterity to see the extent of his labours (Lambert 1984, 75). This suggests there are elements of professional pride involved as well as some uncertainty at the ideas conveyed in sketches before they have reached maturation.

The relationship designers have with their sketches made collecting sketch data a significant challenge. Most of the designers interviewed indicated that as soon as the sketches cease to have value in the process of working through a job they become disposable, even, as one designer said, a burden she needed to destroy to feel she had reached completion of a job. By contrast, one of the participants in the observed sessions said that he kept a sketch book in which he captured many of his ideas. In fact, this was where he had sketched out his early ideas for the job he was working on while being videotaped. Therefore, although no videotape record was made of the execution of these sketches, the sketches themselves were preserved and photocopies of these sketches were given to the researcher.

3.5.5 Interviewing centred on sketches

From these experiences the value of the sketches themselves became even more evident. Therefore, the third study was approached with the intention of capitalising on the collection of sketches the participant had offered to bring with him. Given the challenge of collecting sketches as described above and the difficulty of causing them to be generated and parted with under naturalistic circumstances, this participant's voluntary offer of a set of sketches was a timely gift. It provided an excellent opportunity, to gather more sketch data, to hear his detailed account of those particular sketches, and to gain his insights into sketching in general.

The third study, focusing on the detailed account by a designer of his own and his colleagues' sketches, proved highly successful, and contributed to the design of the evaluation study. Having specific sketches present facilitated both the designer's commentary and the researcher's questions, since they functioned as a clear focus of the discussion.

3.6 Summary

Each method used for the three exploratory studies provided valuable data, and each informed the next stage of research. The open-ended interviews showed up some common themes occurring both throughout the individual interviews and across all six of them. The videotape recorded sessions of the second study showed something of actual practice in action, and yielded some sketches. The material gained from these two studies suggested that sketches themselves were the most valuable form of data for investigating the emerging issues of interest, followed by commentary from designers

about their own practice. The third study, therefore, revolved around the sketches brought to the interview by the designer. These sketches were used both as the focus of that interview and, in conjunction with those already collected, as the core data for developing the initial characterisation of sketching, described in Chapter 4. In combination, the results from the first three studies consolidated one another and laid the ground for the evaluation study, described in Chapter 5. The results of the evaluation study culminated in the refined characterisation of sketching, described in Chapter 6.

4 INITIAL CHARACTERISATION OF SKETCHING FOR TYPOGRAPHIC DESIGN

Despite our desperate, eternal attempt to separate, contain and mend,
categories always leak.

Trinh T Minh-ha
Difference: a special third world women issue

4.1 Introduction

The first three studies yielded several kinds of data: transcriptions of interviews with designers about sketching in general and their own sketching practices in particular; videotape records of designers engaged in sketching for real jobs and sketches made during those observed sessions; a transcription of a detailed and focused account of pre-existing sketches made for real jobs, and that collection of sketches. The continuing analysis of the accumulating data suggested that the sketches themselves formed the central data for investigating the issues of interest. From looking at the sketches carefully, in conjunction with watching the videotapes and studying the transcripts to identify common themes, an initial characterisation of sketching began to emerge. That characterisation is set out in this chapter.

41 sheets of sketches were collected from ten designers from studies 2 and 3. These sketches are reproduced in Appendix 4, listed by designer, subject matter and label. The labelling system is explained in section 3.1.3 of Chapter 3. From the analysis of these sketches, eight recurring *features* in these sketches have been identified. Analysis of the collective data suggests that these features support six *functions* in sketching as an

integral part of the design process. In the following sections each of these features and functions is discussed in detail.

Both the features and the functions may be thought of as separate strands that work in combination to support one another. Since they do not occur in isolation, it is somewhat artificial to present them as discrete entities. But adopting this approach enables us to tease apart the rich complexity of the visual dimensions in sketches, which really occur in an interconnected fashion. In disentangling the strands we can identify the multiple dimensions in sketching and begin to understand more fully how they operate in combination. An account of how the strands interact is provided in section 4.6.

4.2 Features observed in the sketches

The eight commonly occurring features observed in the sketches are as follows:

1 *Scale* — the sketches are made at differing *scales*.

2 *Closure* — the sketches vary in their states of visual completeness, or *closure*.

3 *Degree of detail* — the sketches vary in the *degree of detail* they contain in the overall representation of the design.

4 *Precision* and *tautness* — the sketches are executed to differing levels of *precision* and *tautness* in the rendering of the overall design.

5 *Degree of detail* and *levels of precision of typeface attributes* — the sketches vary in the *degree of detail* and the *levels of precision* in the representation of the individual typographic elements.

6 *Multiple sketches* — many sheets of sketches contain *multiple sketches*, often at different scales, and in differing degrees of detail, closure, precision and tautness.

7 *Mixture of visible languages* — the graphic imagery of the sketches is often amplified through verbal, numeric and symbolic annotation, forming a *mixture of visible languages*.

8 *Artefact simulation* — as a natural extension of sketching, designers make paper mock-ups for *artefact simulation*.

4.3 Functions supported by sketching

The six functions of sketching that the features of sketches are suggested to support are as follows:

1 *Focus* — through a combination of choice of scale, closure, degree of detail, precision and tautness, the designer can *focus* attention on the whole design or part(s) of the design under current consideration.

2 *Provisionality* — through a combination of those features listed under focus, the sketches afford *provisionality*, enabling the designer to withhold commitment to a design solution while still exploring it.

3 *Switching* — the designer can *switch* easily and quickly between aspects of the design under consideration, through working at different scales, levels of detail and precision, and in different visible languages.

4 *Record keeping* — the sketches automatically provide *records* of themselves and the ideas they embody, requiring no additional cognitive overhead beyond sketching itself.

5 *Comparison* — close spatial juxtaposition enables *comparison* to be made easily between alternatives.

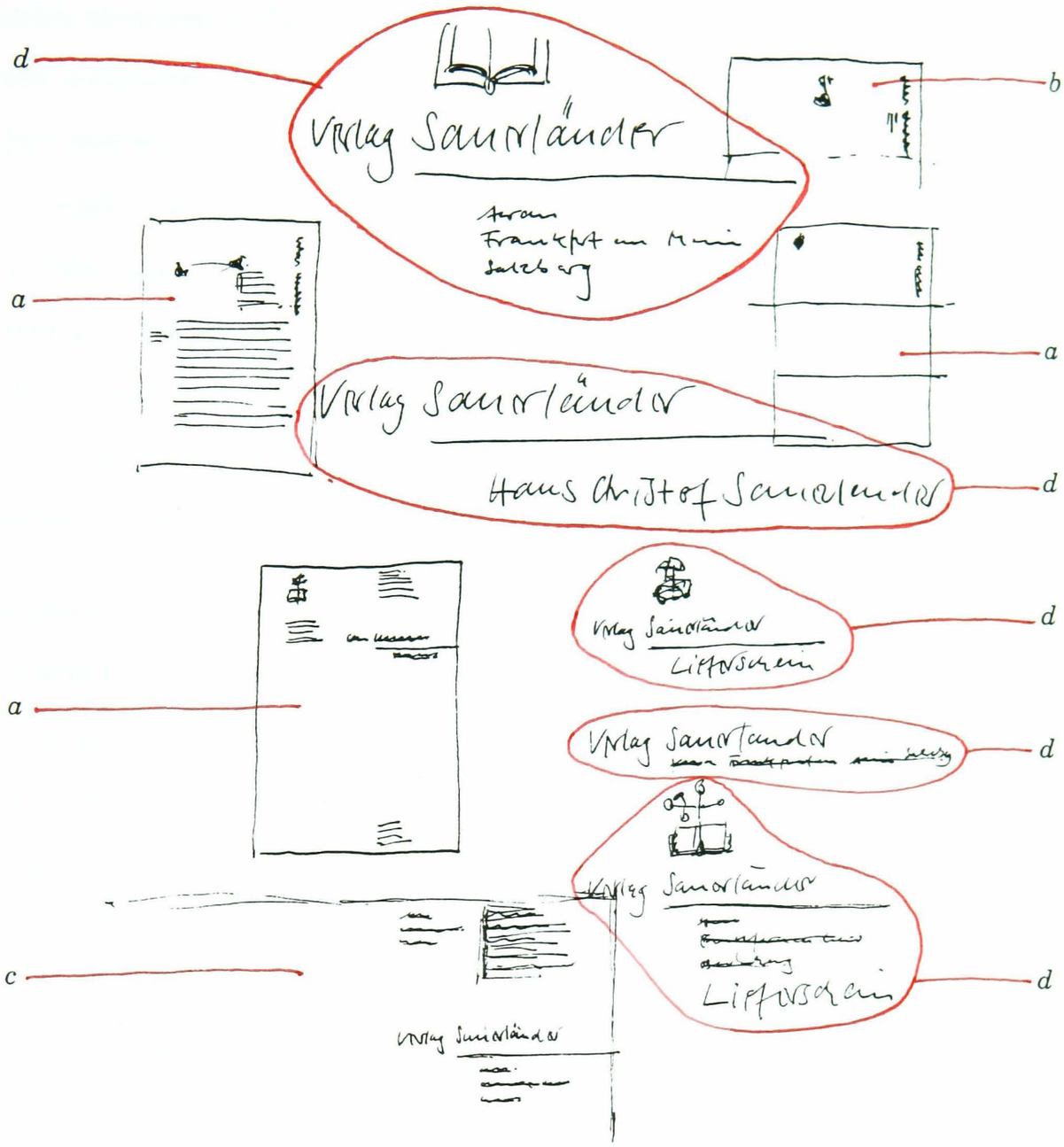
6 *Simulation of experience* — through simulating both the surface aspects of the document and its 3-dimensional characteristics by making mock-ups, the designer is able to engage in *simulation of experience*. This allows the designer to evaluate both the full, physical characteristics of the document, and the experience the end user will have of the document.

4.4 Features

The eight features listed in section 4.2 are described in detail in this section, illustrated by instances of the features taken from the sketches collected from studies 2 and 3. A glossary of typically-occurring key images is provided in Appendix 1 to aid the reader in understanding what these aspects of the sketches represent. In this chapter, unless stated otherwise, the designer's commentary and the sketches used to illustrate the issues are taken from different studies, so the commentary does not refer explicitly to the sketches in the figures.

4.4.1 Scale

Figure 4.1 shows a sheet of sketches in which the document being designed, a letterhead, is shown at different scales. There are three small-



Sheet Cb5. Reduced to 64 percent of original size.

Figure 4.1 Scale

Sketches at different scales on the same sheet:

a Smallscale sketches of the whole document.

b Smallscale sketch of part of the document.

c Larger scale sketch of part of the document.

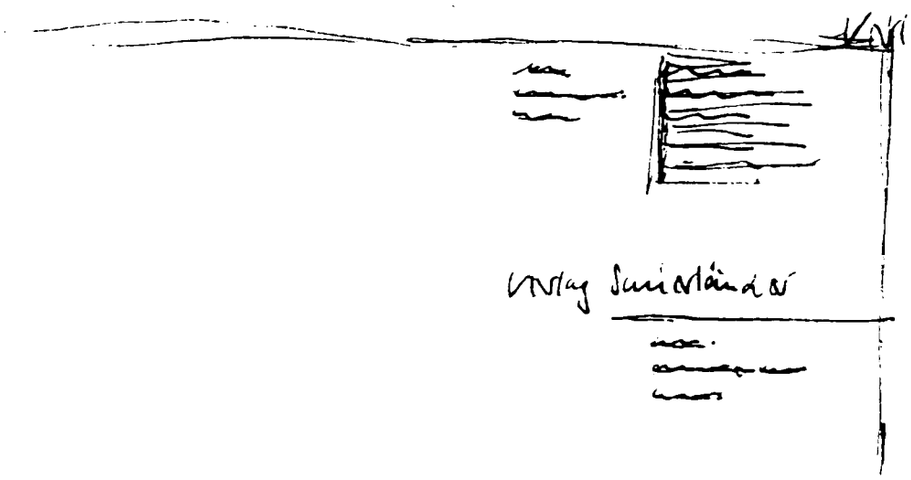
d Life size details of the document.

scale sketches of the whole document (*a*), one small-scale sketch of part of the document (*b*), one larger scale sketch of part of the document (*c*) and five sketches at something close to life size of details of the letterhead (*d*). In making a small-scale sketch of the whole, the designer can address the overall spatial relationships between all the elements within the page, and gauge the visual balance between the elements. In sketching a part of the document at life size, or thereabouts, the designer can concentrate in closer detail on the spatial relationships between just the extracted elements, and begin to resolve the typographic attributes of each element.

A sketch of part of the document may include visual cues as to the relationship between the part and the whole document, as shown, for example, in figure 4.2. This sketch includes horizontal and vertical lines indicating the top and right hand edges of the sheet of paper on which the letterhead will be printed. This representation enables the designer to envisage the spatial relationship this piece of typography will have to that corner of the sheet of paper. Alternatively, the part may be sketched without any indication of the context of the whole document, as shown in figure 4.3. Here, only the potential treatment of the client's name, address and logotype is shown, out of the context of the appearance of the whole document.

This use of different scales is alluded to by Sue in the following two excerpts from her interview:

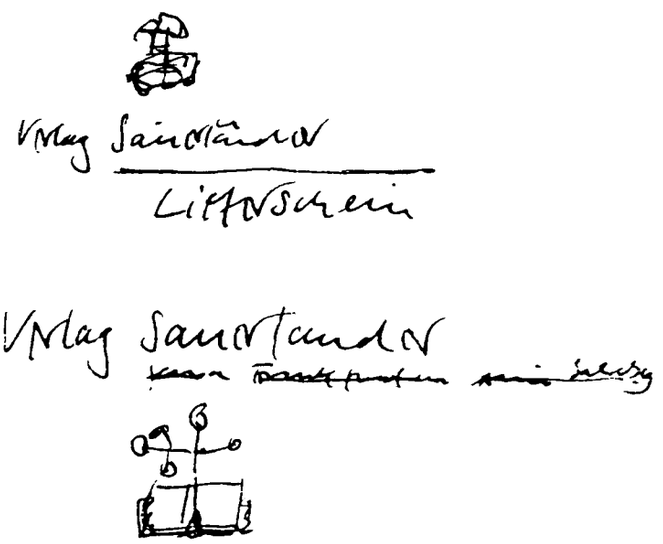
> If you're designing a page, say, it's to do with balance of colour and elements — and their relationship to the envelope — the edge of the page — that's what you're playing with initially and then you have to see, well, if I have the type that small, because it fits compositionally, can I read it? Or can I get the text I want to in that space? But what you're working with is kind of chunks of elements.



Sheet Cb5. Original size.

Figure 4.2 Scale

Sketch showing a part of the document including an indication of the context of the whole document (lines indicating the top right hand corner of the sheet of paper).



Sheet Cb5. Original size.

Figure 4.3 Scale

Sketches of parts of the document without any indication of the context of the whole document.

> You want an arrangement that looks well, that balances well, and so forth. But then you need to go into the detail and see if you can fit in what you need to — if in a certain size you can get all your letters that you need in your headline, or if you have to go down a size. If you have to go down a size, what does that mean in terms of — so you're working very broadly and then you're going down into the detail to check if it works, and then if it doesn't then you go up out again.

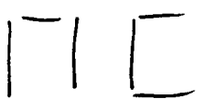
Another example of a series of sketches in which the designer worked at different scales, exploring the aspects of a review for a museum, is shown in figure 4.4. Here the sketches show whole pages and double page spreads at small scale, and parts of the design worked on out of context at a larger scale. The use of different scales is referred to again in subsections 4.5.1 and 4.5.2, dealing with the functions of Focus and Provisionality, respectively.

The sketches in figures 4.1 and 4.4 also illustrate instances of lack of closure and different degrees of detail, as described in the following subsections.

4.4.2 Closure

In the context of this characterisation closure of an element or sketch refers to the visual closure of the image in the sketch. For example, as the glossary of images shows, a single page or column of text may be indicated by a rectangle:

or they may be indicated by an implied rectangle:



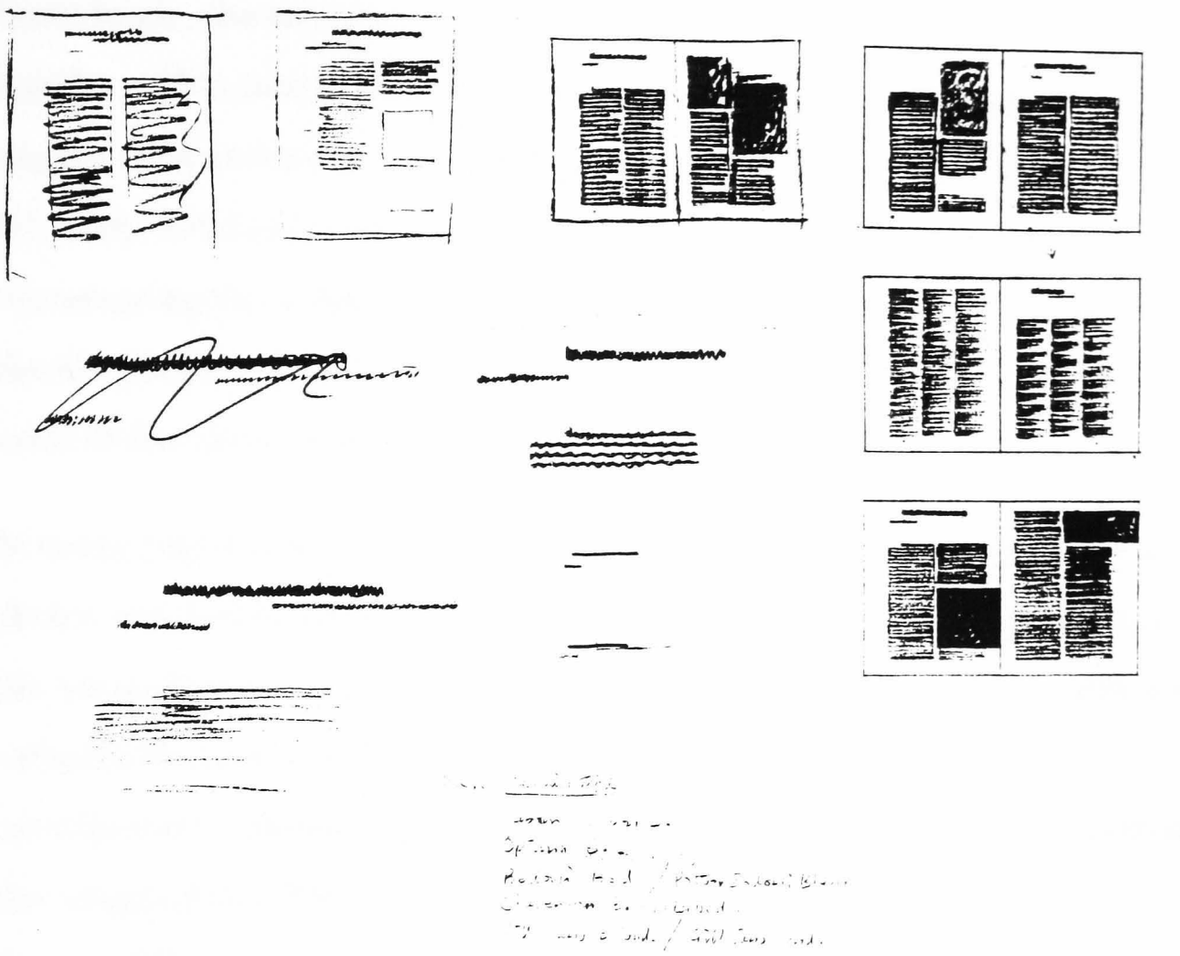


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Figure 4.4 Scale

Another example of a sheet of sketches at different scales.

Accordingly, the two sketches shown in figures 4.5 and 4.6, respectively, may be said to lack closure, since the rectangle representing the whole page in each instance is implied but not fully rendered. Figures 4.7 and 4.8 show sketches in which individual elements (the partial rectangles representing the columns of type) lack closure, on the right hand side in the sketches in figure 4.7 and at the bottom of the implied columns in some of the sketches in figure 4.8.

In using paper and pencil the designer has the option of embarking on a sketch which may not reach visual closure, but through whose execution the issue of concern is explored sufficiently nevertheless. Lack of closure is valuable for enabling the designer to focus on particular parts under consideration, without being obliged to complete, or explicitly contemplate, the image of the whole document. As Don said of his sketches for the design of dictionary pages, illustrated by the sketch in figure 4.9:

> It'll just have the top of the page on it, because that's where the differentiated items happen.

The notion of lack of closure is referred to again in subsection 4.5.1, concerning the function of Focus.

4.4.3 Degree of detail

Closely related to, but separate from, closure, is the degree of detail in a sketch. As observed in section 1.2 of the Introduction, the typographic designer has only two things to work with: the spatial relationships between elements, and the typographic attributes of elements. In this characterisation the notion of degree of detail relates to the treatment of both these aspects in the sketched representation. The degree of detail

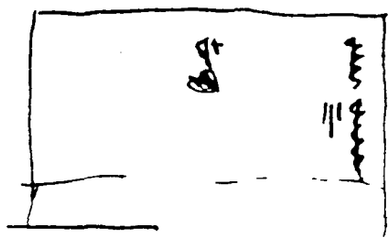

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Figure 4.5 Closure

Sketch showing lack of closure of document representation.

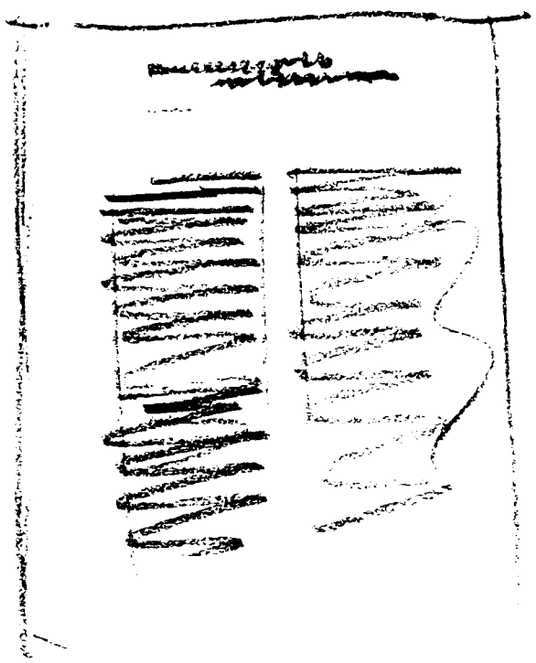

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Figure 4.6 Closure

Sketch showing lack of closure of document representation.

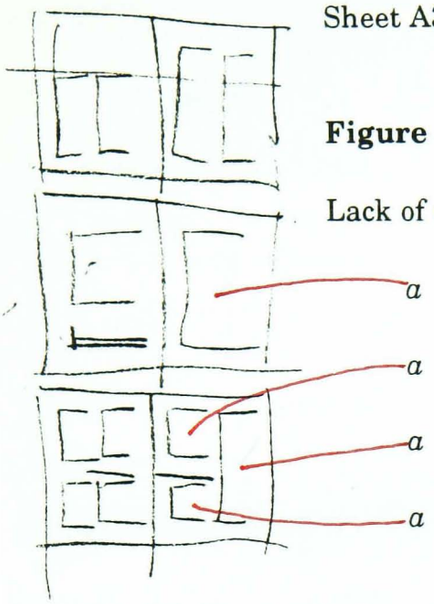

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Figure 4.7 Closure

Lack of closure of individual elements (*a*).

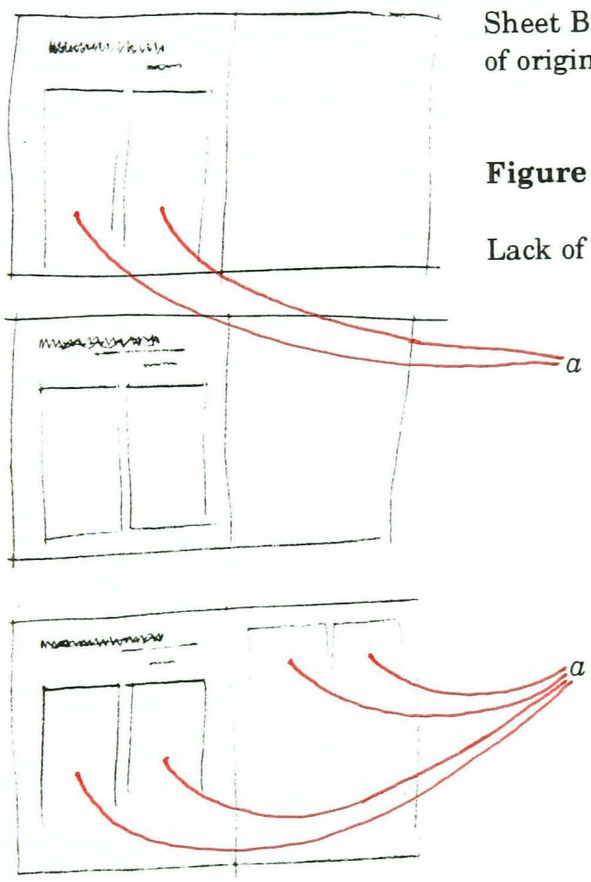

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Figure 4.8 Closure

Lack of closure of individual elements (*a*).

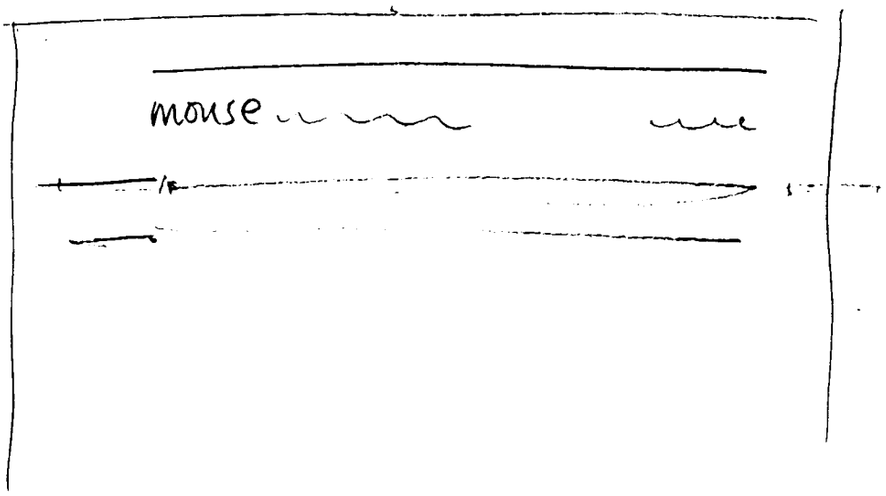

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Figure 4.9 Closure

Lack of closure of document representation.

shown in the representation of spatial relationships between elements is considered in this subsection, and detail of the typographic attributes is considered in subsection 4.4.5.

Differing degrees of detail may be identified in the sketches dealing primarily with the spatial relationships within a document design. The detail may be minimal, as in the sketches in figure 4.10, in which rough rectangles are used to indicate the approximate position and extent of columns of text within double page spreads (*a*), and single, roughly horizontal lines indicate the position of section titles (*b*). In such a representation there is no detail within the frame of the sketched elements, so nothing is conveyed about what spatial relationships there will be within the individual typographic elements, such as indentation in the first line of paragraphs, or the amount of interlinear spacing between the lines of type within a column. Nor is any specific detail conveyed about the typographic attributes of any of the elements, beyond the possible implication that the section titles may be bold, because their representation is dark.

These sketches are enabling the designer to consider the overall spatial relationships of major elements, so minute detail of the typographic treatment of each element is unnecessary. In fact, referring to the value of representations with a low degree of detail for the early stages of designing, Sue said:

> It's not that you can do without more information, it's that you actually don't *want* information. It gets in the way of — you want it vague enough not to mislead.
> (*original emphasis*)

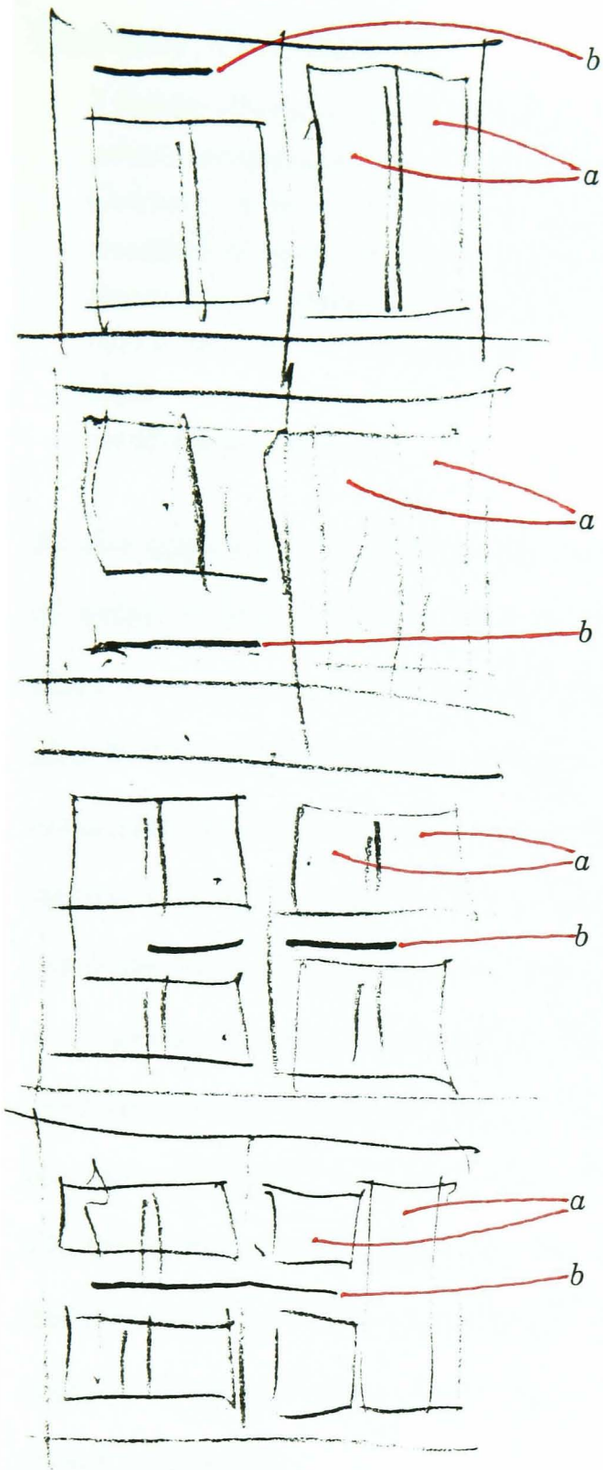

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Figure 4.10 Degree of detail

Sketches showing minimal detail:

a Rough rectangles indicating position of text columns.

b Rough lines indicating position of section titles.

Similarly, Carl observed:

> I think it's very much what it is, to indicate, to show on the paper *where* something is happening. And if this particular thing is now in Calvert or in Bodoni, or in whatever is — becomes important when you decided already where's something happening. I mean in this particular moment this could be even Garamond. Later on in the — when you've — it's another — phase number two is when you look at that.
> (*emphasis added*)

At the opposite end of the continuum of detail, there may be a high degree of detail in the sketches, such as appears in figure 4.11. These examples show how greater detail within the sketch conveys more information about the intended design, relating to both the individual typographic elements and their spatial relationships to one another. The sketches in figure 4.10 are rough enough that there is substantial margin for interpreting the layouts they represent. By contrast, the sketches in figure 4.11 are so detailed in execution that there is little or no margin for interpretation about the spatial distribution of the elements. The text measure, justified line endings, margins and positioning of the title and illustrations are all indicated very specifically. An additional degree of detail implied, by the darkness of their representation, is that the titles will be set in bold type, although the exact detail of their typeface and size is not indicated.

The sketch in figure 4.12 is an example of how the designer may employ lack of closure alongside a high degree of detail, thus illustrating that high degree of detail need not imply closure of the sketch. This supports the observation made above that the designer may explore, almost to the point of resolving the issue, a part of the design away from the context of the

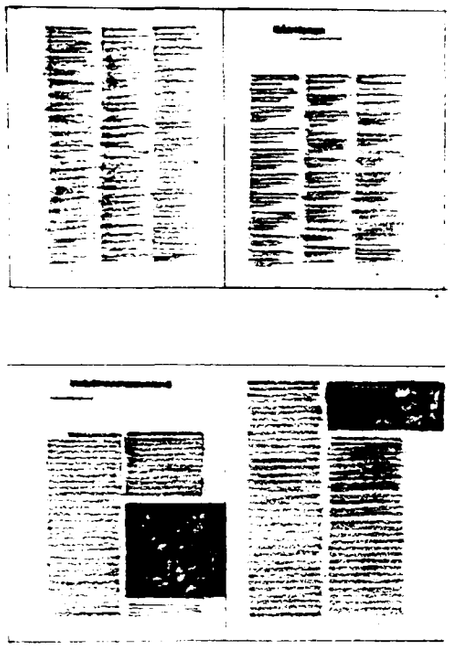

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Figure 4.11 Degree of detail

Sketches showing high degree of detail.

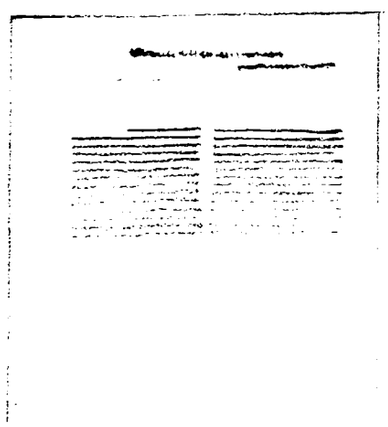

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Figure 4.12 Degree of detail and closure

Sketch showing high degree of detail combined with lack of closure.

whole design, by working on it up to a high degree of detail. Of course, ultimately the design must work as a whole, so pieces cannot be finally resolved without reference to the rest of the design. But particular pieces which are especially challenging or complex need to be addressed thoroughly in their own right, as well as alongside the whole design. Working at different degrees of detail, sometimes in conjunction with lack of closure, assists this exploration. Sue made this statement about working at different levels of detail:

> You work in a sort of sketchy way and then in a more detailed way, because you've got to operate those things and make — there has to be interaction between at least two levels. Maybe there's more in between.

Figures 4.10, 4.11 and 4.12 show varying degrees of detail in sketches at similar scales. Figures 4.12 and 4.13 demonstrate that similar degrees of detail and closure or lack of closure occur in sketches at different scales. These comparisons begin to indicate the flexibility of sketching in this medium, since they show cumulative combination, in several different ways, of the features already noted.

The visual quality of the marks themselves, which constitute the sketches, is discussed in the next subsection.

4.4.4 Precision and tautness

Precision in this context is used to mean the verisimilitude of the sketched representation to the appearance of the final artefact. This precision derives from a combination of detail, closure and tautness of line in the sketch. Figures 4.14, 4.15 and 4.16 are used to illustrate varying levels of precision and tautness of line found in different sketches. The sketches in

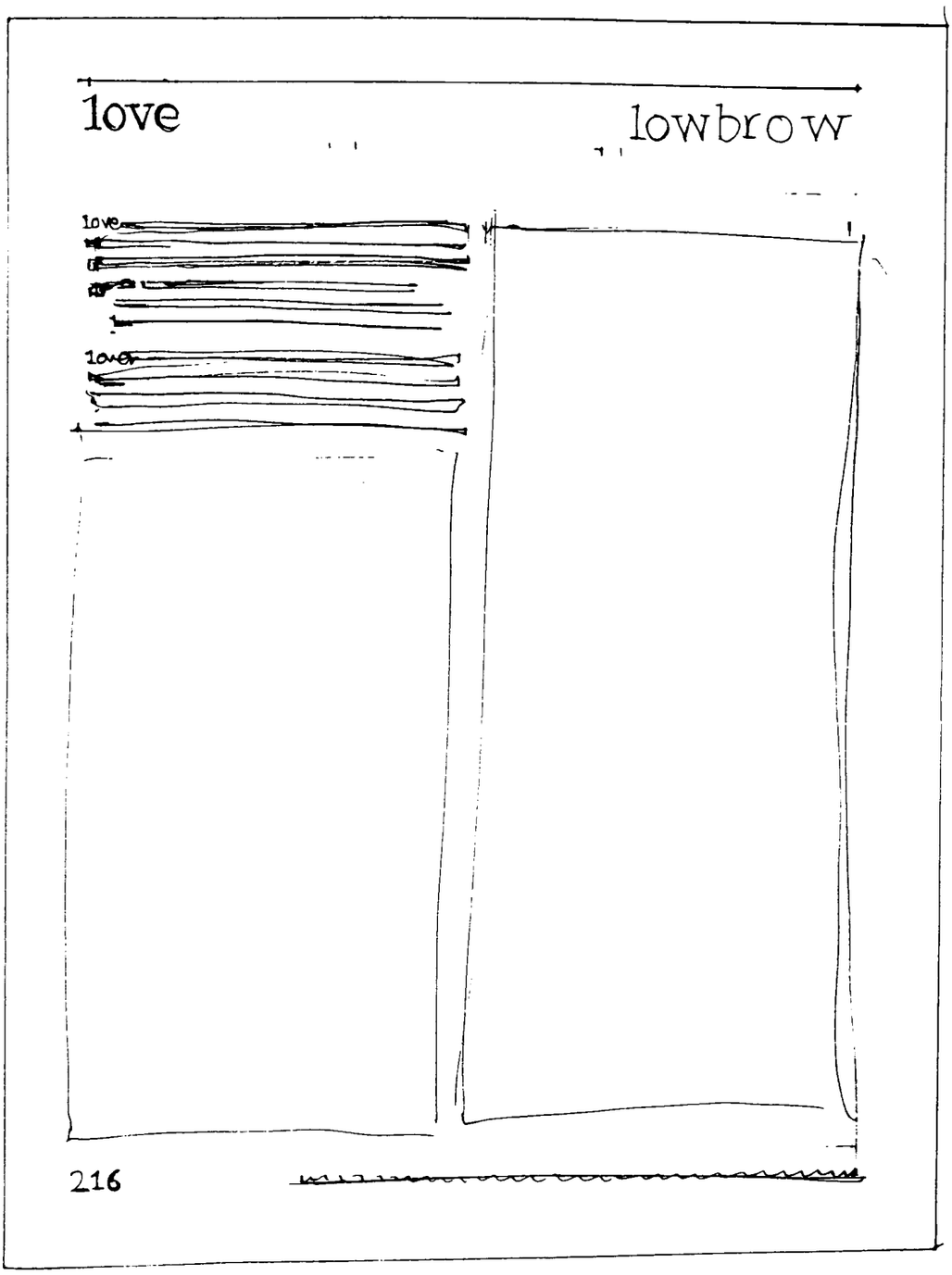

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Figure 4.13 Degree of detail

Sketch showing similar degree of detail to that in figure 4.12.

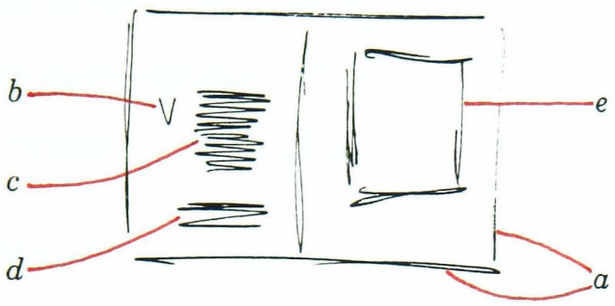

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Figure 4.14 Precision and tautness

Sketch lacking precision and tautness:
a Page boundaries.
b Dropped cap.
c Lines of type.
d Illustration caption.
e Outline of the illustration.

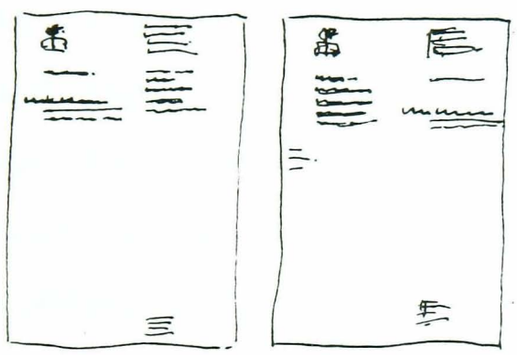

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Figure 4.15 Precision and tautness

Sketches showing more tautness and precision than the sketch in figure 4.14.

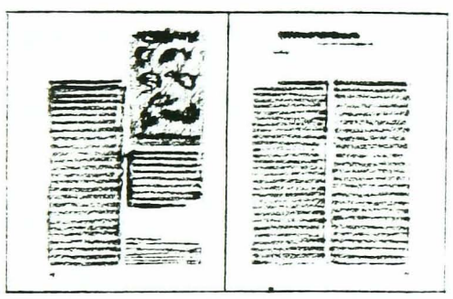

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Figure 4.16 Precision and tautness

Sketch showing most tautness and precision of figures 4.14, 4.15 and 4.16.

all of these three examples have closure, both of the document frames and of every element within the frame, but they differ in their levels of precision and tautness of line.

The sketch in figure 4.14 has the lowest level of precision and tautness of line of the three figures. All the lines in this sketch, showing the boundaries of the page (*a*), the dropped cap (*b*), the lines of type (*c*), the illustration caption (*d*) and the outline of the illustration (*e*) are freely hand-rendered, lacking tautness. Consequently, this sketch appears loose and rough, despite considerable detail within some of the elements. In the sketches in figure 4.15 the typographic elements are rendered with more precision, with lines of type indicated by discrete lines, in contrast to the scribbled zig-zags in figure 4.14. The lines in figure 4.15 are more taut than those in figure 4.14, adding to the inflexion of precision in these sketches. The sketch in figure 4.16 displays the highest degree of precision of these three figures, with the frame of the pages ruled up, and all the lines of type carefully drawn straight and parallel to one another. The lines in this sketch are the most taut of the three.

Figure 4.17 illustrates how a mixture of levels of precision and tautness may be incorporated within the same sketch. The lines indicating the page boundaries (*a*) and the guidelines for the position of the text and illustration (*b*) are ruled and, hence, precise and taut. The marks showing the illustration (*c*) and lines of type (d), by contrast, are loosely rendered and at a low level of precision. The value to the designer of working at different degrees of detail and levels of precision is discussed in subsections 4.5.1 and 4.5.2, on Focus and Provisionality, respectively.

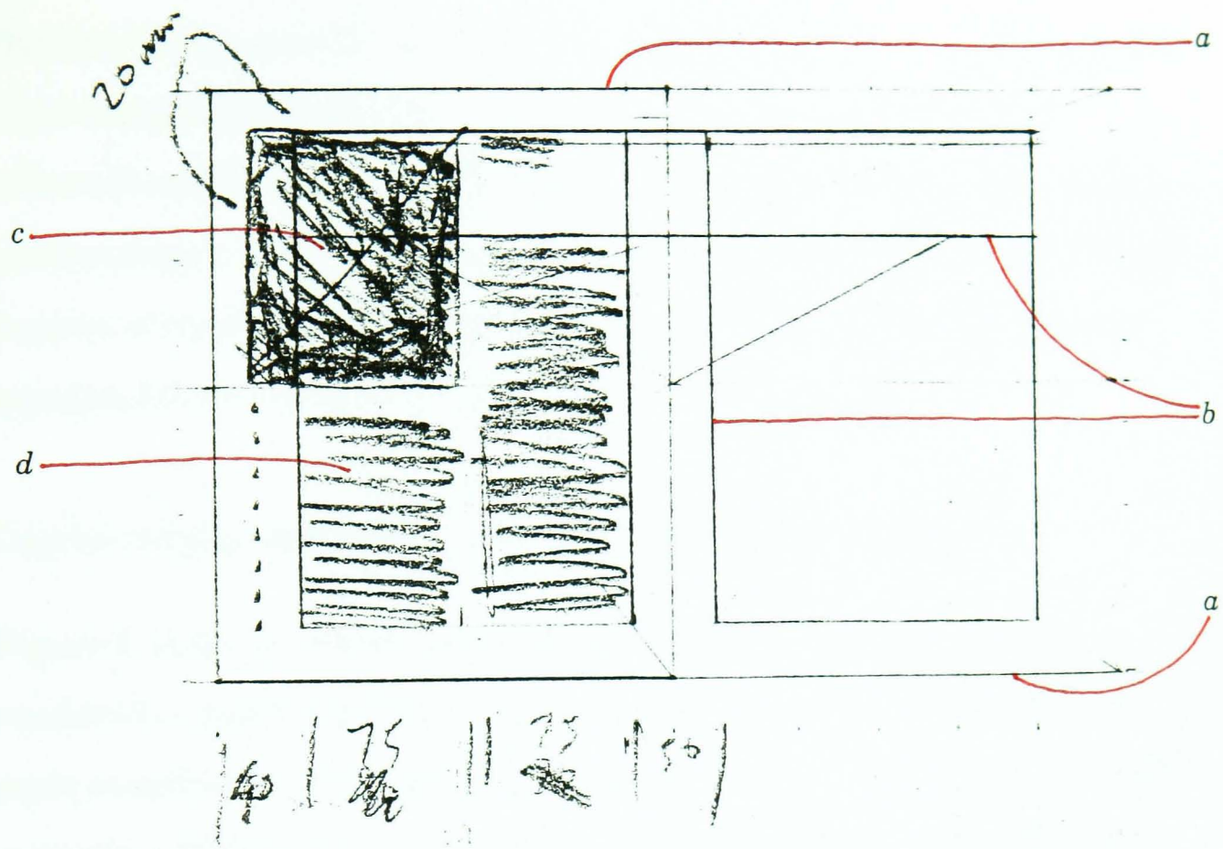

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Figure 4.17 Precision and tautness

Varying degrees of precision and tautness within the same sketch:

a Indication of page boundaries, taut and precise.

b Grid for text and illustration positioning, taut and precise.

c Indication of illustration, loose and imprecise.

d Indication of lines of type, loose and imprecise.

The specific typographic attributes of each of the elements in a design are important in their own right, and decisions made about them both influence and are influenced by the broader issues relating to the spatial relationships in the overall design, as described above. The use of different degrees of detail and levels of precision in the representation of specific typographic attributes is discussed in the following subsection.

4.4.5 Degree of detail and levels of precision of typeface attributes

Figure 4.18 shows a collection of examples of type representations rendered at small scale by lines of varying degrees of tautness. At this scale something may be conveyed about the weight of the typeface, so, for example, a darker line may indicate bold type. But the sketch must be rendered in a uniform tone for it to be clear that the darker line is deliberately employed to indicate a specific phenomenon, and is not just an accidental artefact of a slight, unintentional variation in the pressure of the pencil.

However, nothing apart from weight is conveyed about the typographic attributes of the type, such as actual font or size, in these sketches. In this respect all the examples in figure 4.18 lack this dimension of detail, regardless of how taut they are. At a larger scale the type may be rendered to convey a particular typeface, or at least a general style. Figure 4.19, for example, shows a sketch of a word in type with Modern characteristics (vertical stress, hairline serifs, abrupt transition between thicks and thins). The sketch is rendered loosely, but is detailed enough to be recognisable as being in a particular typestyle.

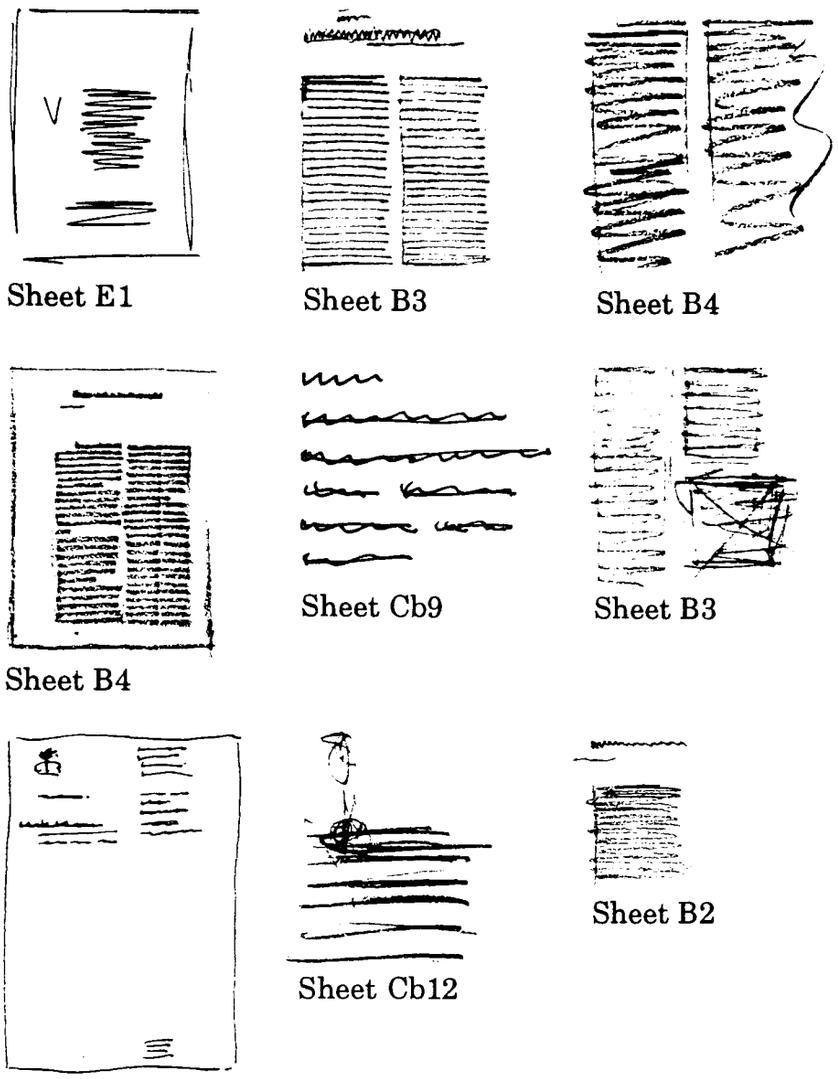

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Figure 4.18 Degree of detail and precision of typeface attributes

Sketches, representing type at small scale, showing varying degrees of detail and levels of precision.

As a contrast to figure 4.19, figure 4.20 shows a sketch of a word loosely rendered, which is only suggestive of a typestyle and is less distinctly recognisable as a specific font. In figure 4.21 the rendering of the two words differs in their degree of detail and level of precision. The word on the left conveys more detail of the typeface under consideration, and so is more precise, with regard to the representation of the final printed text. The word on the right is a skeletal form of the type, indicative only of the letters in the word, the typesize and the length to which the word falls, but showing little internal detail of the typeface. Consequently, the sketch of the word on the right conveys the essential, dimensional aspects of the proposed design without indicating much specific typographic attribute detail.

In referring to his own way of sketching a representation of type without including all possible specific typographic attribute detail, Don said:

> There's only one lettering style, but they're all different typefaces. I can tell you which typefaces these are in.

He went on to describe the value of working like this:

> It's a skeleton face which gives me enough information — I'm just drawing out enough — I'm trying to put in enough information to give — I'm not worried about what typeface it is at the moment I'm trying to work out whether it's *that* arrangement or *that* arrangement. (*original emphasis*)

Clearly, this relates to his addressing the spatial relationships between the elements of the design, while leaving aside the specific typographic attributes of the typeface used for each element, as described above. However, these two considerations set up an interesting tension, since different typefaces, even of nominally the same size, have different metrics, so that lines of the same text set in different faces fall to different

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Figure 4.19 Degree of detail and precision of typeface attributes

Sketch of characters loosely rendered but recognisable as having a particular typestyle.

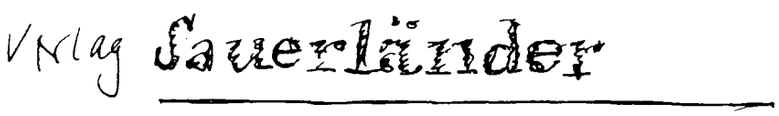

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Figure 4.20 Degree of detail and precision of typeface attributes

Sketch showing characters loosely rendered, only roughly suggestive of a typestyle.

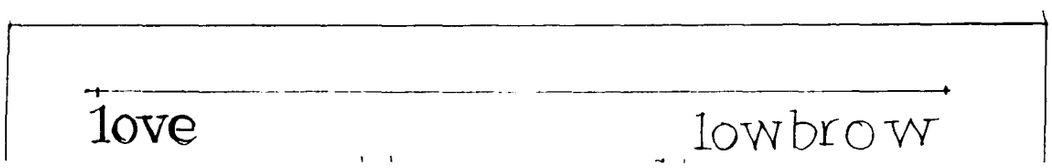

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Figure 4.21 Degree of detail and precision of typeface attributes

Sketch showing characters rendered with different degrees of detail, precision and tautness within the same sketch.

lengths. This means that at some point a specific font must be chosen, so that its particular metrics, as well as its overall stylistic appearance, may be incorporated into the emerging design.

Making reference to this aspect of designing Don said:

> I just then actually wrote it in a real typeface. Although I didn't know what the typeface was I knew there must be a real script typeface that would copyfit like that.

His claim of writing in a 'real' typeface sounds curious, next to his admission that he did not know what the exact typeface would be, until we realise that 'real' stands for 'having the accurate metrics', or, as he puts it, that there must be a typeface that will copyfit as his sketch indicates.

Continuing the theme of illustrating cumulative combination of the features noted so far, the example in figure 4.21 also shows how differing degrees of detail and levels of precision of the typographic attributes may be mixed in the same sketch.

4.4.6 Multiple sketches on one sheet

Of the 41 sheets of sketches collected from studies 2 and 3, 28 contain multiple sketches. In some instances the sketches are variations on one theme, as the examples in figures 4.22 and 4.23 show. In others, such as those in figures 4.24 and 4.25, the sketches represent explorations of different parts of the design in hand.

Figure 4.22 Multiple sketches

Sheet of sketches showing variations on a theme (the section opening to a museum review).

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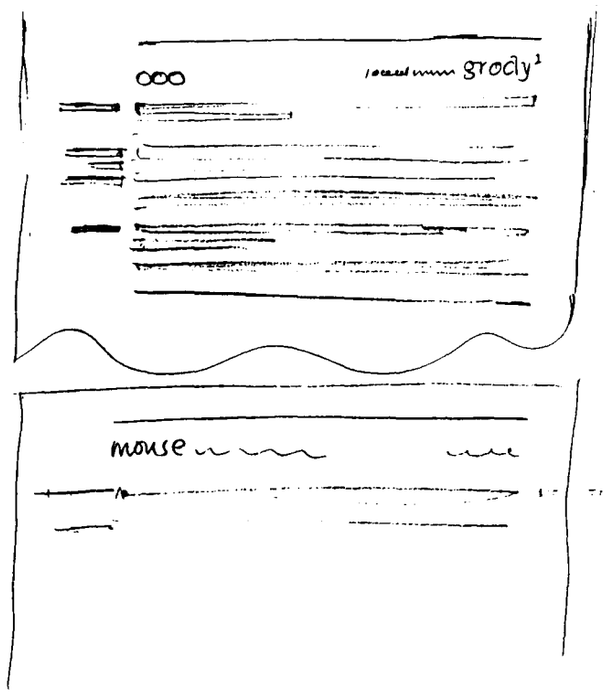

Figure 4.23 Multiple sketches

Sheet of sketches showing variations on a theme (the layout of individual entries in a dictionary).

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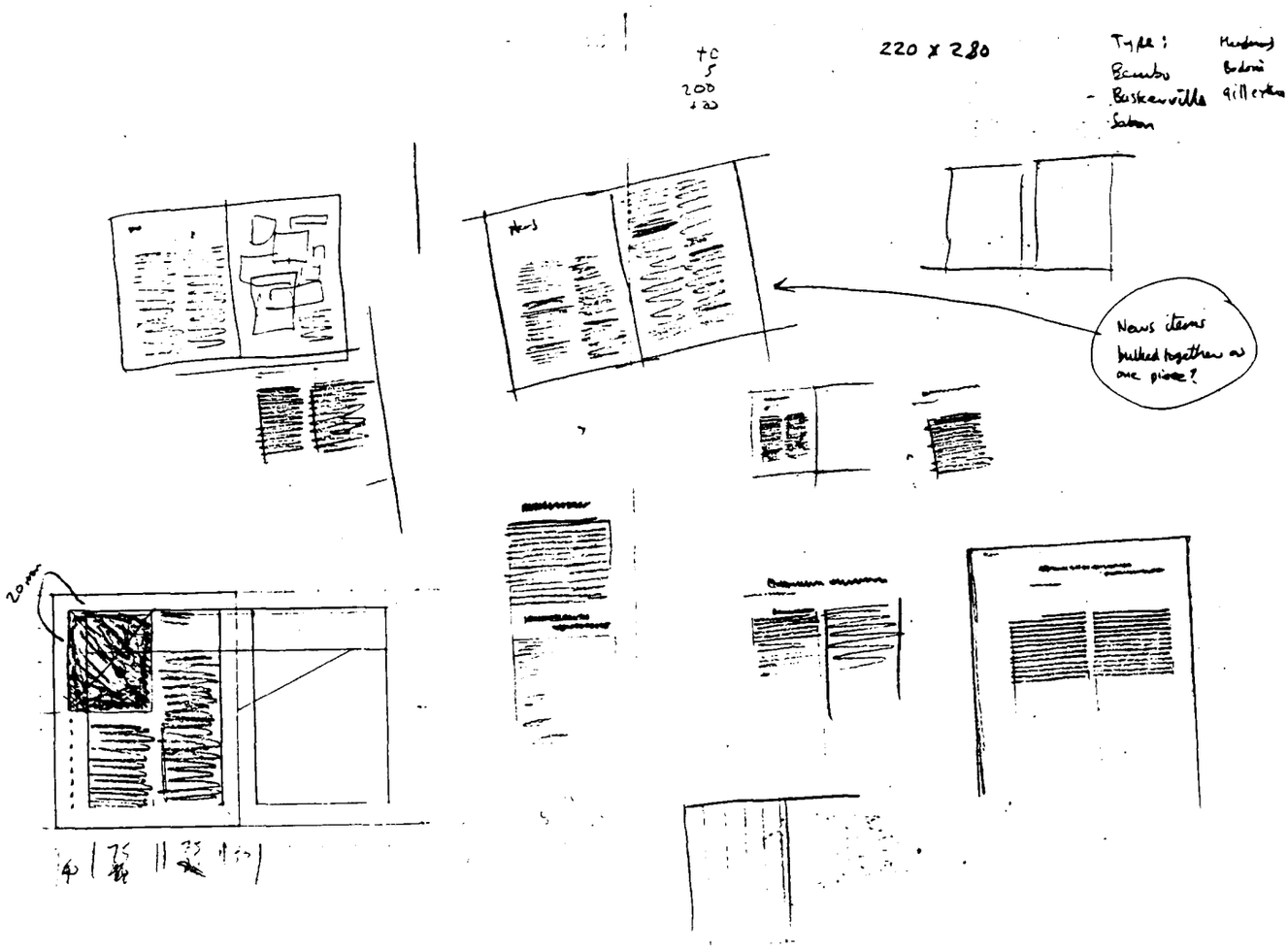

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Figure 4.24 Multiple sketches

Sheet of multiple sketches showing explorations of different parts of the design.

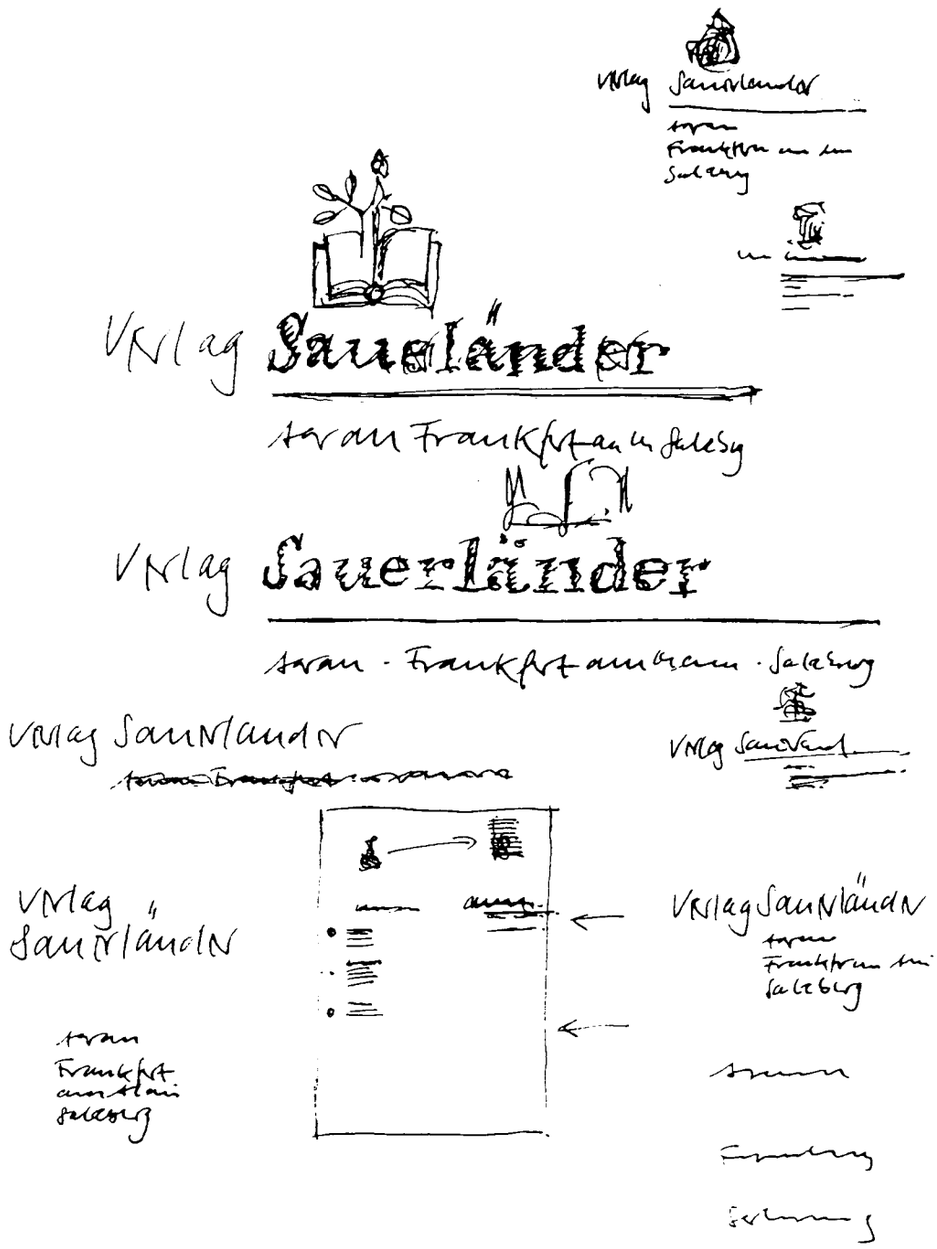

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Figure 4.25 Multiple sketches

Sheet of multiple sketches showing explorations of different parts of the design.

In speaking in a general way about sketching, Sue observed:

> It's the way you work out your ideas, and the thing about sketching is it's fast. So it's a way of remembering what you're thinking, but also seeing what you're thinking and developing what you're thinking.
>
> You put down an idea, or even a bit of an idea — so it's very quick, it's very responsive. And then you see that thing and that prompts you to have other ideas.

This account suggests that the designer is capturing the stream of ideas in a series of sketches, each of which prompts or at least influences the next. From that it is clear that multiple sketches within the designer's field of view is valuable to the designer in evoking new ideas. In addition, in contemplating the issue of what the designer's field of view offers, and the value of having all the related ideas easily to hand (and eye), Sue referred to the designer's memory, of other design solutions, when she spoke of:

> Having everything on the pa- — on the desk in front of you, because your peripheral vision is enough to remind — to remember and remind you of things.

Since any one sketch may incorporate all the features described already, it naturally follows that multiple sketches on the same sheet may incorporate any of them in any combination.

The value of multiple sketches on one sheet is addressed further in subsections 4.5.4, and 4.5.5, on Record keeping and Comparison, respectively.

4.4.7 Mixture of visible languages

The first six features observed have dealt with the purely graphic images in the sketches. 14 of the sheets collected contain written notes as well as graphic imagery. Such annotations may be commentary or calculation, or

a mixture. The use of such written commentary alongside graphic imagery can be described as the mixing of visible languages. Figures 4.26, 4.27, 4.28 and 4.29 show examples of sheets containing written annotations as well as sketches. The sheet in figure 4.26 incorporates written lists of potential typefaces for the design (*a*), and the sketches in figure 4.27 includes a note on colour considerations for the design (*a*). In figure 4.28, one sketch, of a fold-out page (*a*), is embellished with an explanatory note and an arrow indicating the fold-out. Beneath that sketch is the name 'Vickers Vemy', referring to the aircraft in the fold-out illustration. In figure 4.29 the written annotations consist of a list of potential typefaces for the design (*a*) and an encircled query about the typographic handling of the 'news items', connected to the relevant sketch with an arrow (*b*).

Figures 4.28 and 4.29 also show examples of calculations and numerical annotations. In figure 4.28 the calculations relate to overall dimensions of the whole document under design and to the layout of a particular double page spread (*b*), and in figure 4.29 they relate to the particular spread, and perhaps to an emerging grid for the whole document (*c*).

Embarking on solving competing issues in a design problem, Alan mused:

> And as I sit sort of looking at this empty slate here I'm already thinking, 'Well, what would be a reasonable size of type, width of column, size of margin, to accommodate all this material without any sense of it being crushed?' We've got to start making some calculations. If we intend to, say, set this material in this sort of form — two columns — there's the spread — two columns like this, assuming space for headings, certain amount of — allowed off for illustrations, but on the whole a two-column setting — going here, say here and here — can we accommodate the material into this sort of setting?

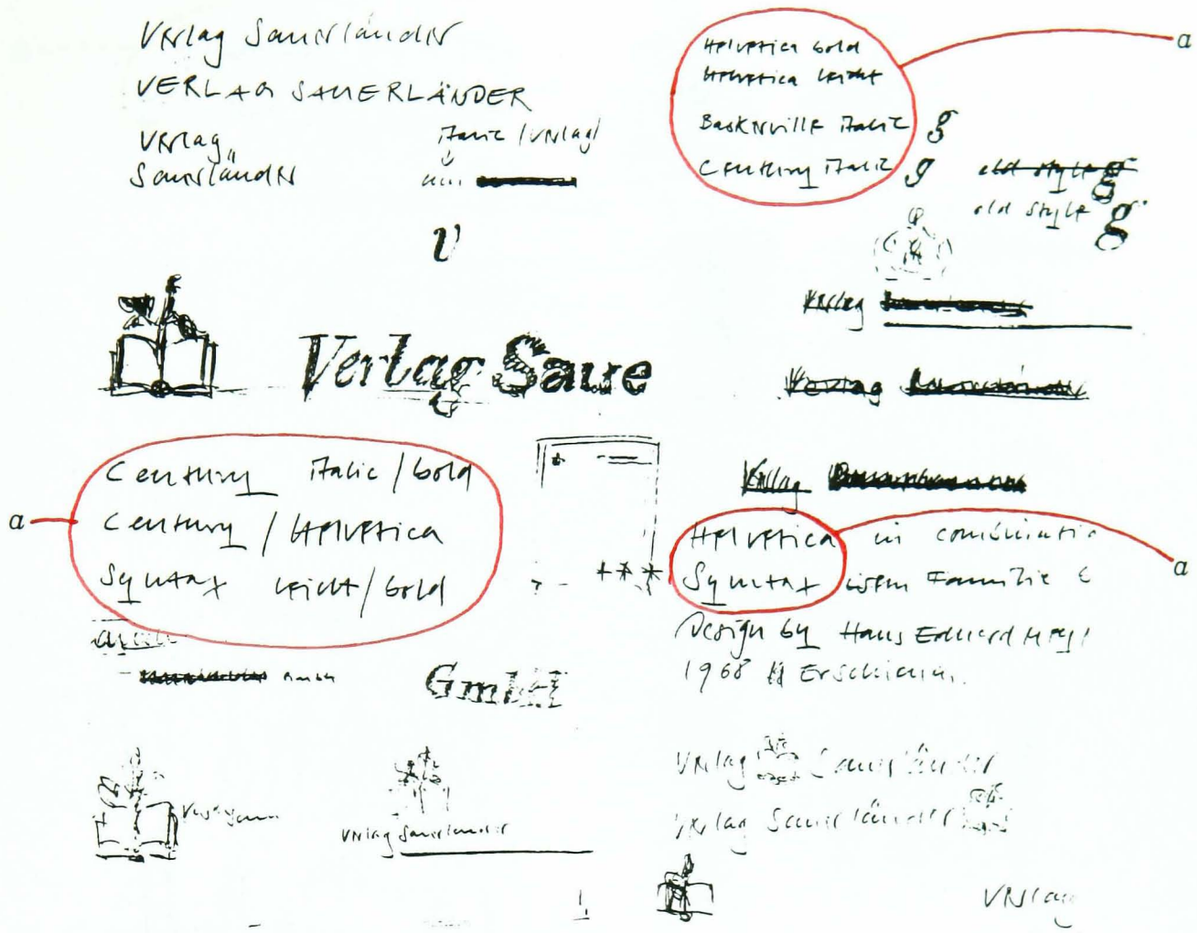

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Figure 4.26 Mixture of visible languages

Sheet of sketches showing annotations:

a Lists of possible typefaces for the design.

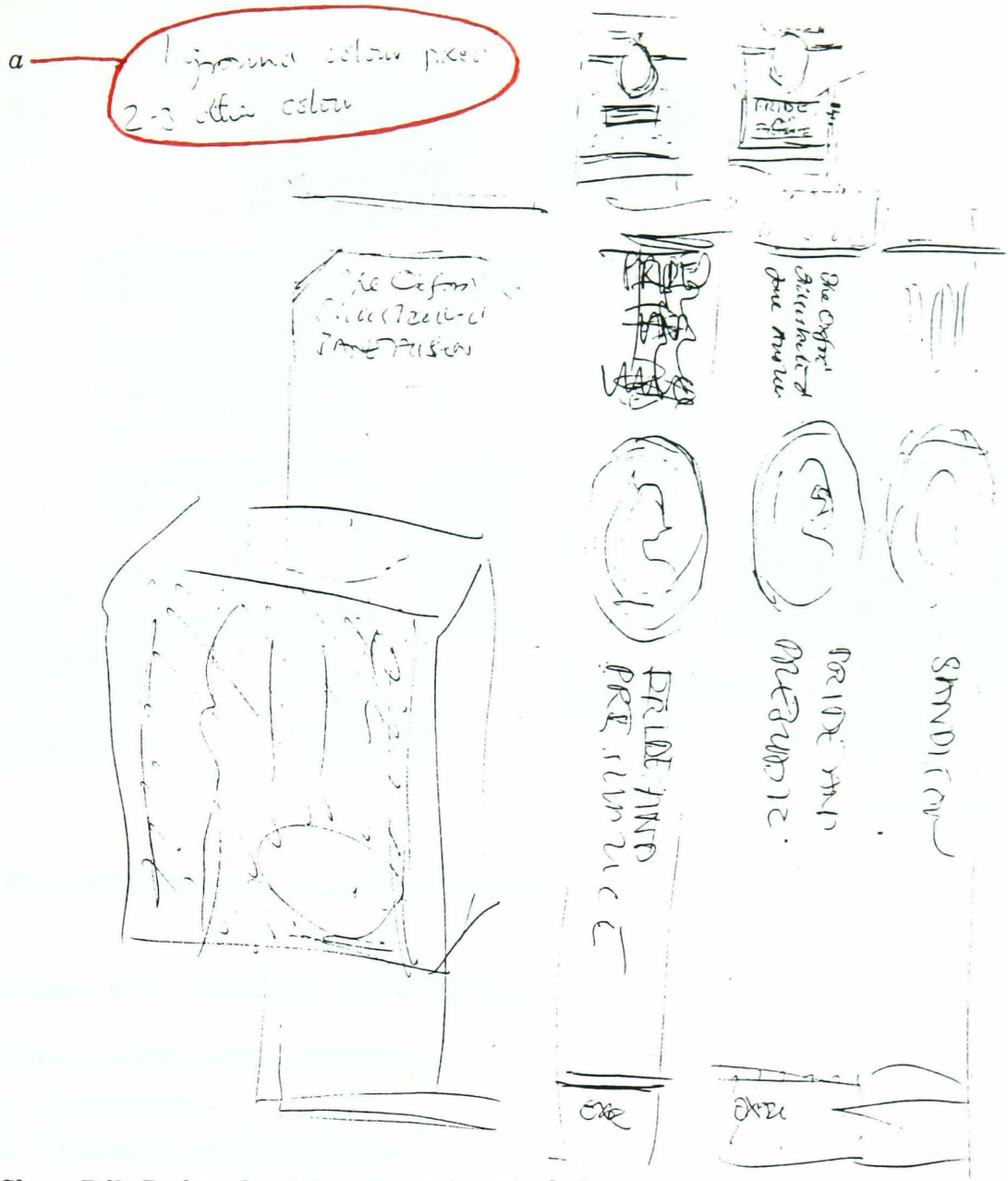

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Figure 4.27 Mixture of visible languages

Sheet of sketches showing written commentary:

a Notes about colours for printing
('1 ground colour fixed 2-3 other colour').

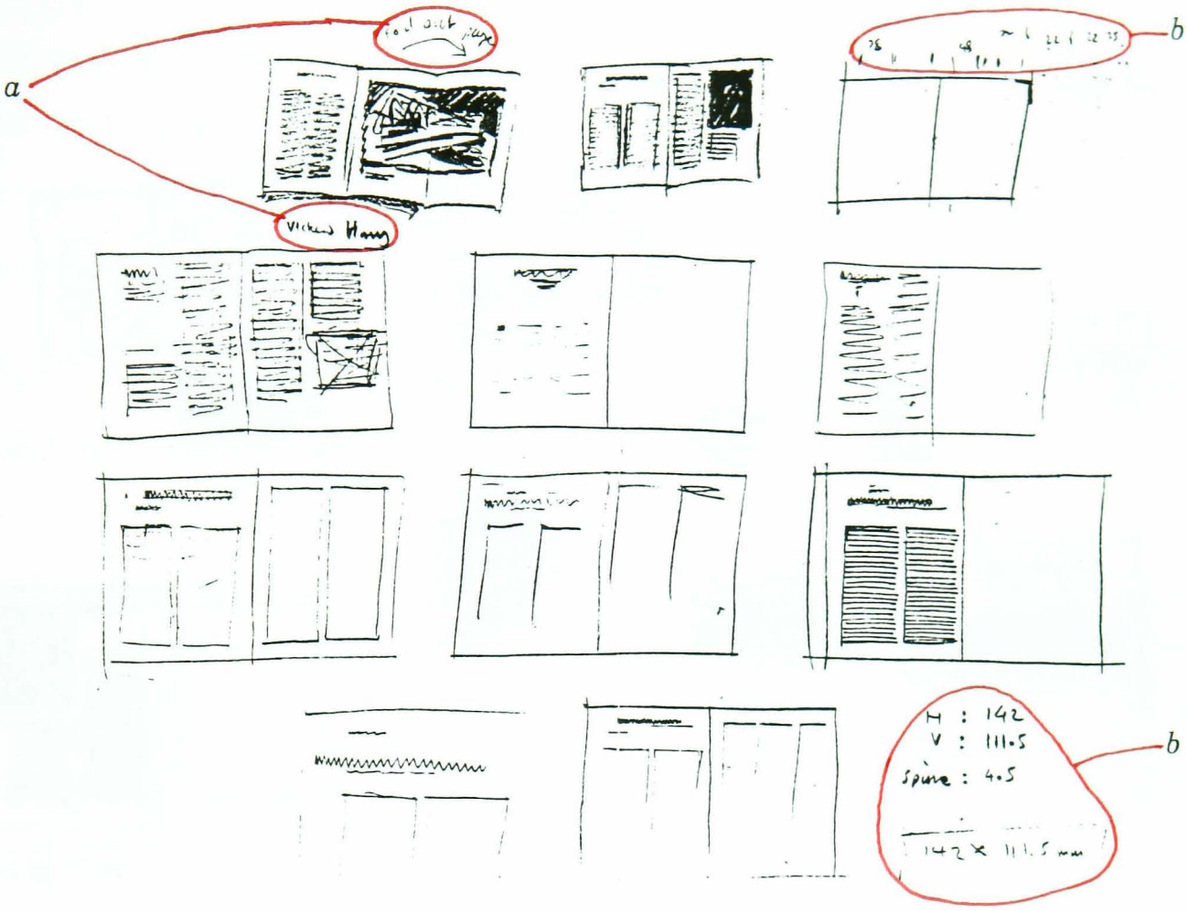

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Figure 4.28 Mixture of visible languages

Sheet showing written annotations:

a Commentary.

b Dimensions and calculations.

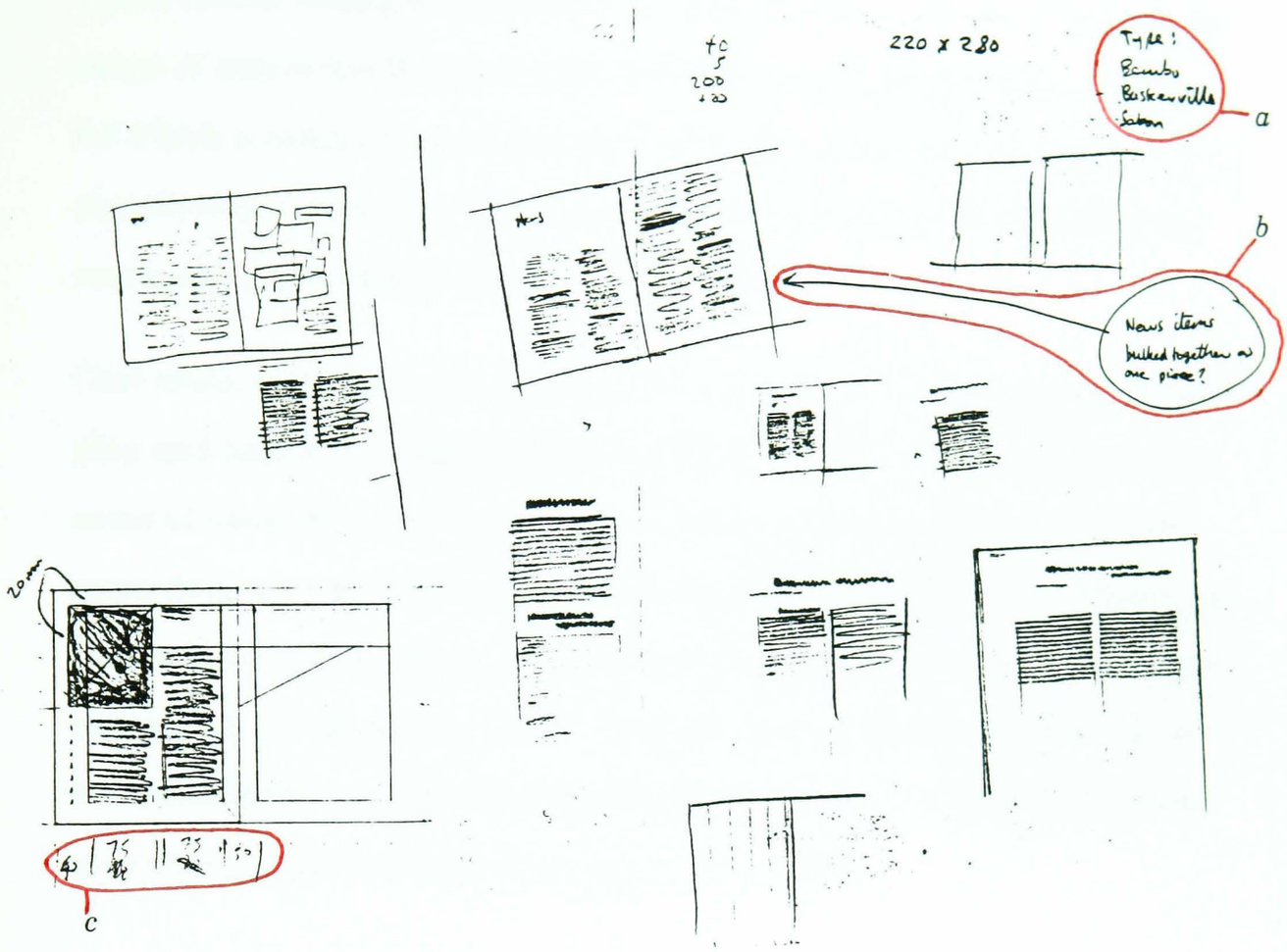

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Figure 4.29 Mixture of visible languages

Sheet showing written commentary and calculations:

a List of possible typefaces for the design.

b Query about an aspect of the design.

c Calculations about margins in the grid.

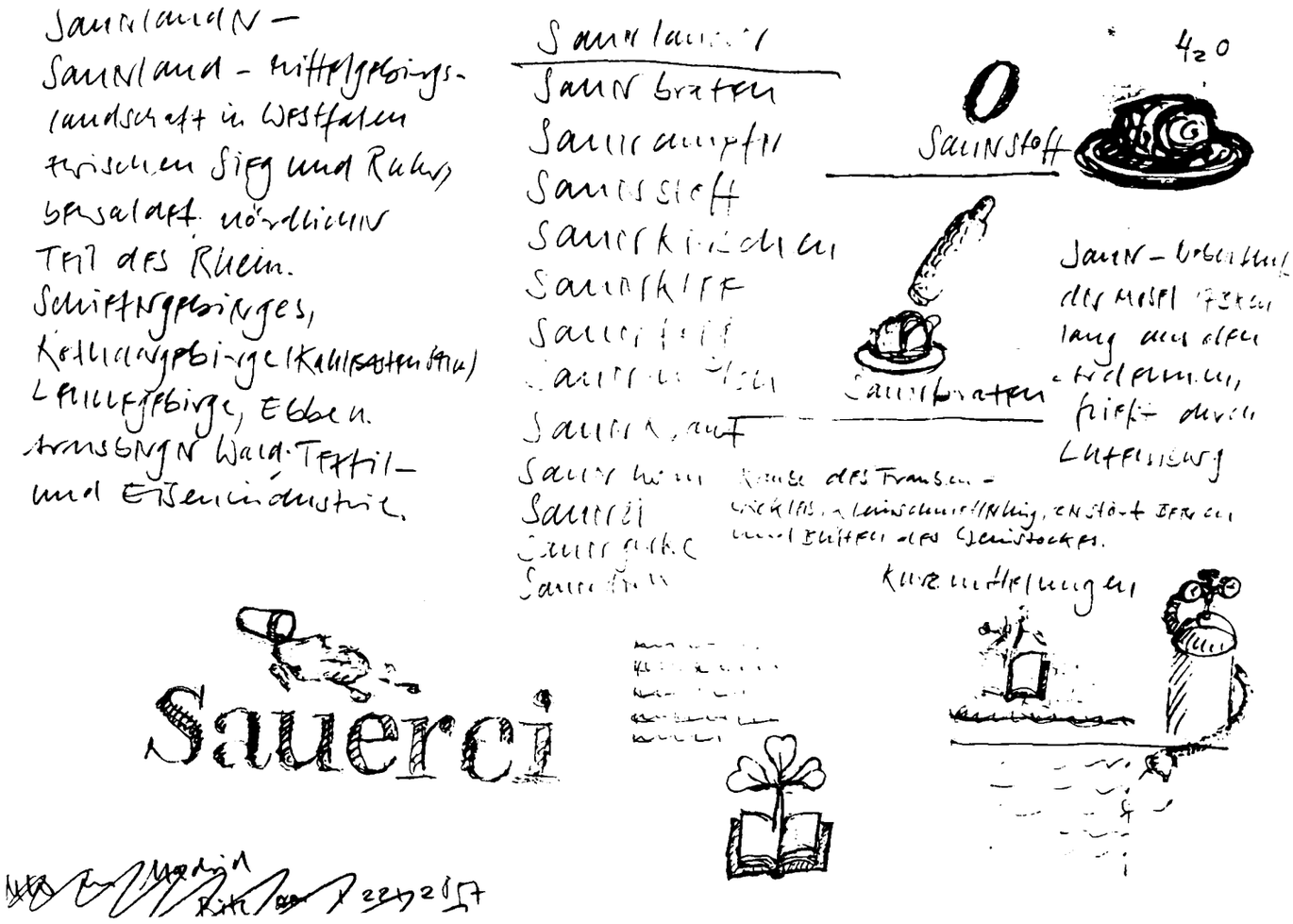
These sketch examples and the commentary from Alan point towards the range of issues the designer must consider in designing a document, and for which a means of recording and association with the relevant sketch(es) is necessary. Different visible languages aid the designer in manipulating different aspects of the design.

Carl made extensive use of writing to capture verbal ideas based on word-play and hence word-association (see figures 4.30 and 4.31), illustrating some of these ideas with sketches. In these instances the writing seems more dominant than the drawing. Once again, these examples emphasise the flexibility of the paper and pencil medium, showing that the designer can switch to working in a more textually-oriented way, and then move back into drawing, with complete freedom, as the verbally-framed ideas give way to graphical associations, and vice versa.

4.4.8 Artefact simulation

The designer uses sketches to capture, explore and manipulate ideas about the relationships between the typographic elements on the surface of the document. In addition, the designer sketches representations of the whole, 3-dimensional artefact (figures 4.32, 4.33, 4.34 and 4.35). These sketches allow the designer to envisage something of the physical characteristics of the emerging design, and to begin to manipulate them.

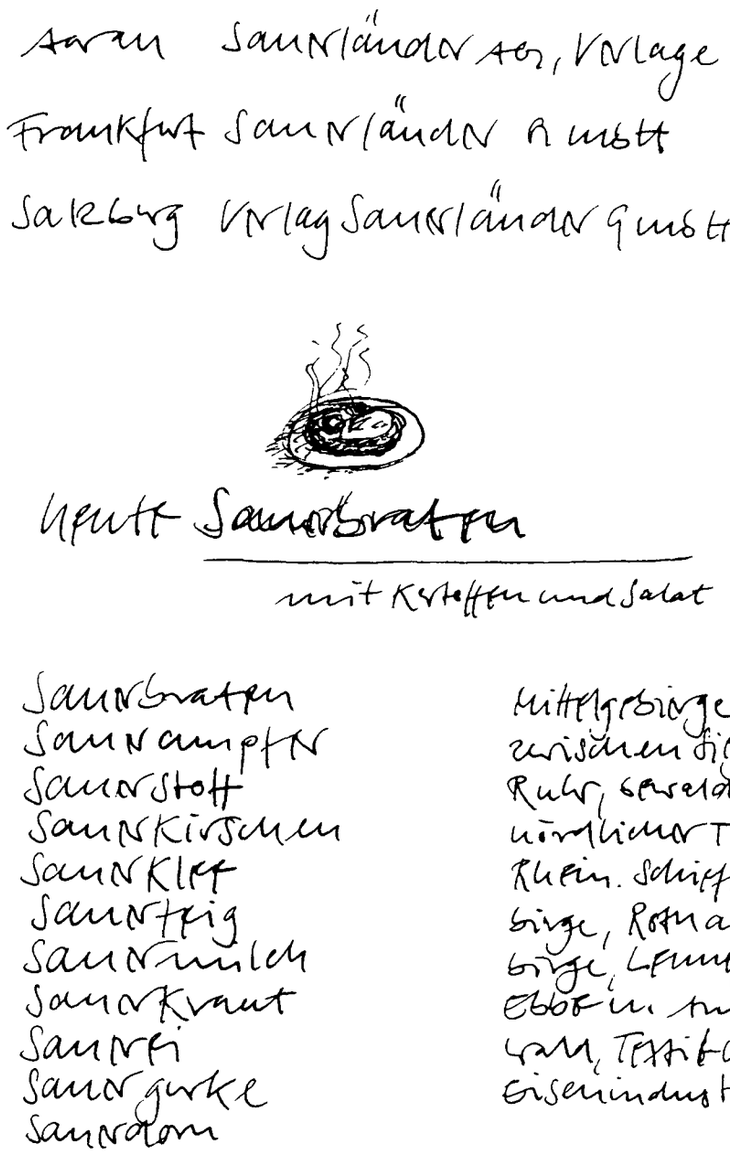
In addition, by working in paper, the designer is able to go further, by taking the paper and folding it or performing other physical manipulations with it, to create a 3-dimensional simulation of the document. Figures 4.36 and 4.37 show instances of such paper mock-ups, simulating the 3-dimensional aspects of the document-to-be. Figure 4.36



Sheet Cb1. Reduced to 41 percent of original size.

Figure 4.30 Mixture of visible languages

Sheet showing written 'ideas capture', playing on word association, with accompanying sketches.



Sheet Cb3. Reduced to 41 percent of original size.

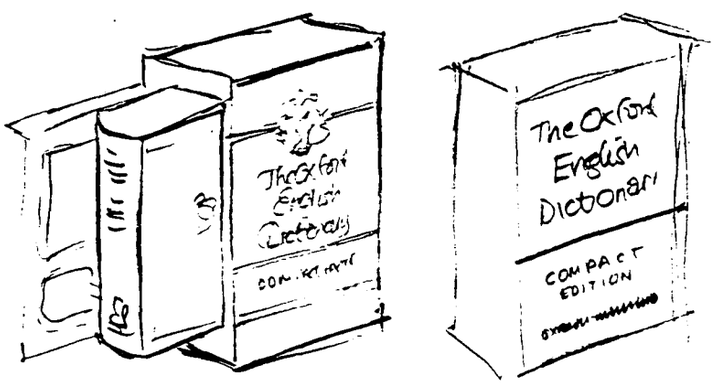
Figure 4.31 Mixture of visible languages

Sheet showing written 'ideas capture', playing on word association with an accompanying sketch.

Sheet Cb4. Reduced to 64 percent of original size.

Figure 4.32 Artefact simulation

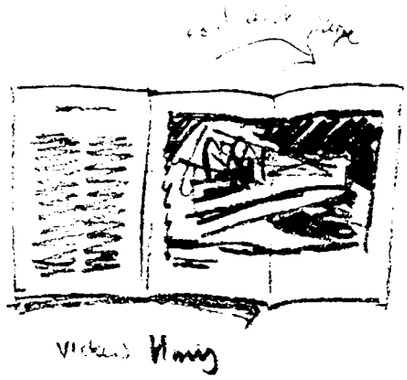
Sketches showing 3-dimensional representations of documents in 2 dimensions.



Sheet Dc1. Reduced to 64 percent of original size.

Figure 4.33 Artefact simulation

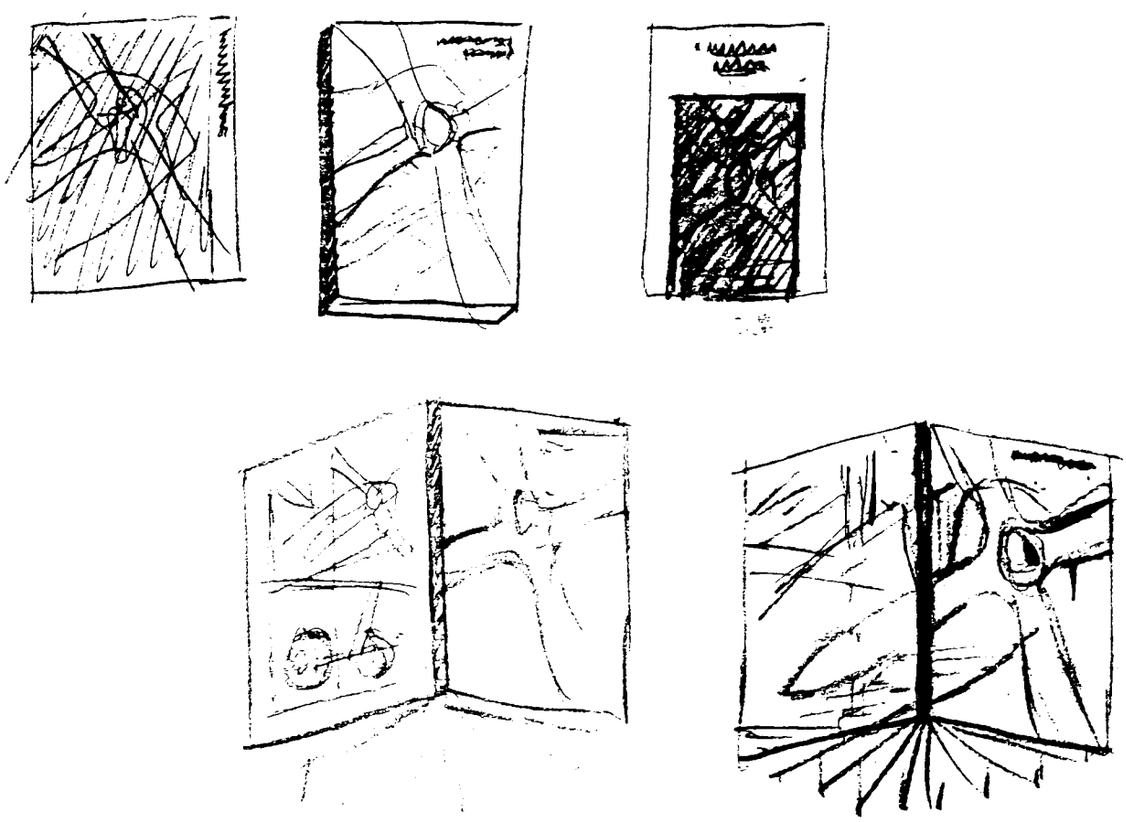
Sketches showing 3-dimensional representations of documents in 2 dimensions.



Sheet B3. Reduced to 64 percent of original size.

Figure 4.34 Artefact simulation

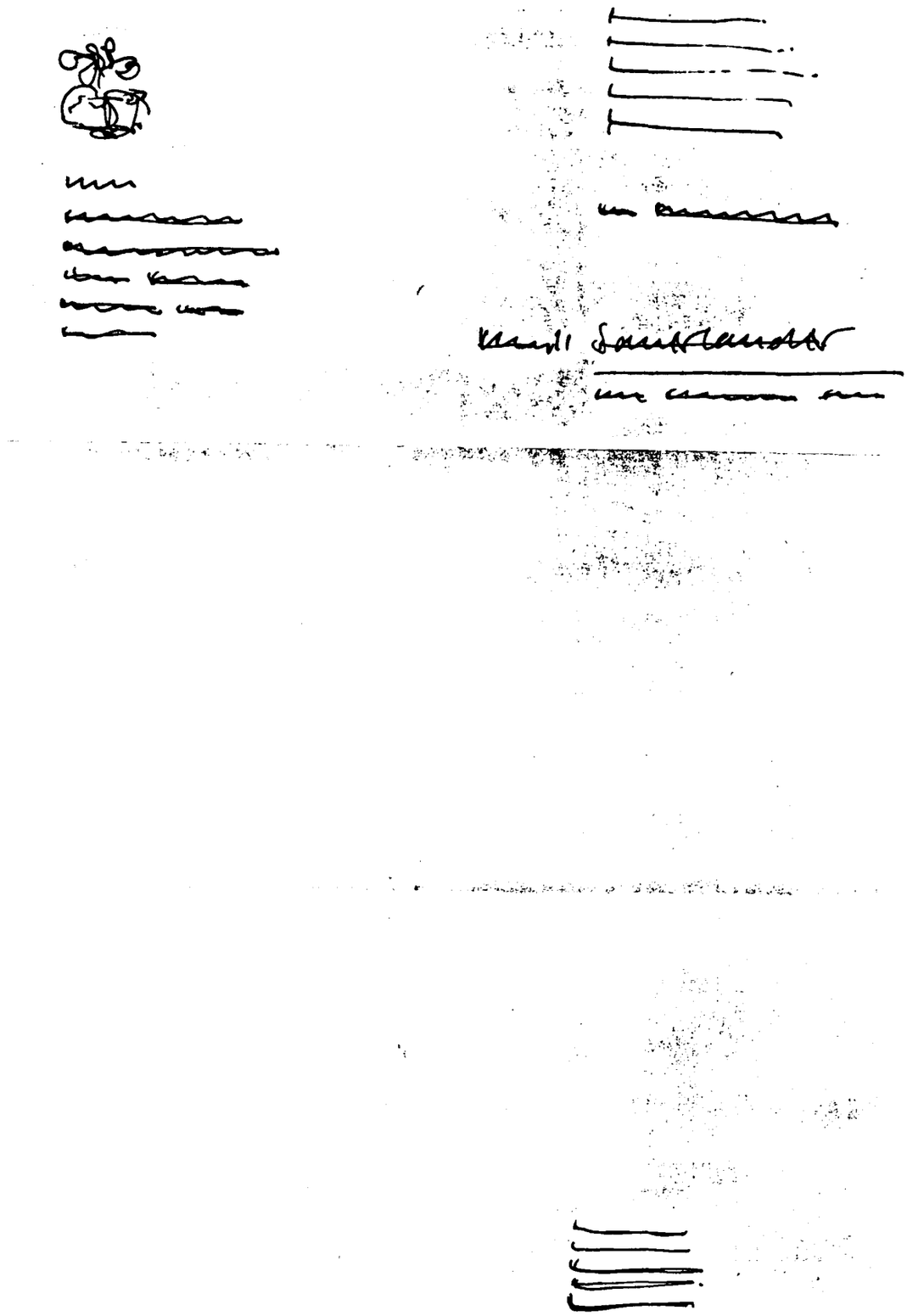
Sketch showing a 3-dimensional representation of a document in 2 dimensions.



Sheet B5. Reduced to 64 percent of original size.

Figure 4.35 Artefact simulation

Sketches showing 3-dimensional representations of documents in 2 dimensions.



Sheet Cb9. Reduced to 64 percent of original size.
Original sketched on blue paper.

Figure 4.36 Artefact simulation

Reproduction of a 3-dimensional mock-up of a document being designed (a letterhead). See sheet Cb9 in Appendix 4 for the reproduction of the folds in the original.

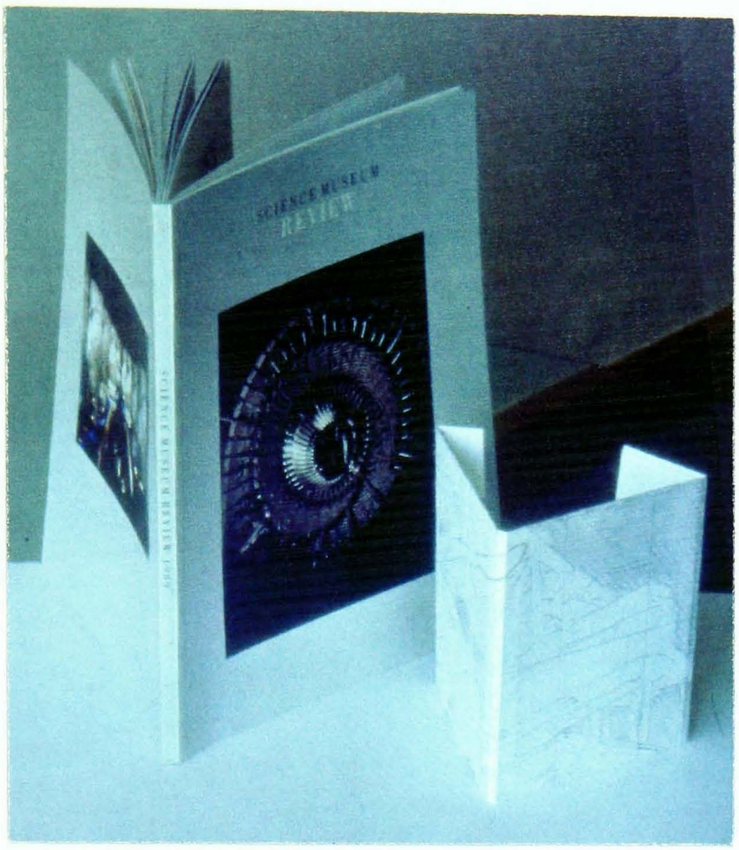


Figure 4.37 Artefact simulation

Reproduction of a 3-dimensional mock-up of a document being designed (the cover for a museum review). Shown next to a previous review of the same size as the one under design, to indicate the scale of the sketch. See sheet A5 in Appendix 4 for the reproduction of the folds in the original sketch.

shows a sketch of a letterhead on a sheet folded as it would be to fit inside a DL envelope (110 x 220 mm, one third A4). Figure 4.37 shows a scaled down, folded mock-up of the cover to a museum review, showing how the illustration wraps around the cover. Alan said of this mock-up:

> It seemed to me that the best way to show this [*drawing*] was to show it as the cover of the review. So this is now being done as a small 'quickie' by us to show how we might let that drawing straggle over the cover of the review.

As he spoke, he turned the sheet around, opening and closing it as though it were already a book. In a similar vein Carl observed:

> I think the — to have the actual format in front of you is very, very important.

He went on to describe his approach to making mock-ups:

> I very often take a B1 sheet of paper [*1000 x 707 mm*], and fold it, and see how many pages I get out. And I just take old printed proofs and fold them — previous catalogues or proof sheets — fold them and cut them open, and realise which size I can make it physically. I think it's very important.

The function that artefact simulations fulfil is treated in more detail in subsection 4.5.6, on Simulation of experience.

4.5 Functions

The features identified and described above occur in combination, and may be specifically exploited to support certain functions during sketching. The six functions listed in section 4.3 are considered in detail in this section, and the sketches are used as illustrative material to support the argument for the existence of these functions.

4.5.1 Focus

In order to reach a design solution, the designer must resolve all the interacting issues in a potential design — the overall spatial relationships throughout the document between elements such as columns of type, headings and illustrations, alongside the detail of specific typeface and size, line measure, text depth and number of pages in the document. To reach a design solution the designer needs to explore the issues both individually and in concert. By sketching in paper and pencil designers can focus on a particular detail, or on the whole design, through the kind of sketch they make (see figure 4.1). Working at small scale, on an overall view of a page layout, for example, and working at a low degree of detail, the designer can concentrate on exploring the spatial relationships between the typographic elements and on achieving a balance between them. While working on these structural issues the designer is not overtly attending to the micro detail of particular typographic attributes of individual elements. As Sue said:

> You don't want to know where every letterform's — it's irrelevant really to designing a spread.

This concentration on certain aspects of the design and not others is further emphasised by some parts of the sketches being left incomplete, or of elements not being represented at all, as the figures illustrating differing degrees of detail and closure show (figures 4.5 to 4.12). Referring to focusing on certain aspects of the design, Don said of his sketches for dictionary pages (figure 4.9):

> Cos you do the first entry or so and you — the first — you do the significant — you do the switches, one thing to another, and you do the one thing up against the other.

Alan cautioned against concentrating solely on smallscale sketches and losing sight of the overall design:

> You see that format sort of sitting there? [*referring to a lifesize version of the document he was designing*] I think it should, because when you do sketches of — little thumbnail sketches, you know, you've always got to keep remembering what the actual format is. And it's all too easy to get carried away by little sketches that represent a larger area and it all seems so simple. But once you get to that scale then it ceases to be simple.

The flexibility of the paper and pencil medium means that the designer is free to address as much or as little of the design as desired at any moment, including abandoning or excluding part of a sketch that is not germane to the issues under immediate consideration. Equally, a part of the design may be taken out of context and worked on in much greater detail, and of course the designer is free to change the focus of attention at any point in the execution of a sketch. Partial solutions reached through working on smallscale views of the overall design have an impact on the details of individual elements, and vice versa. The final design solution is only reached when all the issues have been addressed and reconciled with one another. This is why focusing on different aspects, through working at different scales, in combination with the appropriate amount of detail and precision, is so valuable to the designer.

4.5.2 Provisionality

In executing a sketch the designer inevitably focuses attention on some part of the design, or the whole design at some level of detail, but the imagery and quality of marks used in sketching to represent the issues being considered lends the sketches an air of provisionality. This is an

interesting paradox: the designer must make commitment to some extent in order to make marks at all, but, through a combination of degrees of detail, lack of closure, different levels of precision and tautness, the designer is able to withhold commitment to the ideas the sketches embody, while still exploring aspects of the ideas. As Sue speculated:

> You don't want to fix an idea too early. I think maybe one is floating a lot of ideas in one's mind that are — that have some precise elements, but they don't have detail.

Looking at his rough rendering of an indistinct typeface, Don observed: .

> It's still a decided-undecided item at the moment.

The roughness of the representations, such as those in figures 4.7, 4.8 and 4.10 — notionally 'straight' lines are not straight, where they should form corners they often overshoot or do not meet, the lines graduate in width and darkness — adds to the sense of the sketches being exploratory, reflecting the fluidity of the ideas they encapsulate. Alan made explicit reference to this in saying:

> When we're sketching we're deliberately tentative. It's important not to commit yourself.

Rough sketches can be made very quickly — one designer who was videotaped made a thumbnail sketch of a simple page layout in eight frames of PAL video, i.e. taking less than a third of a second to execute it. Such a sketch cannot contain complete detail, since detail takes time to execute, and so the speed at which a sketch is made contributes to the air of provisionality it possesses. The greater the time and effort invested in making a sketch, the more deliberate and finished it appears and the more authoritative the design it represents seems. Figure 4.11 shows

examples of carefully executed sketches as a contrast to those in figures 4.7, 4.8 and 4.10.

4.5.3 Switching

In sketching in paper and pencil the designer has complete freedom to switch between different aspects of the incipient design, through switching between different scales, levels of detail and precision, and different visible languages. Such switches may occur within sketches (see figures 4.13 and 4.17) as well as between sketches (see figures 4.1 and 4.24). The possibility of switching fluently at any time between comparative degrees of a particular feature, such as levels of detail, or between different features, such as different visible languages, makes the paper and pencil medium a congenial channel for the designer to capture and explore design ideas. There is no restriction on the sequence in which aspects of an idea may be explored, nor any requirement for completion of one aspect before another may be addressed.

The quotation from Sue used in subsection 4.4.1 on designing at different scales is appropriate to cite here as well, since it makes clear (albeit by indirect reference) the value of fluent switching, in this case between different sketches at different scales and levels of detail:

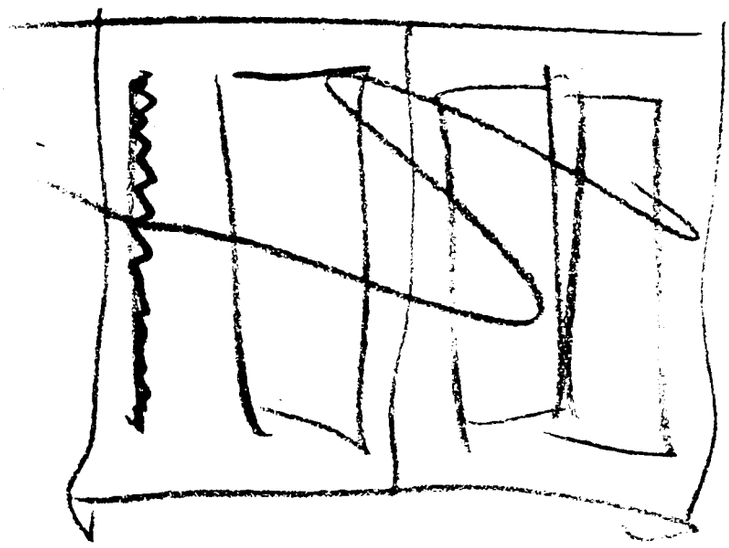
> You want an arrangement that looks well, that balances well, and so forth. But then you need to go into the detail and see if you can fit in what you need to — if in a certain size you can get all your letters that you need in your headline, or if you have to go down a size. If you have to go down a size, what does that mean in terms of — so you're working very broadly and then you're going down into the detail to check if it works, and then if it doesn't then you go up out again.

In fact, the very indirectness of this reference makes clear how this designer, at least, takes such fluency of switching for granted, thus implying its fundamental nature. As observed in subsection 4.5.1 on Focus, working at different scales, degrees of detail, and levels of precision, and moving between sketches enables the designer to explore different aspects of the design. But in addition to being able to work in these ways, the designer must also be able to switch fluently between them.

4.5.4 Record keeping

Every sketch made is automatically a record of itself and of the ideas the sketch embodies. A sheet of sketches also automatically preserves the spatial relationships between the sketches, which may or may not have intended significance, as observed in subsection 4.4.4. There is no additional cognitive overhead required for the designer to preserve the sketch, beyond engaging in sketching. Conversely, there is an additional overhead involved if the designer wishes to erase a sketch, or part of a sketch. Consequently, unless the designer actively erases something, the sheet of sketches provides a full retrospective summary of the ideas worked through on that sheet.

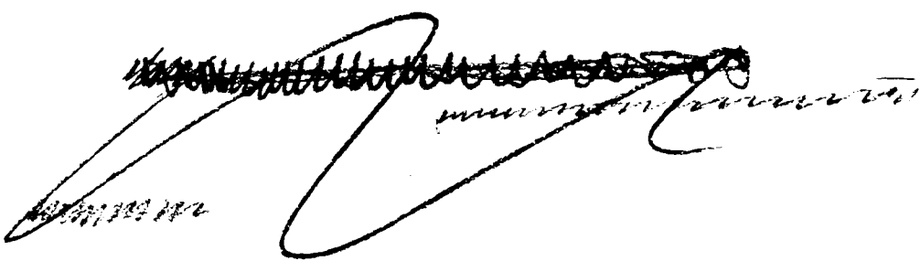
Figures 4.38 and 4.39 show sketches scribbled out. This is sufficient for the designer to signify abandoning the idea in the sketch, but preserves intact the record of the sketches made.



Sheet A1. Shown at original size.

Figure 4.38 Record keeping

Scribbled out sketch.



Sheet B4. Shown at original size.

Figure 4.39 Record keeping

Scribbled out sketch.

Only one of the designers , Alan, spoke explicitly about this aspect of sketching:

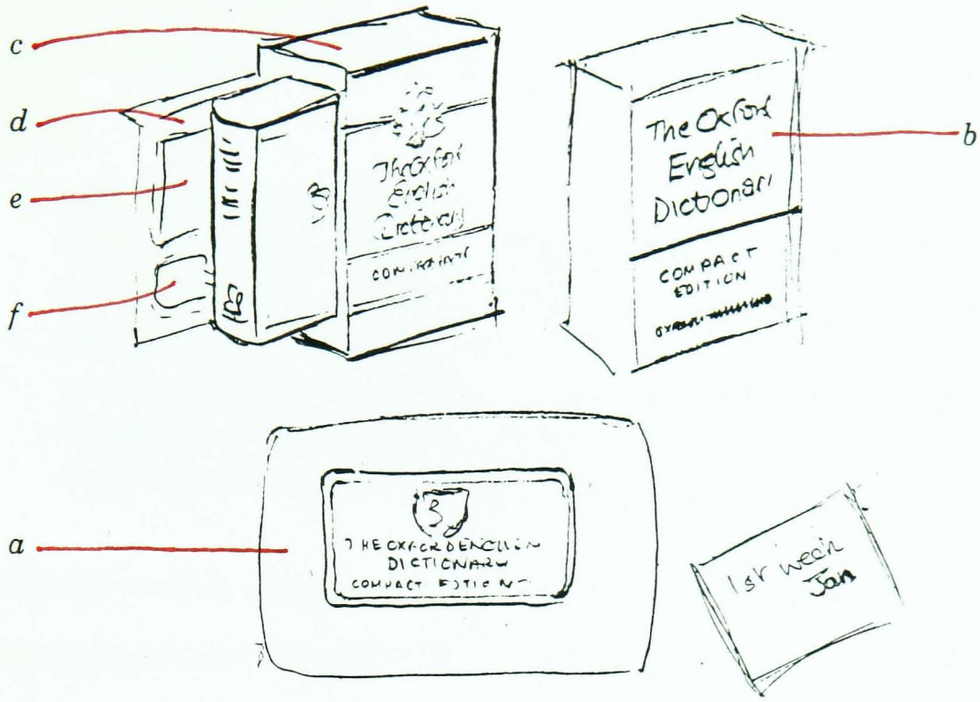
> What I like to do is to run through the sort of expected solutions on my way to perhaps an unexpected one. But what you can never forget is you may go back to the expected solution. You may think, 'Oh, I don't want to do that', but in the end you may. You may think, 'Oh, in the end it's the right one.' So that's why I like to put them all down. Although I'm saying, 'No, I don't want that', I'm also not quite discounting it. I'm saying, 'No, I don't think I want that *now*', but at a later time I may.

Retaining ideas through sketches also aids comparison between the ideas. This function is considered in the following subsection.

4.5.5 Comparison

In exploring design alternatives, the designer may need to compare different potential solutions. Sketching enables comparison of alternative design ideas through the visual comparison of the representation of those ideas. Don made indirect reference to comparing ideas in talking about the sketches in figure 4.40, for the slipcase for a dictionary. His account suggests that he was exploring three different ideas, and comparing them through the sketches:

> And there's three possibilities. One is a suitcase, with a handle, like a little Samsonite suitcase (*a*). This is a little sort of corrugated plastic effort, like you get the complete works of Trini Lopez, or something, you know, the record, compact discs (*b*). And this is a conventional sort of slipcase (*c*), and this is a little holder, moulded polystyrene thing (*d*), which has got a little guidebook (*e*) and a magnifying glass in it (*f*).



Sheet Dc1. Reduced to 64 percent of original size.

Figure 4.40 Comparison

Sheet containing variations on a design theme (packaging for a dictionary), facilitating comparison between them:

a 'Little Samsonite suitcase'.

b 'Little corrugated plastic effort'.

c 'Conventional slipcase'.

d 'Moulded polystyrene holder'.

e 'Guidebook'.

f 'Magnifying glass'.

In addition to exploring these ideas for the 3-dimensional aspects of the design, Don went on to describe his consideration of the typography for each:

> And what I was trying to work out here were three very conventional alternative presentations of the typography relevant to the three, trying to get the status of them right. If this would be a very yuppie thing, so it was gonna be very formal, lines of capitals (*a*). This was very straightforward, this is actually the dictionary — existing dictionary jacket modified and put on here (*b*). And this one here, the visual metaphor was a packet of Rothmans (*c*).

Where several sketches are made on one sheet (as in figure 4.40) it could be claimed that the designer is simply exploiting the space on one sheet of paper to capture the ideas as they occur, with no particular regard for the positioning between similar, or dissimilar, variants. It can also be argued, though, that close spatial juxtapositioning enables the designer to make visual comparisons between alternatives with ease. This is true, whether or not the sketches were deliberately drawn with intentional spatial relationships in mind. Even if the sketches were not deliberately placed close together, their spatial relationships may prompt new associations and hence comparisons. To quote again Sue's observations about the value of being able to see all the design ideas together:

> Having everything on the pa- — on the desk in front of you, because your peripheral vision is enough to remind — to remember and remind you of things.

It is also the case that multiple sheets of paper may be easily manipulated by being shuffled, moved around and placed on top of one another, thus enabling new juxtapositions between sketches on different sheets. The possibilities for new juxtapositions are increased as the designer folds or tears sheets, to cause a sketch from the centre to be at an edge, or uses

tracing paper to transfer sketches from separate sheets to one sheet. The only limitations on the number of sheets viewable at one time are the dimensions of the physical surface upon which they are resting and the designer's field of view.

4.5.6 Simulation of experience

In typographic design the medium in which the designer makes representations of the final artefact is, in the essential respects, the same as the medium in which the artefact will ultimately exist. I refer to this transition between sketching on paper and pencil and the manipulation of the sheet of paper into a 3-dimensional simulation as the *continuum-of-activity* through the *continuity-of-medium*. (The differences exist in the precise weight and surface texture of the paper used for designing as opposed to that used for the final artefact. These differences matter, and need to be taken into account in designing, but do not invalidate the principle of *continuity-of-medium*.)

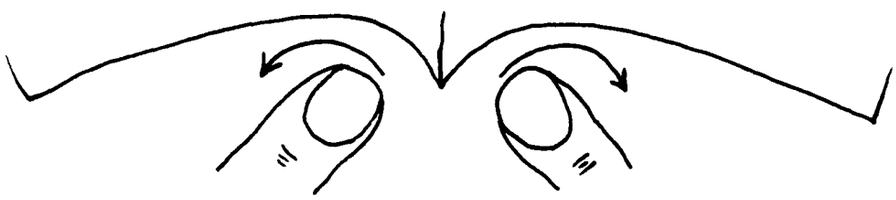
The purpose of making the simulation of the document is to simulate the experience of the document, in order to evaluate the design. Simulation in 3 dimensions is not, strictly speaking, a part of sketching. However, since representation in 2 dimensions flows seamlessly into simulation in 3 dimensions when working in paper, and both are concerned with the creation of representations for the purpose of evaluation, 3-dimensional simulation is included here.

This simulation is an important part of the process, since the physical realities of the document are hard, if not impossible, to discover or

simulate through purely flat, 2-dimensional representations. The physical realities include the physical properties the 3-dimensional document will possess, and the temporal experience of it the reader will have. As Carl said:

> And to have actually the fact that the paper does this —

and he made a gesture with his two index fingers indicating the bowing of the pages from the spine:



> — and not a flat sheet of paper. It's absolutely essential because it's — it's what it makes and what it does. A[n] open book is not a flat sheet of paper.

Carl also observed:

> It's a very physical thing, a book. I think it's — when you turn over a page and all these — you — just the fact that you turn something over and you a get a surprise on the other side which you can't see before.

The tactile dimension of the document under design that becomes more apparent in the 3-dimensional artefact simulation is not easily perceived through simply looking at the sketches. The videotapes of the designers at work, coupled with comments from the designers themselves, provide more insight into this dimension of designing documents.

The designers who were videotaped consistently handled the objects they were creating. They performed certain physical manipulations, such as cutting, tearing, folding, gluing and straightening up, specifically to fashion the object, and other manipulations, such as turning over, opening up and simply holding the object, in order to experience it. There are two reasons the designer seeks this connection with the physical reality of the

object. The first is a purely practical one: the object must be designed to be manufacturable using the appropriate production technology, and keeping within the allotted budget. The second is a more humanistic concern: people will experience the document, reading, using and keeping it according to their needs and its genre, so the document must function appropriately for its intended audience.

The first reason may influence design decisions, such as the sheet size on which a book will be printed, for example. To repeat the quote from Carl:

> I very often take a B1 sheet of paper [*1000 x 707 mm*] and fold it and see how many pages I get out.

Depending on how the sheet is folded, more or fewer pages of different sizes will be derived from the same original sheet size.

The second reason the designer handles the object in the making is to experience it, to evaluate it's performance in all dimensions, physical and temporal, as well as visual. In having the physical contact with the material the designer is continuously aware of the object's physical characteristics, and consequently of how it behaves in the hands of a human. This kind of experience is invaluable for learning about the properties of the materials. When this embodied knowledge is married to the intellectually-determined needs of the intended audience a fitter result is likely to be produced than if a solution were reached purely by reasoning detached from the physical aspects.

The characteristics of sketches described above may be seen together in the surface of a mock-up that includes the surface detail of the document's appearance. The 3-dimensional simulation in paper is the logical conclusion of the 2-dimensional sketches on paper. The paper medium is ideally suited to supporting both these aspects of typographic design, particularly since the final artefacts will be made of the same medium.

4.6 How the features and functions are interlinked

The previous two sections describe the features of sketches and the functions of sketching individually, illustrated with sketches collected from the designers, and their own spoken observations. This section treats the interconnections between the features and functions, describing how they are mutually supportive.

Scale links to *focus*, in that, depending on the scale used, the designer may concentrate on the overall aspects of the whole design, or the micro-detail of a particular part, away from the context of the whole design. In *focusing* on a part of the design, the designer may use *lack of closure* and different *degrees of detail* and *levels of precision* to represent the idea.

Working at different *levels of precision and tautness* is a reflection of the designer's commitment to the ideas embodied in the sketch. Early on, as with degrees of detail, the designer does not invest a great deal of time in making highly finished representations of design ideas, but works at a low level of precision, capturing only the vital aspects of the design idea through rough marks. These sketches enable the designer to concentrate on the broad, overall spatial relationships, without being distracted by specific typeface attribute detail. The *degrees of detail* and *levels of precision* with which the designer sketches contribute to the *provisionality* of the sketches, enabling the designer to manipulate ideas while withholding commitment to them.

Multiple sketches on the same sheet, which may be at *different scales*, support the function of *comparison*, both of variants on the same design idea and between different ideas. *Focus* on different aspects of the emerging design leads not just to *multiple sketches* at *different scales* but also to the use of a *mixture of visible languages* and different *degrees of detail* and *levels of precision* within the sketches. Each of these features is selected and manipulated by the designer as appropriate for the piece of design under consideration, and the designer is free to *switch* between

them at any moment and in any sequence. The sketches collectively form a *record* of the designer's ideas.

The designer may take paper and physically manipulate it to make a mock-up of the document-to-be. Through handling these *artefact simulations* the designer has a *simulation of the experience* of the document that the end user will have.

4.7 Correspondence of the initial characterisation to previous accounts of sketching

Though previous accounts of sketching are much less detailed than the characterisation presented here, some elements in the accounts described in Chapter 2 correspond to aspects of the initial characterisation. These correspondences are outlined below, to show how this characterisation connects to its predecessors and how much further it has been developed.

Although none of the accounts of sketching explicitly states that sketches are made at different *scales*, Radcliffe and Lee imply this by drawing a comparison between their categories *functional sketches* and *geometric sketches*, observing that the latter are drawn to scale, unlike the former, in which 'the size and shape of the elements are not necessarily that in a final arrangement' (Radcliffe and Lee 1990, 148). Krauss and Myer also imply that working at different scales is natural for designers, by stipulating that computer based systems should 'allow the designer to select the scale at which he is to operate' (Krauss and Myer 1970, 20).

Closure relates to Ballay's notion of *coherence*, and conversely, *lack of closure* relates to his *incoherence* (Ballay 1987, 75 and 80). Though he does not observe lack of visual closure within sketches, Ballay's notion implies the sketching of parts of the design out of context and separate from one another, which is one aspect of lack of closure in the initial characterisation presented here.

Degree of detail and *levels of precision* are explicitly referred to by Ballay, using his terms of *inclusion* and *precision*, respectively (Ballay 1987, 75). However, he does not elaborate on the terms beyond their definitions (reproduced on p. 35 of this dissertation), nor does he provide visual examples to illustrate his points. Radcliffe and Lee mention a difference in amount of detail between their categories *functional*, *geometric* and *pictorial sketches*, with *functional* having least detail and *pictorial* having most (Radcliffe and Lee 1990, 148, 149). Although they do provide one visual example for each of their categories, they do not discuss extensively the constituents of visual detail. Fish and Scrivener observe the value of low degree of detail in sketches, although they too do not discuss in depth the visual qualities of the marks that constitute detail, simply listing some visual characteristics of sketches, such as 'wobbly lines' and 'suggestive scribbles' (Fish and Scrivener 1990, 120). These are also not explicitly illustrated with visual examples. Naturally, as none of the pre-exisiting accounts of sketching relates specifically to typographic design, none makes reference to differing degrees of detail and levels of precision in the rendering of typeface attributes.

None of the authors of the pre-existing accounts explicitly observes that designers make *multiple sketches* on the same sheet, although figures in Bly and Minneman's paper (Bly and Minneman 1990, 186) and Ullman *et al.*'s demonstrate that their designers did so (Ullman *et al.* 1990, 264, 270 and 273).

The *mixture of visible languages* in sketches is mentioned by almost all the authors of previous accounts. In fact, the use of, and distinction between, writing and drawing forms the basis of Tang's (Tang 1989), Bly and Minneman's (Bly and Minneman 1990), and Ullman *et al.*'s accounts (Ullman *et al.* 1990). Ballay (Ballay 1987), Radcliffe and Lee (Radcliffe and Lee 1990), Eastman (Eastman 1970) and Lakin *et al.* (Lakin *et al.* 1989) all observe the use of different visible languages in sketching, although none of them uses this term to describe the phenomenon.

Ballay's category *solid models* corresponds, to some degree, to *artefact simulation*, although his claim, from the angle of a different design domain, is that they 'assist cognitive aspects of spatial problem solving', rather than acting as a means for the designer to gain the end-user's experience of the artefact-under-design (Ballay 1987, 81).

By implication, all the authors who observed designers' use of different visible languages, lack of closure, different degrees of detail and levels of precision were indicating how designers *focus* on different aspects of the design. Only Akin, however, makes explicit reference to focus, observing how 'abstract representations used in sketching ... help focus the attention of the designer to specific aspects of the problem as needed' (Akin 1978, 80).

Though no previous author used the term *provisionality*, Fish and Scrivener observe 'deliberate or accidental indeterminacies' in artists's sketches, which correspond to the visual qualities of designers' sketches that contribute to the sketches' provisionality (Fish and Scrivener 1990, 120). They speculate that one reason for such indeterminacies is the need to preserve alternatives. This is similar to withholding commitment, which is the notion behind the concept of provisionality in the initial characterisation.

Switching, particularly between visible languages, is recognised by Tang (Tang 1989), and Bly and Minneman (1990), who use exactly this term. Ballay (Ballay 1987), Eastman (Eastman 1970), Krauss and Myer (Krauss and Myer 1970), Greenberg (Greenberg 1984), and Bleser *et al*. (Bleser *et al*. 1988) imply the need for easy, rapid switching between different aspects of the design in progress, by observing designers' needs to deal with different aspects and to maintain concentration on the design in hand, which is easier if switching is facile and immediate.

The notion of sketches as *records* is little noted, and none of the authors observe that sketches are automatic records of the ideas they embody.

Fish and Scrivener mention recording in saying 'traditional media do not record or use the temporal information intrinsic to the flow of visual thought' (Fish and Scrivener 1990, 124). An alternative view I propose is that the traditional medium does generate a record of the unfolding design, providing no sketches are erased. It may not be possible in retrospect simply by looking at the sketches to identify the precise sequence in which they were made, but a record is nevertheless retained of every sketch that was made.

Simulation of experience is little discussed in the pre-existing accounts, although Fish and Scrivener observe that 'the necessity to sketch arises from the need to foresee the results of synthesis of manipulation of objects without actually executing such operations', and, further, 'the use of words, pictures or models to stand for objects, scenes or events not physically present enormously increases the mind's ability to visualise' (Fish and Scrivener 1990, 117). Ballay's category of *solid models* has something in common with artefact simulation, and hence simulation of experience (Ballay 1987, 81).

None of the accounts of sketching or designing cited above relates specifically to typographic design, so there are, necessarily, certain differences between these accounts and the initial characterisation to which they are compared. Nevertheless, there are numerous points of contact and similarities between them for the initial characterisation to be seen as a more developed version of its predecessors.

4.8 Summary

This initial characterisation derives from an extensive study of the sketches, videotape records and transcripts collected from the first three studies in this research. It is a more comprehensive account of sketching than offered in previous characterisations, as described in Chapter 2,

detailing more of the subtlety and complexity of both the act and products of sketching. In order to determine how accurate and comprehensive this eight-feature, six-function characterisation appeared to other designers, a study was conducted to evaluate it. The account of this study is related in Chapter 5.

5 EVALUATION STUDY OF THE INITIAL CHARACTERISATION

He who does not make mistakes does not make anything.

Old English proverb

5.1 Introduction

The purpose of conducting the evaluation study was to test the initial characterisation, derived from the three investigative studies, for comprehensibility and completeness. This study was designed to provide other professional designers with the opportunity for both direct and indirect confirmation (and criticism) of the characterisation. Direct assessment was facilitated through structured questions, relating explicitly to each part of the initial characterisation. Indirect confirmation was forthcoming through the additional sketch data and the unstructured commentary gathered from the designers, which amplified that already collected from the first three studies.

The method used for the evaluation study is described in section 5.2, and the form of the evaluation study is considered in section 5.3. The results and analysis of the study are discussed in detail in section 5.4, and the implications of the results are observed in section 5.5. A summary of this chapter is provided in section 5.6.

5.2 Method used for the evaluation study

This study was conducted fifteen months after the first three, exploratory studies were completed. The purpose of the evaluation study was to test the characterisation, and it was designed to enable both direct and indirect confirmation of the characterisation.

5.2.1 Participants

Four participants were selected:

Greg: ten years' experience in book, information and graphic design

Hugh: eight years' experience primarily in information design, also teaching and research in typographic design

Judy: six years' experience in diverse design, including book, information and graphic design

Luke: forty years' experience, specialising in book design.

5.2.2 Procedure

Each participant was sent a letter (Appendix 2) and telephoned before the interview. They were asked to show at the interview typical sketches they make during the early stages of a design. Each participant was interviewed in his or her own studio, to facilitate reference to the participant's own sketches and any other relevant material during the interview.

At the interview, each designer was first asked to talk freely about the sketches s/he had selected to show to the interviewer, describing *what* was happening in the sketches. Then the participant was shown an example of each of eight *features* identified by the researcher as typically occurring in

sketches. After being shown the example, the participant was asked to identify three further instances of the same feature in other sketches presented by the researcher (from here on called the *presented* sketches), and then to identify three examples of the same feature in his or her own sketches.

In the second part of the interview, the participant was first asked to describe *why* s/he had made the sketches in the way s/he had. The researcher then described and showed an example of each of six *functions* she had identified as being supported by the features already identified. The participant was asked first to identify three instances of sketches whose features support each function, from the presented sketches, and then to identify three further examples from his or her own collection of sketches.

Lastly the participant was asked whether s/he could think of other features or functions not identified by the researcher.

The tape-recorder was placed on the table between the participant and researcher, who sat opposite one another. While the participant gave the freeform account, s/he handled and displayed the sketches being discussed as s/he chose. During the more formal questioning, the researcher spread out the presented sketches in front of the participant. Each interview lasted about two hours.

5.2.3 Data collected

The interviews were recorded on audiotape, and transcribed. The sketches brought to the interviews by the participants were collected, and analysed

in conjunction both with these transcripts, and the material collected from the previous studies. The presented sketches selected by the participants were analysed to identify the correspondence between the participants' choices and the researcher's predictions of their choices. Appendix 3 contains reproductions of all the selections made in the evaluation study, each one including the commentary made by the participant during the selection. Reproductions at samesize of the sketches collected from this study are contained in Appendix 4, labelled Ga1 to Gc1 (Greg's sketches), H1 to H8 (Hugh's sketches) and Ja1 to Jd4 (Judy's sketches).

5.3 Form of the evaluation study

The participants were presented with whole sheets of sketches (collected from studies 2 and 3), which more often than not contained multiple sketches, and were asked to identify and select particular instances of a phenomenon from that rich and complex context. Of the possible ways to present the sketches, and hence test the characterisation and the participants' comprehension of it, this was the most demanding option. In adopting this approach the participants were not only asked to recognise something described in terms that they had to assimilate immediately, but they also had to select from a visually complex context with which they were not familiar, since they had neither made the sketches nor seen them before. Thus, the participants were in the same position as the researcher in first seeing this data, except that it was more challenging for them, since they had not been exposed to the other data from the first three studies, of

designers' commentaries or the videotapes of designers sketching, nor had they been contemplating these issues explicitly over a long period.

In conducting the evaluation study there were other possibilities for how to present the sketches to the participants. For example, prototypical sketches could have been manufactured to show clearly the feature in question (perhaps alongside prototypical sketches designed to be clearly lacking in the feature). Theoretically, these sketches could have been copied from the sketch data already collected, so preserving some element of authenticity. However, the fact of their all being made by the same person and so having only one visual style, and of their being removed from their original, complex visual context, would reduce the visually rich dimensions of these artefacts to a considerable degree. Another possible approach would have been to isolate portions of sketches, or whole sketches, from sheets containing multiple sketches, and to present them out of the context in which they were originally made. This would have preserved the original visual qualities of the particular sketch (as far as is possible within the vagaries of photocopying), so ameliorating the disadvantage of reduced realism that would occur in the first option.

However, both of these options would have been a move away from the context-oriented approach which had directed the work so far. In the first instance the resulting copies would be bland and contextless objects which could elicit data that might be easy for the researcher to summarise and discuss, but that would be barely connected to the original, more visually complex artefacts. In both instances the presented sketches' relative lack of complexity and variety in comparison with the originals would reduce the

demand on the designers' skill in interpreting the sketches, thus telling us less about the designers' visual interpretation skills.

These two considerations relate to issues that are being addressed in this dissertation. One claim is that sketches are visually complex artefacts. A second claim is that designers exploit — and a large measure of their skill lies in their ability to exploit — that complexity, in making and evaluating the sketches and what they represent, predominantly, though not exclusively, through the visual sense. Therefore, deliberately reducing the dimensions of visual richness in the examples removes naturally occurring complexity. Studying one set of designers' responses to this complexity in sketches made by another set teaches us more about the designers' visual interpretation skills than studying their interpretations of simplified examples. Consequently, the more complex option was adopted.

The reason for including the participants' own sketches in this study was to establish a) whether or not the phenomena already identified in the previously collected sketches appeared in these sketches too (one form of indirect confirmation of the characterisation), and b) whether or not the participants understood the characterisation sufficiently to be able to transfer their interpretations to their own work, and see the same things there, if and where they occurred. Accurate recognition of the features where they occurred and acknowledgement of their absence where they were lacking would be direct confirmation, both of the characterisation and of the participants' visual interpretation skills.

Two of the participants brought comprehensive collections of sketches: Greg produced four sheets of sketches for one job he was currently engaged

in, thirteen sheets for another, and one for a third (Ga1 to Ga4, Gb1 to Gb13 and Gc1). Hugh showed eight sheets of sketches for a job he had completed (H1 to H8). Judy had fewer early sketches: six, one and one, for three jobs respectively (Ja1 to Ja6, Jb1, Jc1). She also showed, and used in her selections, four flat visuals incorporating some sketches (Jd1 to Jd4).

The sketches Judy showed were more limited in comparison to Greg and Hugh's, so there were by default fewer opportunities for her to demonstrate effectively that she could extrapolate from her own sketches the same issues that were in the presented sketches. Luke had no sketches of his own, so could not demonstrate this capacity at all. Thus, this part of the evaluation study was less revealing than it would have been had all the participants brought sketches of their own. Nevertheless, in many instances the selections all four designers made from the presented sketches accorded with one other, which suggests that they perceived the presented sketches and the questions asked about them in similar ways. In addition, Judy in particular frequently used her own limited examples with ingenuity to demonstrate what she understood but realised was hard to exemplify from her own few examples. Also, she explicitly did not make selections from her own work for the features and functions which she recognised, correctly, were not exemplified in her sketches.

The reason both Judy and Luke gave for not having more sketches of their own to discuss was that they throw them away as soon as a job is completed. Although the participants had been asked in advance to bring sketches to the interview, the timing had not coincided with Judy and Luke's starting new jobs, and thus generating new sketches. They both mentioned

several times that they did make sketches like the presented sketches, and they conveyed a certain frustration at the lack of their own material, which prevented them from discussing it more fully in their interviews. This aspect of the ephemeral quality of sketches, which makes them disposable once they have served their purpose, is referred to again in subsection 5.4.12, on Record keeping.

5.4 Findings from the evaluation study

In this section the findings from the evaluation study are discussed, addressing in turn each of the features and functions from the initial characterisation. The findings are presented in the same sequence as the questions were asked and the example of the relevant feature or function shown to the participants is reproduced as a figure at the beginning of each subsection. The participants' selections are summarised in tables in each subsection: those for the presented sketches show which sheets were presented and which were chosen; those from their own sketches simply show the selections. The specific selections each participant made are reproduced in the figures in Appendix 3, accompanied by the relevant excerpt from the participant's commentary.

The selections from the presented sketches are divided into seven categories, four of which relate to pre-determined criteria, and three of which relate to criteria arising from the analysis of the selections.

The seven categories are as follows:

■ appropriate (obvious, predicted to be selected)

◆ appropriate (less obvious, predicted less likely to be selected)

□ inappropriate (obvious, predicted to not be selected)

● appropriate (less interesting, predicted less likely to be selected)

▲ appropriate (unpredicted, one of many possibilities)

▼ acceptable (unpredicted, inappropriate but for accompanying commentary)

△ inappropriate (unpredicted)

Categories ■, ◆ and □ were pre-determined by the researcher. The set of sheets to be shown for each feature or function was chosen by the researcher on the basis of their sketches covering these three categories: each set contained at least two ■, if possible one or more ◆, and where applicable, at least one □. The category ● was pre-determined by the researcher and was included for the functions *focus* and *record keeping*, for which ◆ and □ are inapplicable (see subsections 5.4.9 and 5.4.12, respectively).

The categories ▲, ▼ and △ were created while analysing the results. Selections in the ▲ category were unpredicted because there were so many possibilities for that feature or function that the predictions of appropriate selections were not exhaustive. Those in the ▼ category would be inappropriate, but their accompanying commentary demonstrates that the participant had an accurate and more sophisticated understanding than expected, thereby enabling subtler and more inventive selections than those predicted. The △ selections were simply inappropriate and unpredicted.

5.4.1 Scale

For this feature the participants were asked to select three sheets of sketches at *different scales*. The example sheet is reproduced in figure 5.1. The participants' selections are summarised in table 5.1.

Table 5.1 Presented sheets selected for Feature 1: Scale

	Presented sheets					Example
Participant	B2	Cb7	A3	Df2	A1	Cb5
Greg	√	√		√		
Hugh	√	√	√			
Judy	√	√	√			
Luke	√	√	√			
	■	■	■	◆	□	

√ denotes an instance selected

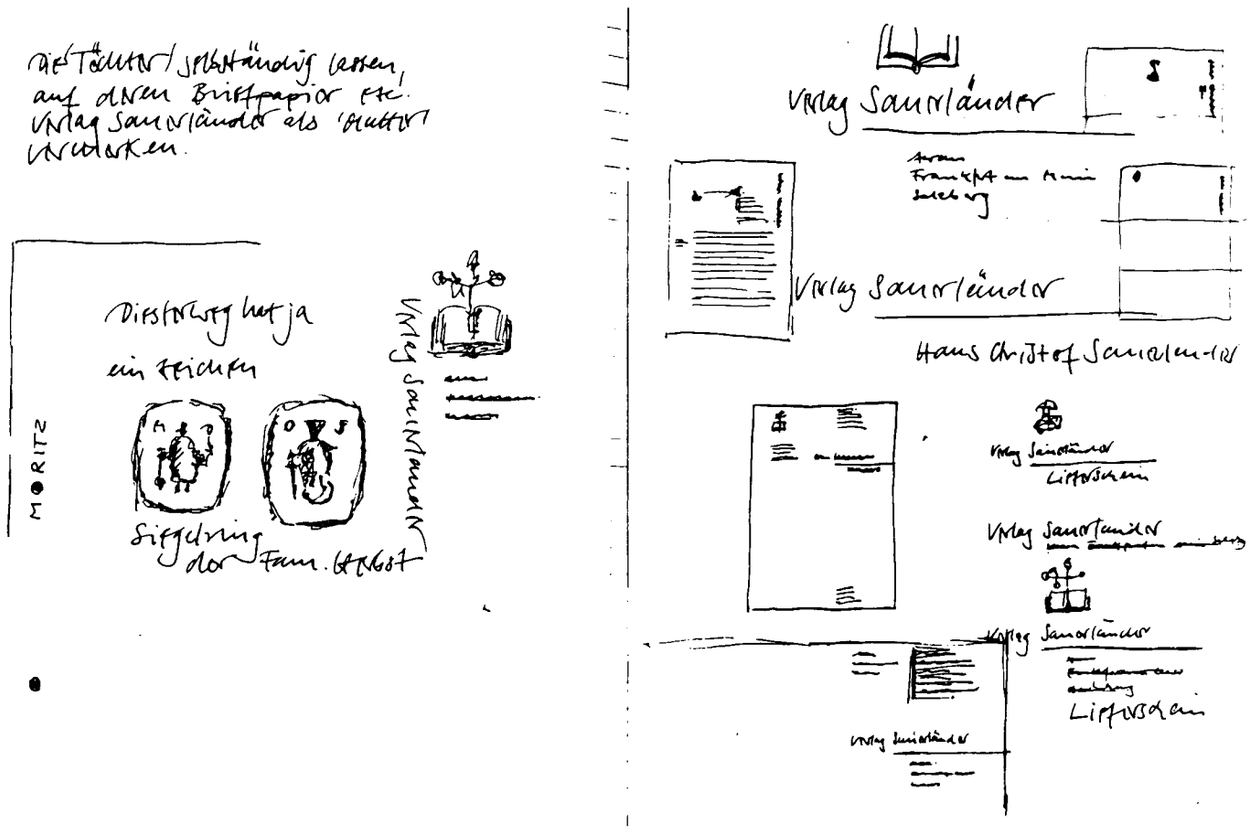
Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ◆ appropriate (less obvious, predicted less likely to be selected)
- □ inappropriate (obvious, predicted to not be selected)

All the designers made appropriate selections for the feature *scale*, and the instances predicted to be easiest to identify were selected most frequently.

Only Greg selected sheet Df2 as one of his choices for this feature. This sheet is a true instance of the feature in question, but was predicted to be harder for the participants to interpret without prior knowledge of what the sketches it contains represent.

Table 5.2 summarises the participants' selections from their own sheets.



Sheet Cb5. Reduced to 41 percent of original size.

Figure 5.1 Scale

Example shown of sketches at different scales.

Table 5.2 Participants' own sheets selected for Feature 1: Scale

Participant	Own sheets		
Greg	Gb1	Ga1	Gc1
Hugh	H3	H2	H1
Judy	Ja1	Ja5	Ja6

Greg and Hugh made appropriate selections for this feature. One of Greg's selections slightly stretches the interpretation of the term sketches at different scales on the same sheet. One of Judy's selections was appropriate, the other two were acceptable.

Greg's selection of Gc1 slightly stretches the interpretation. First, because the images on one side are not sketches, but are laserprinter output, and second because the different scales at which the layout is represented — lifesize and smaller scale — are on opposite sides of the sheet, so are not visible simultaneously in one glance of the sheet.

Simultaneous view of the sketches at different scales on the same sheet was not an explicitly stated requirement, and had not been previously considered. So this selection of Greg's was valuable for prompting consideration of whether simultaneity of view is a necessary condition for the selection to fulfil. In the paper medium it is trivially easy to flip the sheet over and back again, to see each representation. Thus, although the two images on this sheet are not simultaneously visible, aspects of simultaneity, such as ease of comparison, are almost as well supported by this sheet as by those whose sketches are on the same side. In terms of indicating Greg's understanding of the concept of scale, his choice of sheet

Gc1 is perfectly satisfactory, even though this choice was unexpected and pushes the boundaries of the characterisation.

Judy strove to find instances of sketches at different scales from among her own sketches, while acknowledging that none of her sheets contained really clear instances of this feature. Only her second selection is a true instance of this feature, and even in this one the sketches are at similar scales. Her first and third selections are not, individually, instances of sketches at different scales on the same sheet, but her commentary shows that she understood the concept of working at different scales, and was stretching her limited material, both to indicate her understanding and to demonstrate that she works at different scales, even though she had little evidence of this within individual sheets. In making her first selection, of a smallscale sketch on one sheet, she said:

> That [*representation of a running head*] was the beginnings of this running head business that comes across the top here [*on a separate mock-up*].

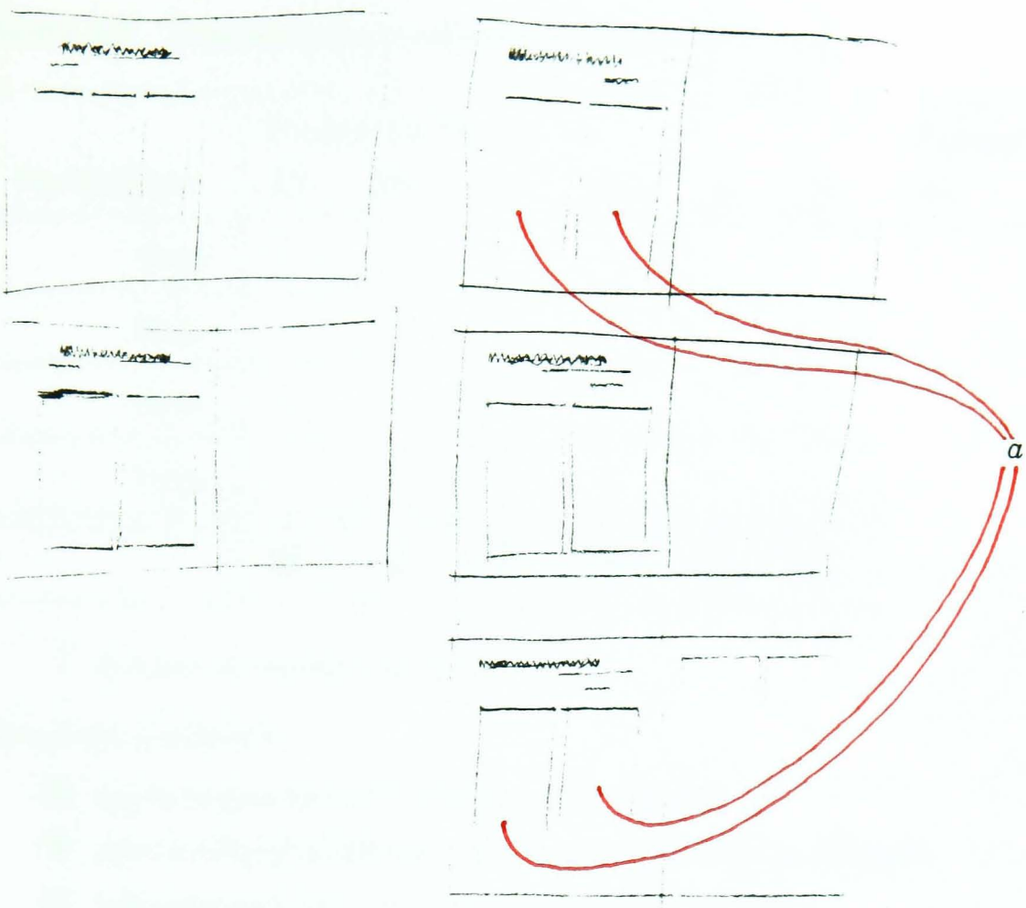
This mock-up was her third selection, of which she said:

> I very quickly go on to, you know, something that's more the true scale. I mean this sort of thing.

All the selections the participants made, both from the presented sketches and their own, demonstrated their accurate understanding of this feature.

5.4.2 Closure

For this feature participants were asked to select three instances of sketches showing *lack of closure*. The example sheet is reproduced in figure 5.2. The participants' selections are summarised in table 5.3.



Sheet B1. Reduced to 64 percent of original size.

Figure 5.2 Closure

Examples shown of elements within sketches showing lack of closure. In this instance, representations of columns of text lacking closure, *a*.

Table 5.3 Presented sheets selected for Feature 2: Closure

Participant	Presented sheets A3	Dd1	B4	Cb5	A1	B5	Example B1
Greg	√	√		√			
Hugh	√	√		√			
Judy	√	√	√				
Luke			√	√	√		
	■	■	■	◆	□	□	

√ denotes an instance selected

Categories of selections

■ appropriate (obvious, predicted to be selected)

◆ appropriate (less obvious, predicted less likely to be selected)

□ inappropriate (obvious, predicted to not be selected)

All except one of the selections made for lack of closure were appropriate and matched the predictions. Three designers selected Cb5, which contains true instances of this feature, but were predicted to be harder to recognise, because they are more embedded in the multiple sketches on that sheet. Only one inappropriate selection was made.

Luke had displayed a misunderstanding about closure from when it was first introduced, interpreting it to mean completion of decision-making or thinking about the design, rather than visual closure of the sketch, as was intended. He showed this by saying of one sheet:

To me the process isn't complete there at all

and of another:

I think that there is completion of thinking in this one.

When the term lack of closure was restated, Luke replied:

> So you're using the term quite literally to mean that it is physically unfinished?

which suggested that he then understood the intended meaning of the term, and perceived the difference between that meaning and his own. His first two choices correspond to predicted selections, thus confirming his correct understanding of the term, and in selecting Cb5 he said:

> Both in your sense and my sense that is not completed.

His third choice, however, suggested that his interpretation was still of 'closure of idea', rather than 'completion of sketch', since the sketches on sheet A1 do not lack visual closure according to the characterisation's definition, though they are loose in terms of the design ideas they convey, and hence could be said to lack closure of the idea. Given his previous, apparently accurate understanding, demonstrated through his first two selections, his last selection was a surprising choice, for which there is no obvious explanation.

Table 5.4 summarises the participants' selections from their own sheets.

Table 5.4 Participants' own sheets selected for Feature 2: Closure

Participant	Own sheets		
Greg	Gb4	Ga1	Gc1
Hugh	H3	H2	H2
Judy	-	-	-

All of Greg's and Hugh's selections were appropriate, indicating their understanding of lack of closure of both elements within the frame, and of the frame itself. Judy confirmed her understanding of this feature, already

conveyed by her selections from the presented sketches, by correctly observing that there were no instances of closure in her own sketches.

In making his second selection, from Ga1, Greg applied the term lack of closure in a new way, saying:

> These, in a way. I mean it's — lack of closure in this case is lack of any defining edge at all.

This concept of the lack of defining edge was included in the initial characterisation in the subsection on scale (Chapter 4, subsection 4.4.1 Scale, and figures 4.2 and 4.3). Greg's observation suggested that a more appropriate place for it was in the piece on closure, into which it was later incorporated in the refined characterisation (see Chapter 6, subsection 6.2.3, and figure 6.3).

With the exception of one of Luke's selections, all the selections the participants made, both from the presented sketches and their own, demonstrated their understanding of this feature. In addition, some of the selections made from the presented sketches showed the participants had more sophisticated visual interpretation skills than predicted, and one of Greg's insights directly influenced the refined definition of this feature.

5.4.3 Degree of detail

For this feature the first two participants were asked to select three pairs of sketches showing *contrasting degrees of detail*. The pairs could be selected from within the same sketch, the same sheet or from different sheets. As there were so many possible appropriate pairs both within and across the sheets, fewer sheets were presented. For the same reason the table does

not show an exhaustive list of possible pairs. Different pairs selected from the same sheet are distinguished by the addition of *a*, *b*, etc. after the sheet label. The example sheet is reproduced in figure 5.3. Greg and Hugh's selections are summarised in table 5.5.

Table 5.5 Pairs of presented sketches selected for Feature 3: Degree of detail

	Presented sheets						Example
Participant	B1	B3	Dg1*a*	B2*a*	B2*b*	Dg1*b*	B4
Greg				√√	√√	√√	
Hugh	√√		√√		√√		
	■	■	■	▲	△	△	

√√ denotes a pair of sketches selected

Categories of selections

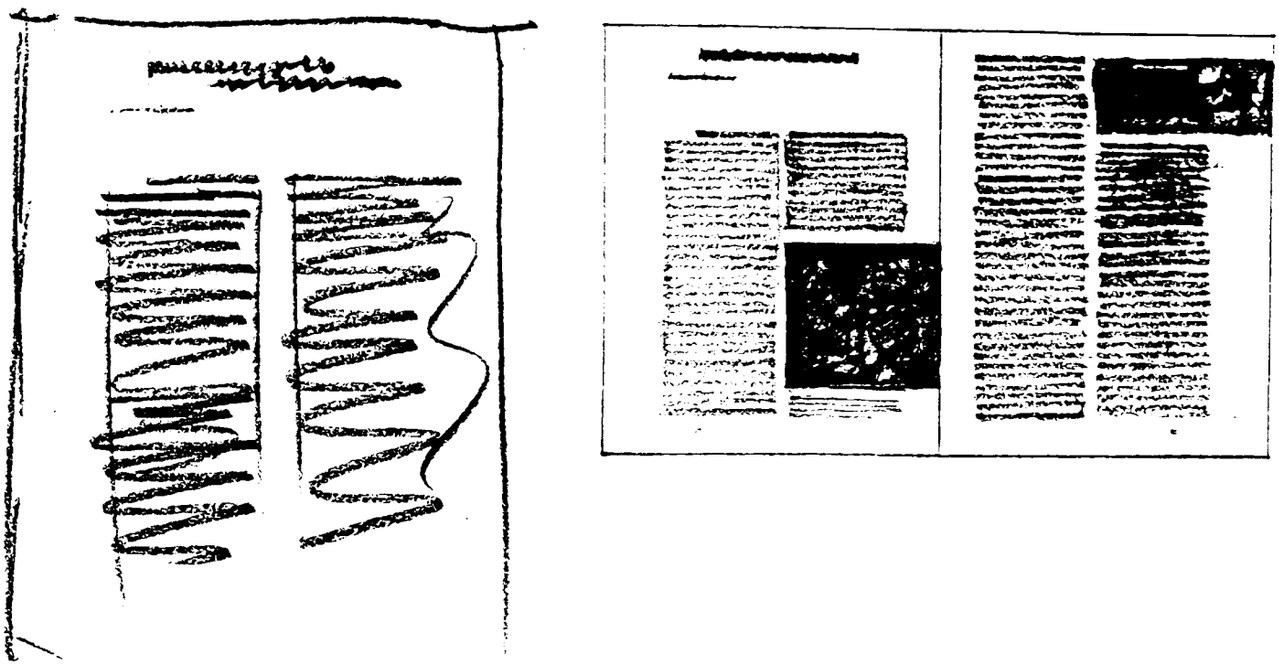
■ appropriate (obvious, predicted to be selected)

▲ appropriate (unpredicted, one of many possibilities)

△ inappropriate (unpredicted)

Only one of Greg's selections and two of Hugh's are appropriate for this question. The other selections they made were unpredicted and are inappropriate.

The question for this feature was intended to prompt selections of pairs in which one sketch shows focus on the issue of spatial positioning of the major elements, with little or no explicit detail of the typographic treatment within the elements, while the other shows focus on the explicit detail, with spatial positioning either resolved or unattended to. The phrase used in the question to Greg was *contrasting degrees of detail*



a Sheet B4. Original size.

b Sheet B4. Original size.

Sketches shown closer together than on original sheet.

Figure 5.3 Degree of detail

Pair of sketches shown as an example of contrasting degrees of detail: less in *a*, more in *b*.

of representation. Greg expressed confusion and his selections confirmed that he did not understand the question as intended.

Because of Greg's puzzlement the question was rephrased for Hugh in order to make the issue more explicit. He was asked to select pairs showing *contrasting degrees of detail about structural relationships*. However, Hugh still showed some uncertainty with the rephrased question, although his commentary and selections suggest that he came closer to grasping the notion of this feature than Greg.

Given Greg and Hugh's confusion, it is not surprising that their selections do not tally closely with the predicted selections. Greg's first choice, which is appropriate, seems more a result of chance than of true understanding, given that his other two selections are inappropriate. Hugh's first two selections are clear instances of contrasting degrees of detail, but the pair in his last selection is very similar and therefore inappropriate. Of this selection he said:

> You have got a structure here and I would guess from reading that, that headings would occur within these columns, but you haven't ... identified as such.

In this case, Hugh was using the term *structure* to refer to semantic structure within the text, indicated by the presence of headings, rather than spatial structure of the major elements, which was the sense the term was intended to have in this context.

Greg's and Hugh's confusion over their questions suggested that the term *degree of detail* was not immediately familiar to them. By extension, therefore, this form of question was not effective in addressing their understanding and recognition of this feature.

Therefore, when Judy and Luke were interviewed the question was modified, and different sketches were presented, in order to clarify the issue, and provide clearer instances of the feature. Judy and Luke were asked to select three individual examples of sketches (rather than contrasting pairs) in which the *spatial relationships between, and positioning of, the main elements is the dominant theme*. The example shown is *a* in figure 5.3. Their selections are summarised in table 5.6.

Table 5.6 Presented sheets selected for Feature 3: Spatial relationships

	Presented sheets						Example
Participant	E1	A1	A4	Cb3	B3	Cb4	B4
Judy	√	√	√				
Luke	√			√	√		
	■	■	■	▲	▼	□	

√ denotes an instance selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ▲ appropriate (unpredicted, one of many possibilities)
- ▼ acceptable (unpredicted, inappropriate but for accompanying commentary)
- □ inappropriate (obvious, predicted to not be selected)

All Judy's selections and one of Luke's match those predicted. Of Luke's other selections, one is appropriate, though unpredicted, and the other is acceptable in conjunction with his commentary.

The original question was aimed at verifying the participants' capacity for recognising sketches made at different degrees of detail, by eliciting selections of pairs of clearly contrasting detail. The questions asked of Greg

and Hugh failed to prompt such selections. Thus, these results did not demonstrate the participants' capacity to identify such differences by explicit reference to *degree of detail.* In addition, Greg and Hugh's commentary suggested that the terminology in the question was obscure.

Therefore the question was changed for Judy and Luke, to elicit selections whose focus is at one end of the spectrum of detail, namely the low end. Such sketches are typically made in addressing issues of *spatial relationships*, so the question was modified to refer to this issue. Thus, the question was aimed at establishing both whether these participants understood the term *spatial relationships*, and whether they perceived sketches concerned with this issue to be made at a low degree of detail. Judy and Luke's selections both demonstrate their accurate understanding of the concept of sketches focusing on spatial relationships, and show that their interpretation of such sketches is of those with a low degree of detail.

Tables 5.7 and 5.8 show the participants' selections from their own sheets.

Table 5.7 Participants' own sheets selected for Feature 3: Degree of detail

Participant	**Own sketches**		
Greg	Ga1	Gb4	Gb2/Gb12
Hugh	H2	H3	H1/H7

Table 5.8 Participants' own sheets selected for Feature 3: Spatial relationships

Participant	**Own sketches**		
Judy	Jd1	Jc1	Jb1

None of Greg's or Hugh's selections is appropriate. All three of Judy's are appropriate.

Given Greg's confusion over the term *degree of detail*, and the lack of explicit reference in the question to focus on spatial relationships, as opposed to micro-detail, it is not surprising that Greg's selections from his own sketches do not accurately reflect this contrast. The pairs he selected are contrasting, but only at the level of more or less resolved detail of a small part. Likewise, Hugh's selections from his own sketches reflect his interpretation of the question, and illustrate contrasting degrees of detail within a much more limited set of boundaries than was intended. Judy's three selections, by contrast, confirm her accurate understanding of *spatial relationships between, and the positioning of, the main elements as the dominant theme*, already demonstrated by her assured and appropriate selections from the presented sketches.

The issue of differing degrees of detail in sketches proved difficult to verify through asking for identification of contrasting pairs. The reason for this seemed to rest in the phrasing of the questions asked to prompt the selections, rather than in the absence of such differences. Once the question had been modified to address only one end of the spectrum of detail, the remaining participants demonstrated, through their selections, an accurate understanding of this issue. The first two participants' responses suggested strongly that the terminology was not immediately clear or comfortable for them. Although the degree of detail in sketches differs this seems not to be an aspect of sketching the participants consciously address.

5.4.4 Precision

For this feature the participants were asked to select three pairs of sketches showing *contrasting levels of precision of rendering of the main elements, excluding typeface attributes*. Each pair could be selected from within the same sketch, the same sheet of sketches, or from two different sheets. As there were so many possible pairs, the table does not show an exhaustive list of the possible selections. The example is shown in figure 5.4. Greg and Hugh's selections are summarised in table 5.9.

Table 5.9 Pairs of presented sketches selected for Feature 4: Precision

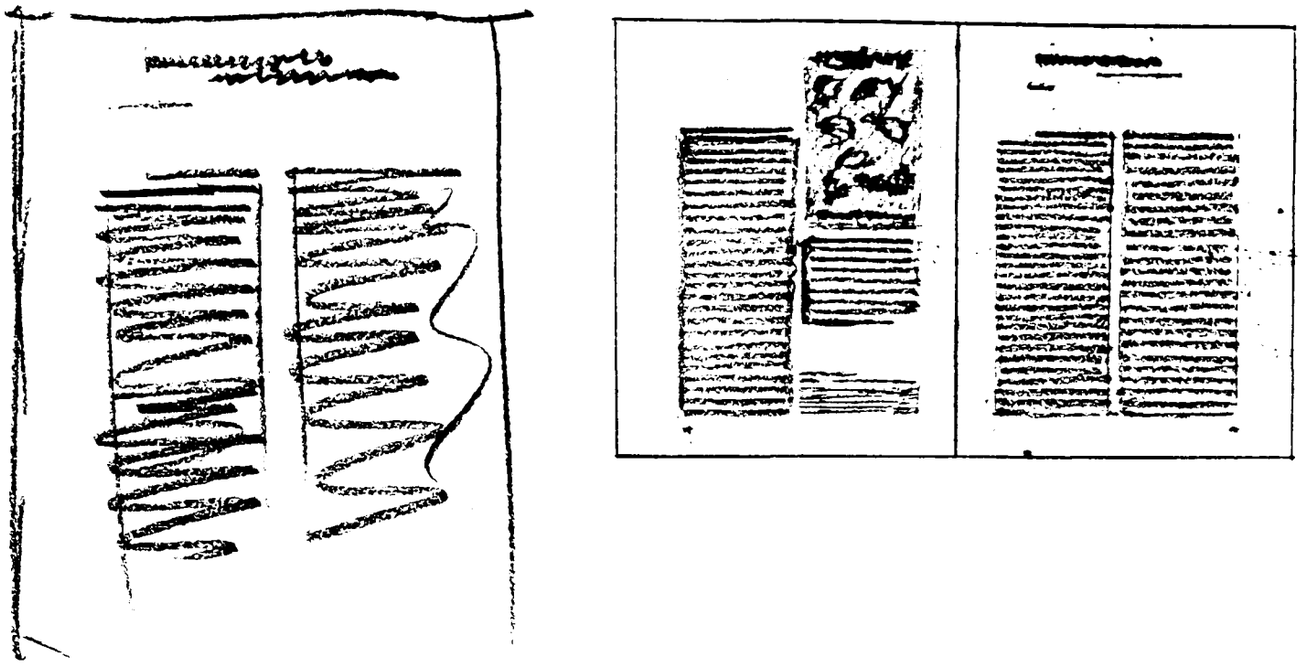
Participant	Presented sheets A1/B3*a*	B3	Cb3*a*	Cb3*b*	A4	A1/B3*b*	Cb4	E1	Example B4
Greg	√√		√√		√√				
Hugh		√√		√√		√√			
	■	■	▼	▼	▼	▼	□	□	

√√ denotes a pair of sketches selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ▼ acceptable (unpredicted, inappropriate but for accompanying commentary)
- □ inappropriate (obvious, predicted to not be selected)

One each of Greg's and Hugh's selections matched those predicted. Their other selections were all unexpected, but the accompanying commentary makes them acceptable. None of their selections is inappropriate, though the four unexpected ones each addresses only one aspect of precision.



a Sheet B4. Original size.

b Sheet B4. Original size.

Sketches shown closer together than on original sheet.

Figure 5.4 Precision

Pair of sketches shown as an example of contrasting levels of precision of rendering of the main elements, excluding typeface attributes: lower level in *a*, higher level in *b*.

The confusion Greg and Hugh displayed in interpreting their questions about degree of detail, and their subsequent unease at making selections for this feature, increased when the feature *levels of precision of rendering* was introduced. They seemed to find the distinction between *degree of detail* and *levels of precision* unclear, and Greg expressed the opinion that some of the selections he had made for the former feature were more appropriate for the latter. However, despite this expressed unease, all of Greg's and Hugh's selections are acceptable and informative.

The sketches in Greg's first selection are a clear contrast in their respective degrees of detail, and therefore in that aspect of precision, but in terms of the other aspect of precision, the tautness and formality of their marks, they are quite similar. The two sketches in Greg's second selection are very similar to each other in terms of the sparse detail they convey, but they are different in terms of their tautness and formality.

Greg's commentary about his second selection reveals that his interpretation of precision centres on the formality of the marks — the relative 'sketchiness' of them — and how this contributes to the exactness of the representation, in terms of the spatial positioning of the main elements. In describing the depiction of the columns of text he implicitly refers to the relative straightness and tautness of the lines in the two sketches, and the way in which the lines form more or less clearly recognisable units (in this case, rectangles) to represent columns of text. This interpretation of *levels of precision of rendering* accords with part of the intended use of the term, but lacks reference to the depiction of micro-

detail within the main elements, which is an important aspect of the term precision as used in this characterisation.

Hugh's first selection is a very similar pair to Greg's first selection. Hence it displays a clear contrast in degree of detail but is similar in tautness and formality. Hugh's selection is different in that the larger scale drawing in his pair is a visual pun on the piece of the design shown in the larger scale drawing in Greg's pair. Thus, the largescale drawing in Hugh's pair is not strictly representative of the same thing as the thumbnail sketch. However, Hugh's interpretation of the relationship between the sketches in his pair is correct and hence this suggests he has the same understanding of this feature as Greg. Again, in Hugh's third selection there is some contrast in terms of the degree of detail, but the tautness and formality of marks is very similar.

Because of Greg and Hugh's confusion and unease in trying to distinguish between the features *degree of detail* and *precision*, the set of presented sketches for this feature was changed for Judy and Luke, to provide clearer examples. Because there are so many possible pairs within and across this second collection of sheets, fewer sheets were presented. For the same reason the table does not show an exhaustive list of possible pairs.

Judy and Luke's selections are summarised in table 5.10.

Two of Judy's and all Luke's selections are appropriate, showing contrasting levels of precision both their degree of detail and tautness and formality of mark. Judy's last selection is not appropriate, as the marks in both sketches are at the same level of formality and there is hardly any

difference in their degree of detail. It is not clear why she made this selection, given her previous, appropriate selections. Only Luke selected a contrasting pair from within the same sketch.

Table 5.10 Pairs of presented sketches selected for Feature 4: Precision

	Presented sheets					Example
Participant	B2	B3	Dg1*a*	Dg1*b*	B1	B4
Judy	√√	√√			√√	
Luke	√√	√√		√√		
	■	■	■	◆	Δ	

√√ denotes a pair of sketches selected

Categories of selections

■ appropriate (obvious, predicted to be selected)

◆ appropriate (less obvious, predicted less likely to be selected)

Δ inappropriate (unpredicted)

Judy and Luke, in contrast to Greg and Hugh, seemed comfortable with the phrasing used for the question about this feature, and displayed no overt confusion between this feature and that of degree of detail.

Table 5.11 summarises the participants' selections from their own sheets.

Table 5.11 Participants' own sheets selected for Feature 4: Precision

Participant	**Own sheets**		
Greg	Gb10/Gb3	Ga1/Ga2	Gb12/Gb1
Hugh	H5	H5/H7	H5/H1
Judy	Ja1/Ja5	-	-

All Greg's and Hugh's selections from their own sketches are appropriate. Judy's only selection from her sheets is not appropriate, as it is not a clear contrast, but her commentary shows that she was striving to use her limited material to confirm her understanding of the feature, already demonstrated by her selections from the presented sheets.

Greg's and Hugh's selections are surprisingly clear instances, given the confusion they expressed while selecting pairs from the presented sketches. Greg's commentary indicated that he had recognised three aspects of precision: accurate sizing and position of elements; high degree of detail within the elements; and precise visual effects through formality of marks. This commentary contributed to clarifying the feature of precision, and was later incorporated into the refined characterisation. Hugh's three pairs demonstrate clearly that the feature of precision lies on a continuum, and contrast is relative — he used the same sketch to show comparatively less precision in one pair and comparatively more in another.

Greg's commentary also suggested that the confusion he had earlier expressed was increased by the restricted possibilities of selection of appropriate pairs of sketches from the presented sheets. This contributed to a different set of sheets being presented to the last two participants.

Despite the confusion and unease Greg and Hugh expressed in their commentary, their selections for this feature, both from the presented sketches and their own, all show an accurate recognition of at least one aspect of precision, and some show recognition of two aspects. In addition, Greg made a perceptive observation about a third aspect, which contributed directly to the refined characterisation. All of Luke's and one of

Judy's selections from the presented sketches demonstrated their clear understanding of this feature, with all their selections containing at least one aspect of precision, and some of them two. This feature, like degree of detail, proved complex, and few of the selections exemplified precision fully. However, the participants' commentary, in conjunction with their selections, contributed to clarification of this feature.

5.4.5 Degree of detail and levels of precision of typeface attributes

For this feature the participants were asked to select three pairs of sketches showing *contrasting degrees of detail and levels of precision of rendering of typeface attributes.* The example is shown in figure 5.5. The participants' selections are summarised in table 5.12.

Table 5.12 Pairs of presented sheets selected for Feature 5: Degree of detail and precision of typeface attributes

	Presented sketches									**Example**
Participant	Df1/Df2	Cb7*a*	Da2	Dc2/Df1	Cb7*b*	Cb7*c*	Da2/Dc2	Df2/Dg1	F1	Cb2
Greg				√√				√√	√√	
Hugh	√√	√√	√√							
Judy	√√					√√	√√			
Luke			√√	√√	√√					
	■	■	◆	▲	▲	▲	▲	▲	▲	

√√ denotes a pair of sketches selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ◆ appropriate (less obvious, predicted less likely to be selected)
- ▲ appropriate (unpredicted, one of many possibilities)

a Sheet Cb2. Original size.

b Sheet Cb2. Original size.

Sketches are side by side on original sheet.

Figure 5.5 Detail and precision of typeface attributes

Pair of sketches shown as an example of contrasting degrees of detail and levels of precision of rendering of the typeface attributes: *a* has more detail and a higher level of precision of rendering than *b*.

All of the selections made were appropriate. There was not a high correspondence across the participants' choices, but this reflects the high number of possible choices from among the sheets, rather than widely-differing or faulty interpretations by the participants.

Although sheet Da2 was gauged as a less clear example by the researcher and therefore predicted to be less likely to be selected, it was selected by three of the participants. Two of them drew the contrast between the two depictions of the same text on that sheet, and one of them drew the contrast between that sheet and sheet Dc2. Three of the participants selected valid pairs from sheet Cb7, though all three were different, with only Hugh selecting the particular one predicted.

No inappropriate selections were made.

Table 5.13 summarises the participants' selections from their own sheets.

Table 5.13 Participants' own sheets selected for Feature 5: Degree of detail and precision of typeface attributes

Participant	**Own sheets**		
Greg	Gb6	Gb1	Gb4
Hugh	H3	H4	H7/H5
Judy	Jd3/Jc1	Jb1/Jd1	-

All of Greg's, Hugh's and Judy's selections from their own sheets were appropriate, and confirm their accurate understanding of this feature. Judy's sheets were limited in instances of this feature but she accurately selected the only two possibilities.

This feature, combining degree of detail and precision, seemed to present no difficulties for the participants. All the selections they made demonstrated their accurate understanding, and their more subtle selections indicated their sophisticated interpretations of the feature.

5.4.6 Multiple sketches

For this feature the participants were asked to select three examples of *multiple sketches on the same sheet.* The example is shown in figure 5.6. The participants' selections are summarised in table 5.14.

Table 5.14 Presented sheets selected for Feature 6: Multiple sketches

	Presented sheets					**Example**
Participant	B2	E1	Dc1	Da1	Dg1	Cb5
Greg	√	√		√		
Hugh	√	(√)		√		
Judy	√	√	√			
Luke	√		√	√		
	■	■	■	◆	□	

√ denotes an instance selected

(√) denotes 'selected with reservation'

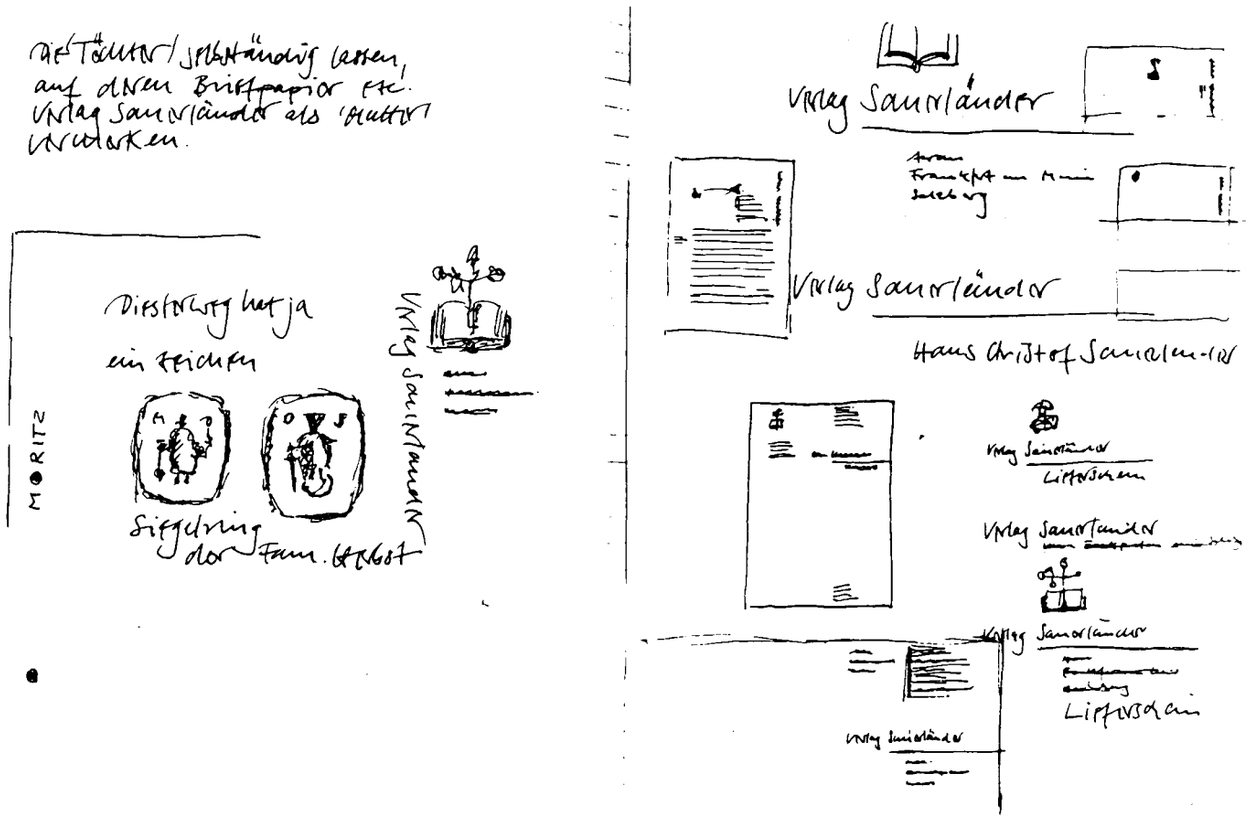
Categories of selections

■ appropriate (obvious, predicted to be selected)

◆ appropriate (less obvious, predicted less likely to be selected)

□ inappropriate (obvious, predicted to not be selected)

All the selections made were appropriate, and three participants selected the sheet gauged a less obvious instance.



Sheet Cb5. Reduced to 41 percent of original size.

Figure 5.6 Multiple sketches

Example shown of a sheet containing multiple sketches.

Hugh selected E1 'with reservations', objecting to it because he saw the sketches as continuation spreads of the same document, rather than as variants on the design. The existence of variants seemed to be a necessary condition for him to count sketches as different. It is not clear why he did not select Dc1 instead, though he may have perceived the sketches on that sheet in the same way, so that he held the same objection to it. For the purposes of verifying this feature of multiple sketches, Hugh's objection to E1 is not germane, since the important point is whether more than one sketch of any kind appears within the same frame of visual display.

Table 5.15 summarises the participants' selections from their own sheets.

Table 5.15 Participants' own sheets selected for Feature 6: Multiple sketches

Participant	Own sheets		
Greg	Ga1	Ga2	Gb1
Hugh	H2	H4	H5
Judy	Ja5	-	-

All of Greg's, Hugh's and Judy's selections are appropriate.

Greg neatly summarised the prevalence of sheets among his own containing multiple sketches by replying to the request for three examples with:

Well, there isn't a sheet that doesn't.

This is not strictly true — Gb7, Gb8 and Gb11 each only contain one sketch, but each of them is cut out from larger sheets, which may originally have contained other sketches. And it is true that all Greg's sheets that are intact contain many sketches. Judy could only find one sheet of her own containing multiple sketches, but this selection is appropriate.

All the selections the participants made, both from the presented sheets and their own, demonstrated their accurate understanding of this feature.

5.4.7 Mixture of visible languages

For this feature the participants were asked to select examples of sketches or sheets of sketches containing a *mixture of visible languages*. The example is shown in figure 5.7. The participants' selections are shown in table 5.16.

Table 5.16 Presented sheets selected for Feature 7: Mixture of visible languages

	Presented sheets						**Example**
Participant	B3	A4	B5	Dc1	A2	E1*	B4
Greg	√	√		√			
Hugh	√	√				√	

* E1 Removed after second interview

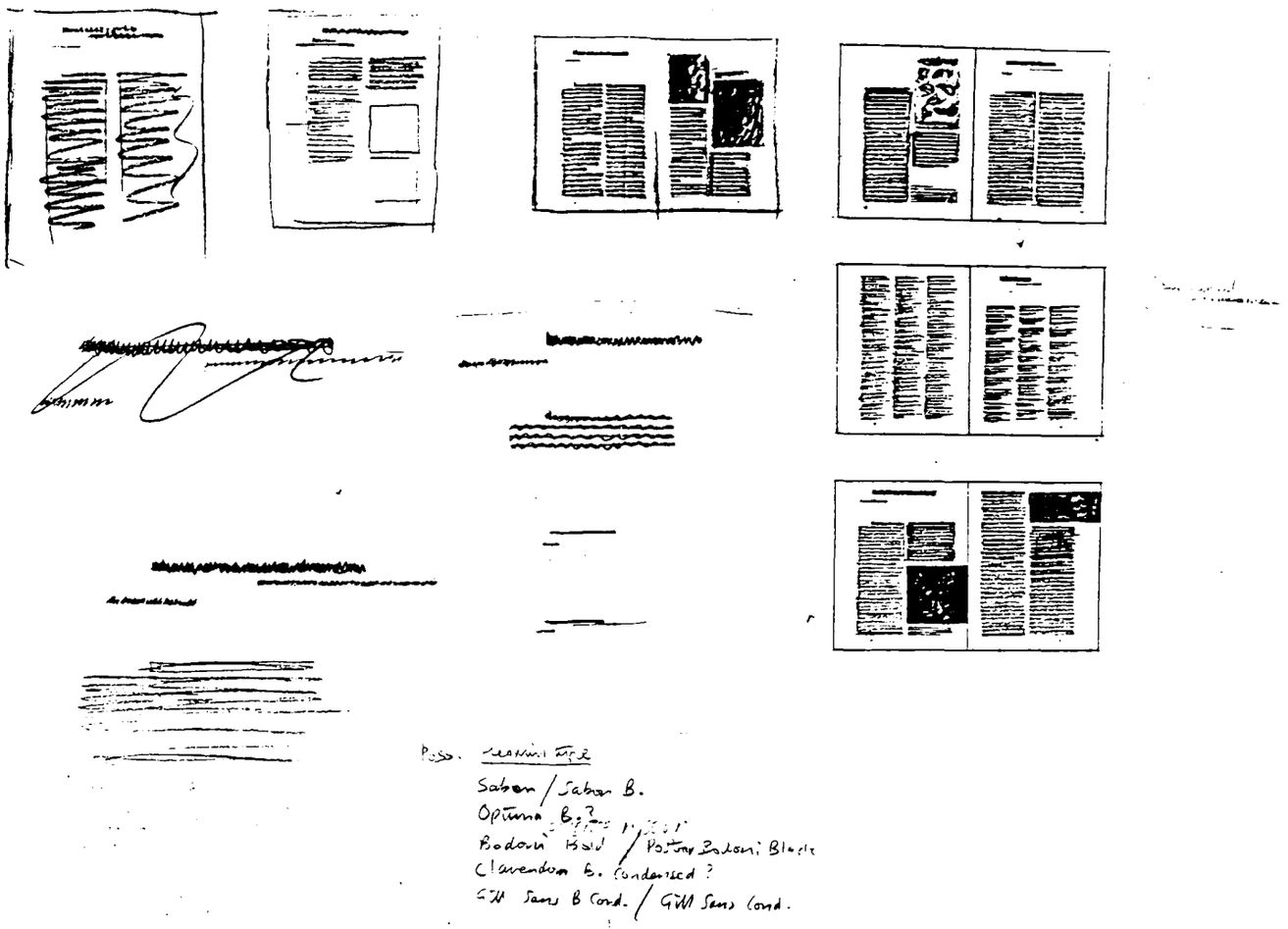
Judy	√	√	√			
Luke	√		√	√		
	■	■	■	◆	□	□

√ denotes an instance selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ◆ appropriate (less obvious, predicted less likely to be selected)
- □ inappropriate (obvious, predicted to not be selected)

All except one of the selections was appropriate and there was a close correspondence between the participants' selections and those predicted.



Sheet B4. Reduced to 41 percent of original size.

Figure 5.7 Mixture of visible languages

Example shown of a sheet containing a mixture of visible languages.

Two designers selected the less obvious instance. One inappropriate selection was made.

Unexpectedly, Hugh selected sheet E1, which had been included as containing only graphic imagery, and therefore not an instance of the feature of *mixture of visible languages*. He selected it because of the small piece of printed typography at the head of the sheet, although he himself did not perceive it to be a good example, referring to the type as coincidental to the hand-rendered markings, which are otherwise uniformly graphic imagery. However, he selected it in preference to Dc1, on the basis of the faulty interpretation that the whole of Dc1 is one sketch, of a bookjacket, and that it therefore does not contain a mixture of visible languages in the same way as the other sheets do. It is not clear why he did not select sheet B5, which is a clear instance of mixed visible languages.

Because sheet E1 introduced this unintended layer of confusion, it was removed from the set before Judy and Luke were interviewed.

Table 5.17 summarises the participants' selections from their own sheets.

Table 5.17 Participants' own sheets selected for Feature 7: Mixture of visible languages

Participant	Own sheets		
Greg	Ga1	Gb1	-
Hugh	H3	H8	H1
Judy	Jc1	-	-

All the participants' selections from their own sheets confirm their accurate understanding of this feature. Greg was only able to find two sheets from

among his own that contain a mixture of visible languages. There are in fact no other sheets from his collection that fulfil the criteria of this feature, so his perception was accurate. Judy only selected one example of this feature from her sheets although her material does contain other examples, but her one selection is appropriate.

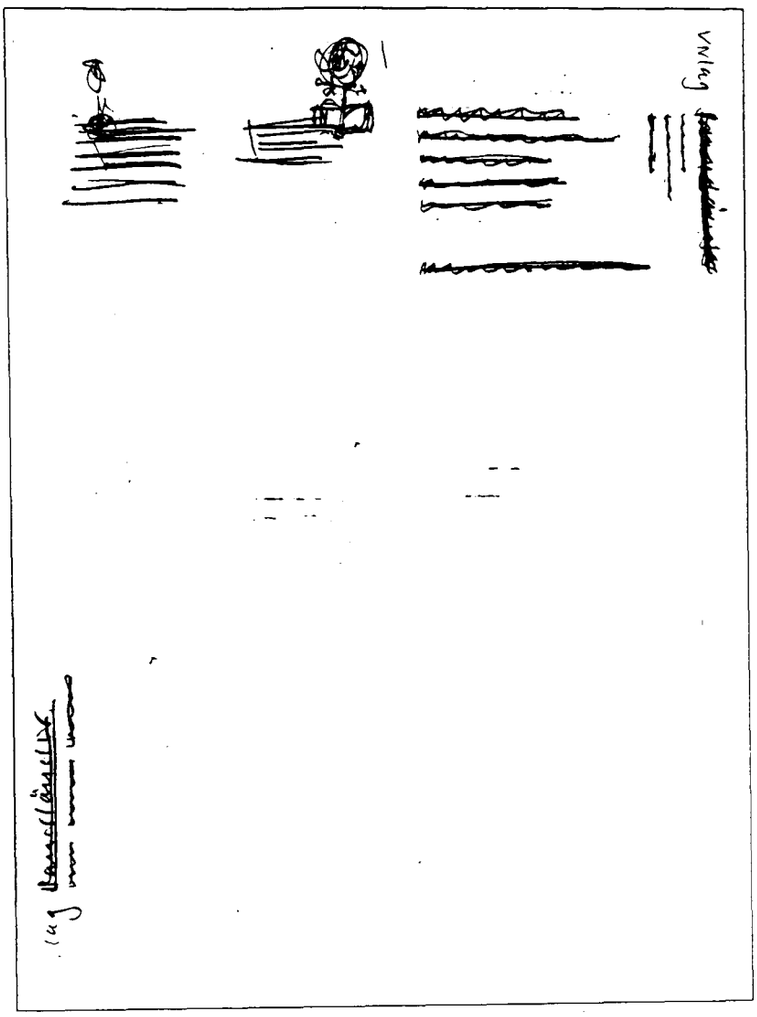
With the exception of one selection, all the participants' selections, both from the presented sheets and their own, demonstrated their accurate understanding of this feature.

5.4.8 Artefact simulation

For this feature the participants were asked to select three examples of *simulated artefacts.* The example is shown in figure 5.8. The participants' selections are summarised in table 5.18.

All the participants made appropriate selections for this feature.

This was the only case in which there was complete correspondence between the selections predicted (which were the only appropriate ones) and those that were made. This is worth noting, since it suggests that the phenomenon of simulated artefacts is clear and immediately familiar to these participants, further confirmed by how they grasped the concept easily and made their selections without hesitation.



Sheet Cb12, front only shown.
Reduced to 41 percent of original size.

Figure 5.8 Artefact simulation

Example shown of a simulated artefact.

Table 5.18 Presented sheets selected for Feature 8: Artefact simulation

Participant	Presented sheets A5	Cb10	Cb8	Dc1	Cb4	B5	Example Cb12
Greg	√	√	√				
Hugh	√	√	√				
Judy	√	√	√				
Luke	√	√	√				
	■	■	■	□	□	□	

√ denotes an instance selected

Categories of selections

■ appropriate (obvious, predicted to be selected)

□ inappropriate (obvious, predicted to not be selected)

Table 5.19 summarises the participants' selections from their own sheets.

Table 5.19 Participants' own sheets selected for Feature 8: Artefact simulation

Participant	Own sheets		
Greg	Gb13	-	-
Hugh	-	-	-
Judy	-	-	-

Greg made one, appropriate, selection from his own sheets. Hugh and Judy correctly observed that they had no instances of this feature in their own material.

Although all the participants demonstrated a clear understanding of this feature, and claimed to make such objects, they had few instances of their

own to show. Greg selected Gb13, as a mock-up of a letterheading, saying it was the only one he could find. Two other sheets of his could also be instances of this feature: Gb12 is a rough mock-up of two letterheadings (there is a different version on each side of the sheet) and Gb11 could perhaps also qualify, as a mock-up of a business card, the next stage on from Gb10. Gb10a (which is on the reverse of Gb10 in the original) is a rough drawing of a window envelope, and may have been used in combination with Gb11 (the original of Gb11 is cut out to the size of the business cards drawn on Gb10, and is folded in half to be the same size as the window in the drawing of the window envelope) to establish whether the typographic layout of the address on Gb11 would be visible through the window of such an envelope, and might, therefore also be suitable for a letterhead. Although these observations about Gb11 and Gb12 are clearly speculative, the circumstantial evidence to support them is quite strong. It is not clear why Greg did not select them.

All four of the participants echoed statements made by the designers in the first three studies, to the effect that physically manufacturing and handling representative artefacts is an important part of designing documents, even to the level of feeling the paper surface to gauge its suitability for the job in hand. Rough mock-ups are perhaps even more ephemeral than early sketches, since the most basic ones are simply folded sheets of blank paper. Blank sheets with folds in them quickly assume a tired and unkempt quality that makes them susceptible to being thrown away. This, then, could explain why the participants had so few examples of early mock-ups to show, though they all claimed to make them, since these mock-ups are even more unlikely to survive than rough sketches.

The lack of instances of this feature among the participants' own material prevented their making corroborative selections of their own. Nevertheless, the selections they made from the presented sketches demonstrate their accurate understanding of this feature.

5.4.9 Focus

For this function the participants were asked to select three examples of sketches whose features support *focus*, and to describe what they perceived the designer of the sketch was focusing on in each selection. The example is shown in figure 5.9. The participants' selections are summarised in table 5.20.

Table 5.20 Presented sheets selected for Function 1: Focus

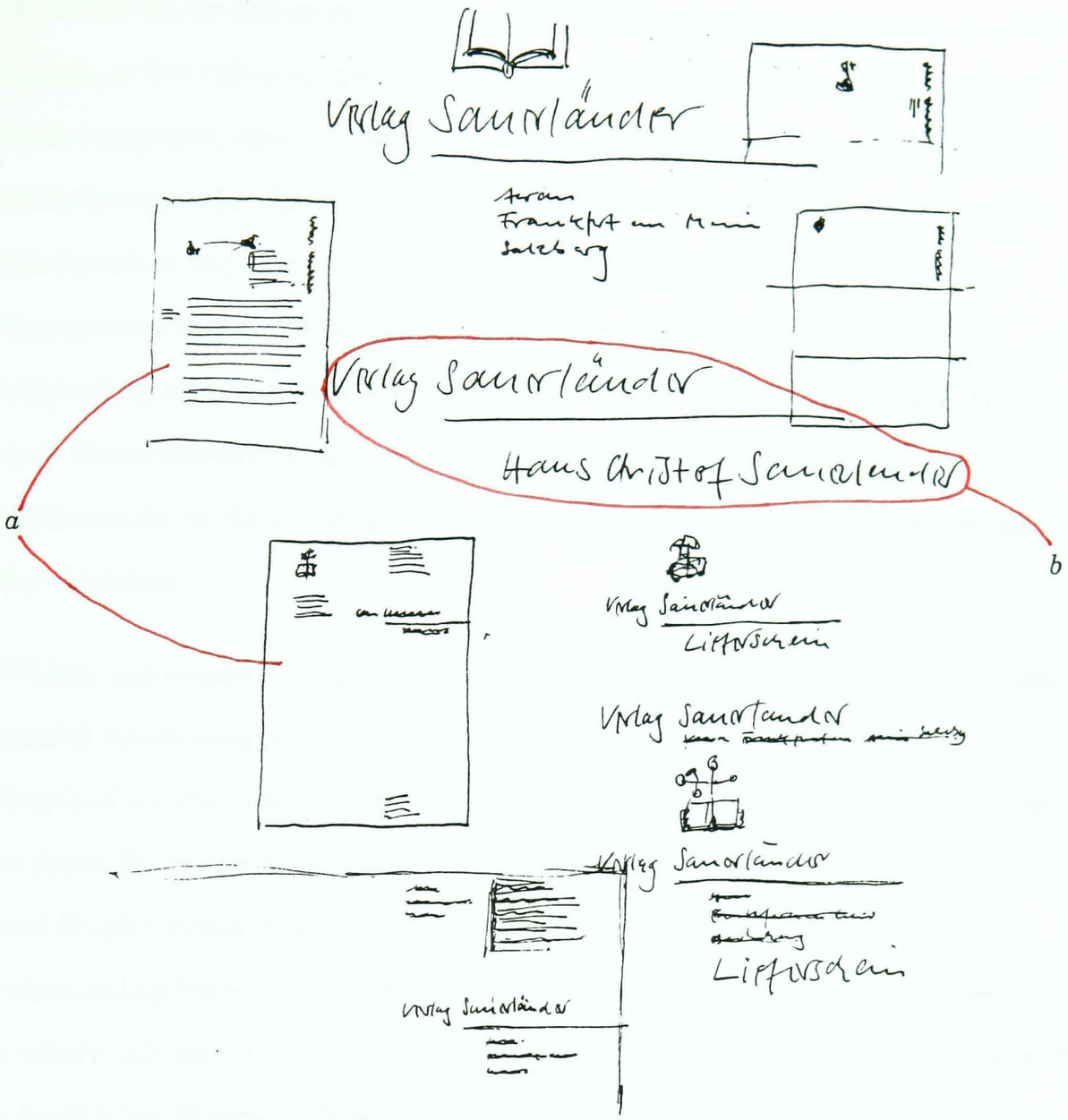
	Presented sheets					Example
Participant	Cb3	B3	A4	B1	Db1	Cb5
Greg	√	√	√			
Hugh	√		√	√		
Judy	√	√		√		
Luke	√	√			√	
	■	■	■	●	●	

√ denotes an instance selected

Categories of selections

■ appropriate (obvious, predicted to be selected)

● appropriate (less interesting, predicted less likely to be selected)



Sheet Cb5. Reduced to 64 percent of original size.

Figure 5.9 Focus

Example shown of sketches supporting focus: on the overall design in the smallscale, overall views, *a*, and on details of the design in the larger scale sketches of parts taken out of context, *b*.

All sketches, by definition, manifest the designer's focus on some part of the design, so the value of this question lay not so much in an identification of three instances, since no selection could be inappropriate, but in what the participants said about the particular sketches they selected. Hence, for this function the researcher distinguished between instances that were appropriate and predicted, and those which were appropriate but less interesting and therefore less likely to be predicted. Most of the selections were those predicted, and there was considerable consistency among the participants in their interpretations of what are the issues of focus within the sketches.

All four participants described the designer of sheet Cb3 as focusing on the spatial relationships and the positioning on the page of the elements sketched on that sheet. Both Greg and Luke described the designer's focus in sheet B3 as the 3-dimensional aspect of a fold-out page in a book. Greg and Hugh interpreted the same sketch from sheet A4 as focused on the relationship between a particular element and its placement on the page as a whole. All the other observations the participants made about the focus of a particular sketch, although uncorroborated by another participant, are thoroughly plausible. The participants' observations confirm their familiarity with sketches made for typographic design, their highly-developed visual interpretation skills, and through these two capacities, their ability to interpret other designers' sketches.

Table 5.21 summarises the participants' selections from their own sheets.

Table 5.21 Participants' own sheets selected for Function 1: Focus

Participant	Own sheets		
Greg	Ga1	Gb4	Gb9
Hugh	H1	H8	H4
Judy	-	-	-

Greg's selections from his own sketches relate to focus on a detail, on the overall design, and on the use of a second colour. In selecting from his sketches, Hugh referred to his focus on the document structure, the style and layout of a document, in contrast to its structure, and the precision of objects within the layout. Judy declined to select any of her material for this function.

All the participants' selections, and their commentary, indicate their clear and accurate recognition of sketches supporting this function.

5.4.10 Provisionality

For this function the participants were asked to select three examples of sketches supporting *provisionality*. The example is shown in figure 5.10. The participants' selections are summarised in table 5.22.

All of the selections were appropriate or acceptable, taken in conjunction with the participants' commentary.

There was not a high correspondence across the participants' selections, but this reflects the number of possible choices and the variety of their unexpected selections, rather than widely differing or faulty interpretations

Sheet A2. Reduced to 64 percent of original size.

Figure 5.10 Provisionality

Example shown of highly provisional sketches.

of the function. Three participants used their selections to illustrate contrasting levels of provisionality, rather than simply selecting three instances of highly provisional sketches.

Table 5.22 Presented sheets selected for Function 2: Provisionality

Participant	Presented sheets A1	E1	F1	B3*a*	B3*b*	B3*c*	B3*d*	B4*a*	B4*b*	Example A2
Greg		√	√				√			
Hugh	√						√	√		
Judy	√			√					√	
Luke			√		√	√				
	■	■	■	▲	▲	▲	▼	▼	▼	

√ denotes an instance selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ▲ appropriate (unpredicted, one of many possibilities)
- ▼ acceptable (unpredicted, inappropriate but for accompanying commentary)

Greg selected the sketches on sheets E1 and F1 as highly provisional, and three sketches from sheet B4 as much less provisional. Hugh made his three selections, A1, B3 and B4, as a series, showing gradations in provisionality, from most to least provisional respectively. Judy selected sheet A1 as highly provisional, the series on sheet B4 as showing progressively less provisionality, and a pair from B3 as illustrating different levels of provisionality. Luke's selections, all of highly provisional sketches, are all appropriate, although two of them were unpredicted.

While making his selections for this feature, Hugh referred several times to the speed with which the more provisional sketches had been drawn. When asked how he knew about the speed with which these sketches had been made he replied:

> The precision isn't important, they [*the lines*] overlap, they're all over the place.

He described the sketches he chose from B4 as having been drawn 'less speedily', and, asked to account for that claim, replied:

> The lines are more precise, wider, less expressive I suppose. There is attention to detail, working out measures, how wide you can get a column, two column structure into the spread onto the page. There is definite distinction between images and text and headings.

The issue of speed, and the connection between the speed of sketching and the visual appearance of sketches is considered in more detail in Chapter 6, section 6.2.5.

Table 5.23 summarises the participants' selections from their own sheets.

Table 5.23 Participants' own sheets selected for Function 2: Provisionality

Participant	**Own sheets**		
Greg	Gc1	Gb12	Gb4
Hugh	H1	H2	H4
Judy	-	-	-

All of these selections are appropriate, or acceptable, taken in conjunction with their commentary.

From his own material, Greg selected sketches from Gc1 and Gb4 as highly provisional, and the sketch on Gb12 as much less provisional. In selecting

the sketch from Gc1, Greg made a reference to speed as well as to lack of detail (similar to Hugh's comments cited above), saying:

> Well, this one, that's a good example of something that is utterly provisional. Small scale, thumb nail sketch, just hastily looking at size of columns, but not fixing anything.

He drew this contrast, in talking about the sketch from Gb12:

> This is a sort of more committed level where I have actually, for some unearthly reason, decided that this design needs to be perceived to the extent where I am actually seeing it life-size on a sheet in the correct position with typography relatively accurately laid out.

As in his choices from the presented sketches, Hugh selected three from among his own showing gradations in provisionality, Ranging from most to least provisional, he selected groups from H1, H2 and H4, observing:

> This example here is probably the most provisional. There is some reference to structure and content, but there is not commitment at all to grid, typeface, layout.
>
> This sequence here really doesn't say anything about type, image, or any of the elements that will actually be used to make this layout. But, having said that, it does give a feeling for the dynamics of the page.
>
> This one shows a lot more commitment to layouts and content and structure.

Judy observed, accurately, that none of the material she had brought was highly provisional, and so she declined to make any selections from it.

Greg made the observation that provisionality is more a visual *feature* of sketches, which enables designers to remain flexible about the design solution the provisional sketch represents, rather than being a *function* itself. This observation was instrumental in the reworking of the description of provisionality in the refined characterisation (see Chapter 6, subsection 6.2.2) and the inclusion of *interpretability* (see Chapter 6, subsection 6.2.5.).

All the participants' selections from both the presented sheets and their own, demonstrate their accurate recognition of sketches supporting this function. In addition, some explicit observations they made influenced directly the definition of provisionality, and the inclusion of *interpretability* and *speed* in the refined characterisation.

5.4.11 Switching

For this function the participants were asked to select three examples of sketches or sheets of sketches that support *switching*. The example is shown in figure 5.11. The participants' selections are shown in table 5.24.

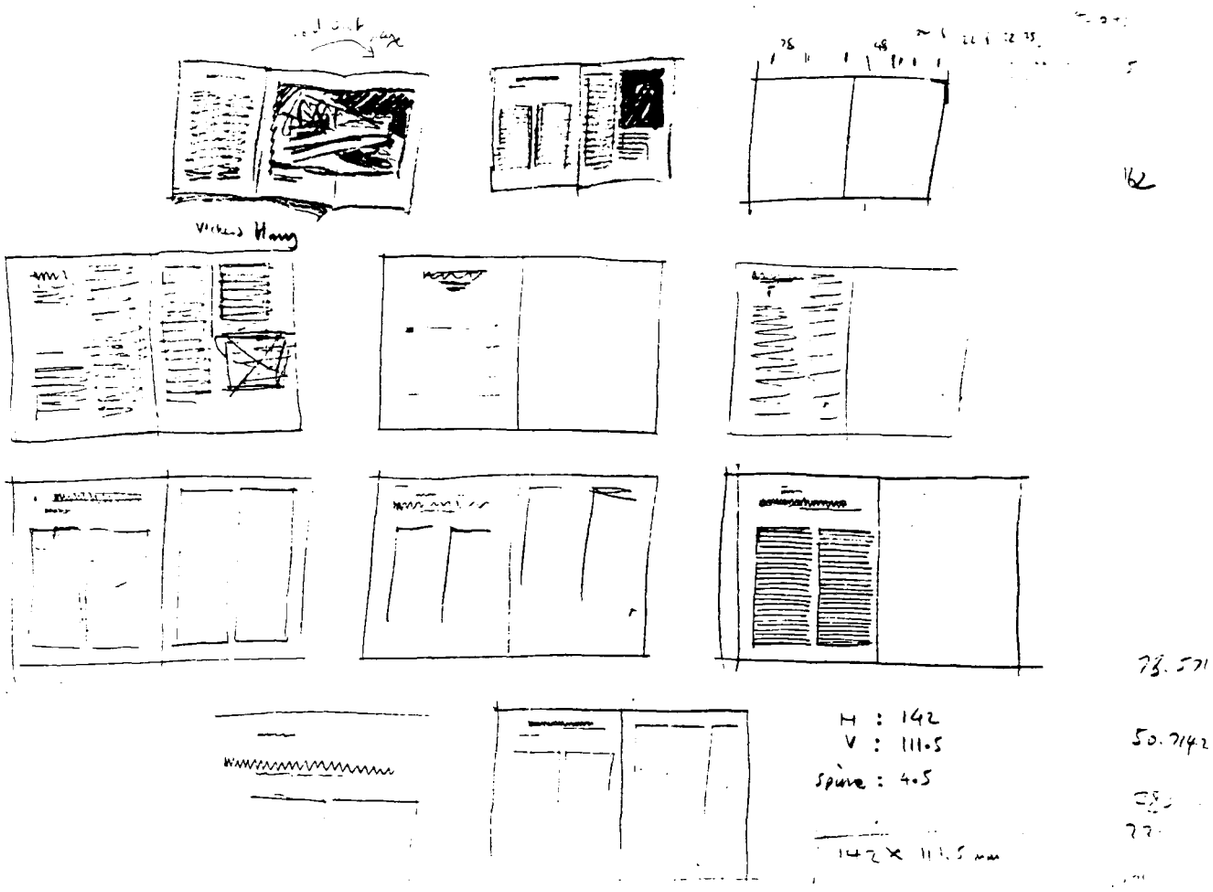
Table 5.24 Presented sheets selected for Function 3: Switching

Participant	Presented sheets									Example
	B4*a*	Cb5*a*	B2	Dc1	F1	B4*b*	B4*c*	Cb5*b*	A1	B3
Greg	√			√				√		
Hugh	√	√			√					
Judy			√			√	√			
Luke	√	√		√						
	■	■	■	◆	◆	▲	▲	▲	□	

√ denotes an instance selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ◆ appropriate (less obvious, predicted less likely to be selected)
- ▲ appropriate (unpredicted, one of many possibilities)
- □ inappropriate (obvious, predicted to not be selected)



Sheet B3. Reduced to 41 percent of original size.

Figure 5.11 Switching

Example shown of switching within a sheet of sketches: switching between focus on details and overall views of the design, between degrees of detail, and between different visible languages.

All the participants' selections were appropriate. No one selected A1, the sheet showing only graphic images, all at the same scale and all addressing much the same image. Although it could be argued that even in this sheet the designer was switching between alternative treatments of the same double page spread, the other five presented sketches contained much more prominent examples of switching, and the participants' selections reflected their recognition of this.

The participants' commentary indicated that they had a clear and accurate understanding of the notion of switching. The two less obvious instances were selected, showing more sophisticated visual interpretation skill than predicted, enabling the participants to make more subtle selections.

Table 5.25 summarises the participants' selections from their own sheets.

Table 5.25 Participants' own sheets selected for Function 3: Switching

Participant	Own sheets		
Greg	Ga1	Gb1	Gb3
Hugh	H1	H3	H2
Judy	-	-	-

All of Greg's and Hugh's selections are appropriate. In making his selections Greg referred to switching between visible languages in sheet Ga1. In sheet Gb1 he observed that there were multiple instances of switching, between detail of graphic images, consideration of page outlines and layout of pages, and an annotation about hourly rates of pay. Of the two sketches from Gb3 he picked as his third selection, he spoke of switching between degrees of detail and levels of precision of rendering, saying:

> This is slightly different levels of switching, I guess. But switching between looking at an image in relation to a bar of type, and here looking at it in relation to the precision, I mean the precise details of the type. So it's kind of positional, but it's also — I mean there are the two different things I am looking at there.

It is interesting to see him making this distinction here, between precision in terms of detail of type and accuracy of position, even though he expressed uncertainty about the term precision during the selection for that feature.

Before making his selections, Hugh observed that one prevalent form of switching he engages in is switching between projects. This is a level beyond the ones considered in deriving the initial characterisation, but is a valid point. In making his selections he observed in them switches between considerations of the graphic structure and the written structure, between scales, between degrees of detail and between levels of precision.

Judy's material did not show evidence of this function, so she was unable to make selections of it from her own work.

All the participants' selections were appropriate, and their commentary confirmed their accurate understanding of this function. In addition, as a side-effect of discussing switching, the participants used terms introduced during the part of the interviews concerned with features. Their adoption and fluent use of these terms suggests that they became comfortable using them, even when they had initially exhibited confusion at their introduction. This adopted use of the terms could be taken as an indirect endorsement of them, and hence of the ideas they embody.

5.4.12 Record keeping

For this function the participants were asked to select three examples of sketches or sheets of sketches that support *record keeping*, and to say whether there was anything particularly noteworthy about those records. The example is shown in figure 5.12. The participants' selections are summarised in table 5.26.

Table 5.26 Presented sheets selected for Function 4: Record keeping

Participant	B4	Cb3*a*	Dg1	Da1	F1	Cb3*b*	**Example** A1
Greg	√		√			√	
Hugh	√	√		√			
Judy	√	√	√				
Luke	√	√			√		
	■	■	■	●	●	▲	

√ denotes an instance selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ● appropriate (less interesting, predicted less likely to be selected)
- ▲ appropriate (unpredicted, one of many possibilities)

All sketches are, by definition, records of the ideas they embody. So, as with the function *focus*, the issue of interest was not whether the participants could select instances of record keeping, since no selection could be inappropriate, but rather what they said about the sketches they selected, and what they observed about the function itself.

Sheet A1. Reduced to 41 percent of original size.

Figure 5.12 Record keeping

Example shown of a sheet of sketches as a record, including a scribbled-out sketch, *a*.

The two sheets that were selected by all four participants contain many sketches, and the participants' comments indicate that they could identify many aspects of the emerging designs from these sheets, and hence saw them as detailed records. But even the other three sheets, which contained fewer sketches, seemed to enable the participants to provide plausible reconstructions of what the sketches were recording, at the time they were made.

Greg raised an objection to the term *record keeping*, and made an astute observation about the distinction between records made with the intention of later referral, and sketches made simply, as he put it:

> To actually see a thing that's just running through the mind and it will never be referred to again.

This was a valid observation, which contributed to the term for this function being divided into *ideas capture* and *record making*. These terms both clarify the distinction between these two aspects of the recording concept which were confounded in the previous term, and remove the claim implied by the term *record keeping* that there is a temporally-based purpose in the recording aspect, which may not be true of all sketches by all designers (see Chapter 6, subsection 6.2.5).

Table 5.27 summarises the participants' selections from their own sheets.

Table 5.27 Participants' own sheets selected for Function 4: Record keeping

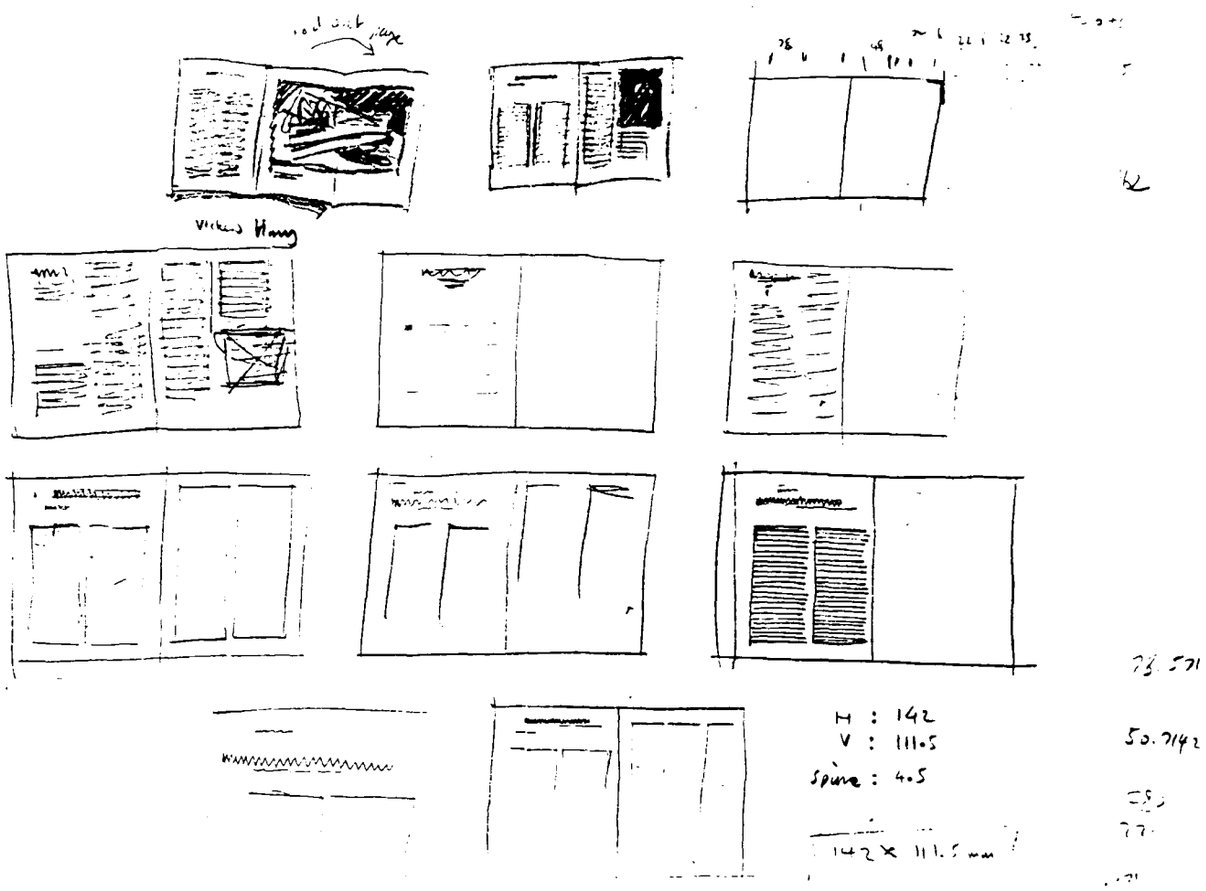
Participant	**Own sheets**		
Greg	Ga1	Ga1	Ga1
Hugh	H1	H4	H7
Judy	-	-	-

Greg selected three instances from his own work, all from the same sheet, of marks he made with the specific intention of recording something for later reference. Hugh's selections from his own work reflected his interpretation of record keeping in the sense originally intended, that is simply the capture of ideas at the time they occurred to the designer, without a specific intention of referring to the sketches again later. So in making his selections he spoke about records of decisions he was making about the structure, layout, style and resolution of detail in the document he was designing. Judy felt that none of her sheets was similar enough to the presented sketches to justify selecting any of them for this function.

The notion of sketches acting as records was understood by all the participants, each of whose commentary indicated their ability to reconstruct another designer's activity through sketch records. Greg's observation that the term *record keeping* implies preservation for the purpose of later reference, which may not necessarily be a designer's intention in making a sketch, contributed to the division and renaming of this function as *ideas capture* and *record making* in the refined characterisation.

5.4.13 Comparison

For this function the participants were asked to select three examples of sketches or sheets of sketches that support *comparison*. The example is shown in figure 5.13. The participants' selections are summarised in table 5.28.



Sheet B3. Reduced to 41 percent of original size.

Figure 5.13 Comparison

Example shown of a sheet of sketches supporting comparison.

All the participants' selections were appropriate.

Table 5.28 Presented sheets selected for Function 5: Comparison

Participant	Presented sheets							Example
	Cb7*a*	A3	Da1	Dd1	Cb7*b*	Cb7*c*	Dg1	B3
Greg		√		√	√			
Hugh	√		√	√				
Judy	√	√	√					
Luke		√	√			√		
	■	■	■	◆	▲	▲	□	

√ denotes an instance selected

Categories of selections

- ■ appropriate (obvious, predicted to be selected)
- ◆ appropriate (less obvious, predicted less likely to be selected)
- ▲ appropriate (unpredicted, one of many possibilities)
- □ inappropriate (obvious, predicted to not be selected)

No participant selected Dg1, which contains only one sketch, and does not, therefore, on its own, support comparison.

All the participants selecting sheet Cb7 referred to comparisons of spatial relationships, positioning and size of the elements within this sheet. Hugh and Judy made these comparisons between all the sketches on the sheet, while Greg and Luke each chose specific pairs of sketches to compare. The comparisons identified in sheet A3 were of page layouts, and in sheet Da1 of differing treatments of the same book title. Dd1, though gauged less obvious, was selected by Greg and Hugh, who saw in it comparisons of different treatments of the same components of a title page.

Table 5.29 summarises the participants' selections from their own sheets.

Table 5.29 Participants' own sheets selected for Function 5: Comparison

Participant	Own sheets		
Greg	Ga1	Gb1	Gb1
Hugh	H4	H2	H1
Judy	-	-	-

The three instances of comparison Greg selected from among his own sketches compared relative compression or expansion of the image, the effect of the image filled in solid or kept as an outline, and mirrored positions of the same image. In selecting from his own material, Hugh spoke of his three choices as follows:

> Five renderings of the same spread, showing comparisons of layout and graphic treatments.
>
> Here we have four — five examples of the treatment of a heading in relation to an image.
>
> Here we have a series of thoughts on the treatment of a diagram. One, two, three, four.

Judy found no instance of sketches supporting this function from her own material.

Although all the participants selected appropriate instances of sketches supporting comparison, they expressed a measure of disagreement about the notion of comparison. The common objection centred on whether or not the act of comparison was explicit, and all four participants expressed the view that it was not. However, they acknowledged the value of multiple variants on a design within the same field of view, and agreed that the

designer could be making comparative judgements at a less conscious level, simply through seeing more than one sketch simultaneously. This relates to peripheral awareness, mentioned in Chapter 1, subsection 1.2.1.

5.4.14 Simulation of experience

For this function the participants were asked to select three instances that support *simulation of experience*. The example is shown in figure 5.14. The participants' selections are summarised in table 5.30.

Table 5.30 Presented sheets selected for Function 6: Simulation of experience

Participant	Presented sheets								Example
	A5	Cb8	Cb10	Cb8/Cb10	A5/B5	B3	B5	Cb5	Cb12
Greg	√	√	√						
Hugh				√√	√√				
Judy	√	√	√						
Luke	√	√				√			
	■	■	■	▼	▼	▼	□	□	

√ denotes an instance selected

√√ denotes a pair of sketches selected as one choice

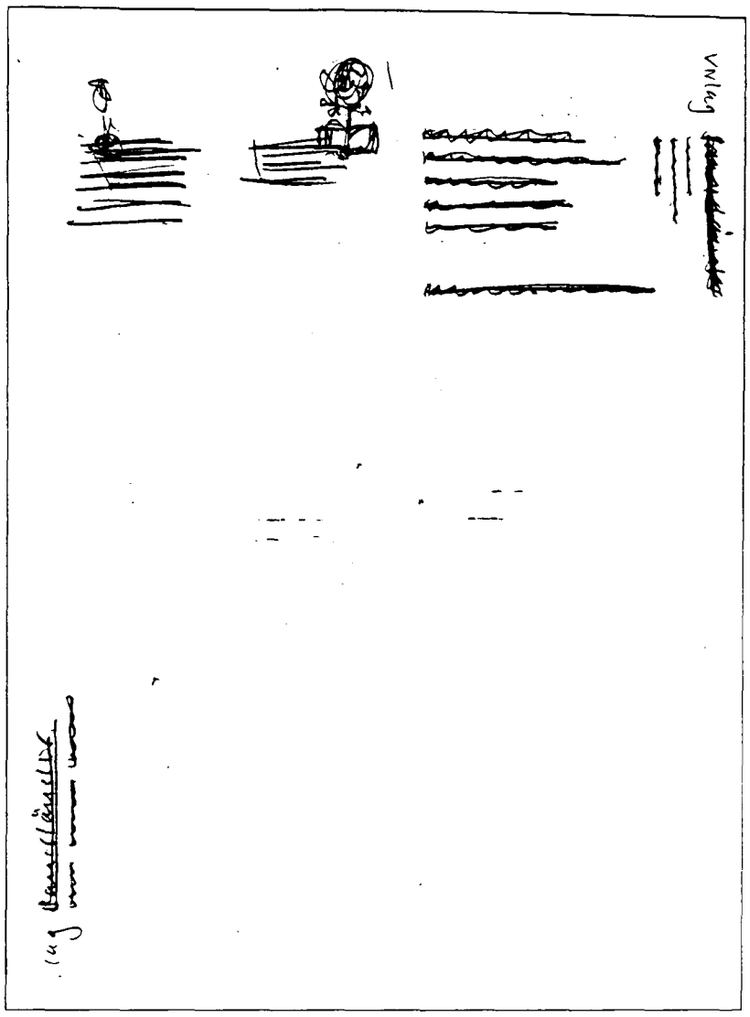
Categories of selections

■ appropriate (obvious, predicted to be selected)

▼ acceptable (unpredicted, inappropriate but for accompanying commentary)

□ inappropriate (obvious, predicted to not be selected)

Two of the participants made all of the predicted selections.



Sheet Cb12, front only shown.
Reduced to 41 percent of original size.

Figure 5.14 Simulation of experience

Example shown of an artefact simulating the experience of the final document.

Hugh selected the pairs A5/B5 and Cb8/Cb10 as two choices, and then observed, correctly, that there were no more selections he could make from the available sketches that satisfied the term. Explaining his selections of the two pairs he said of A5/B5 and Cb8/Cb10, respectively:

> I would put these two together and say that here the designer was concerned with the treatment of the image and how it works as a book jacket, not only as a front cover, but how it works as a whole, working around the spine and onto the back, and what part of the image would be seen where.
>
> These are actual size, so here the designer was concerned with scale of type, image, layout and how it relates to the user, how they engage with it, with — in terms of its space and its scale. I imagine this was folded as well so that you get the feeling of 'this is a letterhead' when opened out of the envelope. They're a pair again, I think, because it's addressing the same issues. They're a comparison.

Although these pairings were unexpected selections, Hugh's reasoning was internally consistent, and did not contradict the concept. Rather, Hugh's interpretation of *simulation of experience* embraced the two notions of representation: in two dimensions, of the 3-dimensional object (sketches that explicitly convey 3-dimensionality of a document) and the 3-dimensional artefact representing the 3-dimensional document.

This interpretation, embracing representation of 2 dimensions and 3 dimensions, was echoed in one of Luke's selections, from sheet B3, which includes a sketch about which he said:

> When we get to these sketches, when someone's ideas have advanced as far as this in the rough, I find it very useful to see the thing projected as the possibility of three dimensions. I think that, considering how rapidly that's been done, that does really give one quite a feel of the bulk of the thing and the way that throw-out is going to work.

This was not a predicted selection, and strictly speaking is not a true simulation in 3 dimensions of the final artefact. However, it is one of several 2-dimensional representations among the sketches collected that indicate something of the 3-dimensional behaviour of the proposed final artefact. Thus, it has some connection to the phenomenon of simulation of experience, albeit in a more restricted way than selections for this function were intended to show.

All the participants made statements to the effect that simulation of experience is a crucial part of designing, and all claimed to engage in it as a matter of course. Greg, Judy and Luke observed that an important design decision connected to this concept is choice of paper or other substrate to be used for a document. These observations echo statements made by designers who participated in the earlier studies.

Table 5.31 summarises the participants' selections from their own sheets.

Table 5.31 Participants' own sheets selected for Function 6: Simulation of experience

Participant	Own sheets		
Greg	Gb13	-	-
Hugh	-	-	-
Judy	-	-	-

Only Greg had examples of his own that support simulation of experience, sheets Gb12 and Gb13, though he only selected Gb13, saying:

> I am showing the letter in its actuality to show the way it works in its correct context, having a letter typed on it, seeing the way the typed letter relates to the printed letterheading, and the way the letterheading relates to the folded letter.

Given the complete correspondence between the participants' selections and those anticipated for the feature *artefact simulation*, it was slightly surprising that this correspondence was not repeated in the selections made for the function *simulation of experience*, since the two are directly related.

However, all the responses combine to suggest strongly that the tactile, and indeed temporal, experience of documents is intricately entwined with the visual experience. Consequently the document designer needs to be able to engage during the design process with materials like those from which the document will finally exist, in order to gain the necessary feedback to make design decisions concerning the physical aspects of the document. Since the visual and physical dimensions are so entwined, it becomes clear how the continuum-of-activity is so well supported through the continuity-of-medium, and explains why even designers who are fluent users of electronic systems nevertheless make paper mock-ups of the document under design.

5.5 Concluding discussion

The evaluation study was designed to give practising typographers the opportunity to respond to the initial characterisation of sketching. The results of the study reveal interesting issues about the participants and the characterisation. These themes are considered in the following subsections.

5.5.1 Participants' need to interpret sketches

A recurring theme in the participants' commentary was their desire to identify exactly what the sketches represented. Sometimes they expressed

a measure of confidence in guessing. For example, in making his selection of A3 for the question about scale, Luke looked at sheets A3 and A1, saying:

> Are these related sheets? Presumably the same job, is it?

At other times the participants seemed more uncertain about the sketches' content, and implied that without such certain knowledge they could not make informed selections. Several times they made statements such as:

> It's hard when you don't know what the sketch is about.
>
> I can see there are two different things going on here but I can't see how they relate to one another.

The participants appeared to need to interpret the sketches in order to make sense of the questions they were being asked. Although they sometimes expressed uncertainty about their ability to interpret other designers' sketches accurately, they nevertheless often did interpret successfully, and sometimes in subtle ways. This is a demonstration of the visual interpretation skills that designers possess, referred to in section 5.3.

5.5.2 Areas of agreement with the characterisation

The participants' responses, both their selections of sketches and their commentary, demonstrated that, by and large, they easily and accurately understood all the functions and almost all the features. The features *scale*, *lack of closure*, *spatial relationships as a dominant theme*, *detail and precision of typeface attributes*, *multiple sketches*, *mixture of visible languages* and *artefact simulation*, and the functions *focus*, *provisionality*, *switching*, and *simulation of experience* were grasped correctly and agreed with. Although the participants sometimes made unexpected selections, these were more often inventive rather than mistaken.

By using the terms for the features and functions, which had been introduced in the early stages of the interviews, during discussions later in the interviews the participants indirectly endorsed those terms and the concepts they encapsulate.

5.5.3 Areas of disagreement with the characterisation

Only the features *lack of closure*, *degrees of detail* and *levels of precision* caused confusion. *Lack of closure* was misinterpreted by one participant, who confused lack of closure of idea with lack of closure of sketch, which are not necessarily synonymous. This is explained further in Chapter 6, subsection 6.2.3. This feature was easily and accurately understood by the other participants. The features *degree of detail* and *levels of precision* were unclear for the first two participants, who found it difficult to distinguish between them. Their confusion seemed to derive from lack of clarity in the phrasing of their questions concerning these features. This confusion was not present in the responses of the last two participants, for whom these questions were rephrased.

Only the two functions *record keeping* and *comparison* were disagreed with, and then on the basis of intention, not existence. They were, though, correctly understood.

5.5.4 Additional observations made by the participants

Two of the participants mentioned colour as an issue they work with and have to resolve in design. Greg observed that it could be included in the characterisation as an aspect of detail or precision. Luke talked about the

enjoyment he derives from his work, and how that is an important aspect of it for him. This important but intangible aspect of sketching is acknowledged and mentioned again at the end of Chapter 8.

5.5.5 Overall assessment of the initial characterisation

The majority of the selections made were appropriate, and many matched those predicted. Conversely, very few selections were completely inappropriate. Thus, much of the characterisation was validated. The few selections that were inappropriate gave insights which were valuable in revising the characterisation. Several selections were inventive and unpredicted. These selections, together with those gauged less obvious and therefore predicted less likely to be selected, indicate that the participants possessed a more sophisticated understanding of the concepts, enabling them to make subtler selections. The occasions on which the participants declined to make selections from their own material, because they perceived accurately there were no appropriate selections to be made, provide further evidence of their accurate understanding.

5.6 Summary

The results of the evaluation study indicate that much of the initial characterisation was easy for the designers to grasp, and comfortable for them to accept. Only two features seemed to be difficult for the first two participants to understand and distinguish between, and these difficulties were reduced for the last two participants by rephrasing the related questions and presenting alternative sketches. Some disagreement about

two of the functions identified in the characterisation was expressed, although this disagreement concerned intention rather than existence. Two additional aspects of sketching that were not included in the questions in the evaluation study were mentioned by the participants.

The study also demonstrated the participants' highly-developed visual interpretation skills, shown in their sometimes unexpected but nevertheless accurate and often subtle selections.

The findings from the evaluation study contributed to changes being made to the characterisation. The reworked version is set out in Chapter 6 as the refined characterisation.

6 REFINED CHARACTERISATION OF SKETCHING FOR TYPOGRAPHIC DESIGN

Before enlightenment there is much carrying of water;
After enlightenment there is much carrying of water.

Buddhist saying

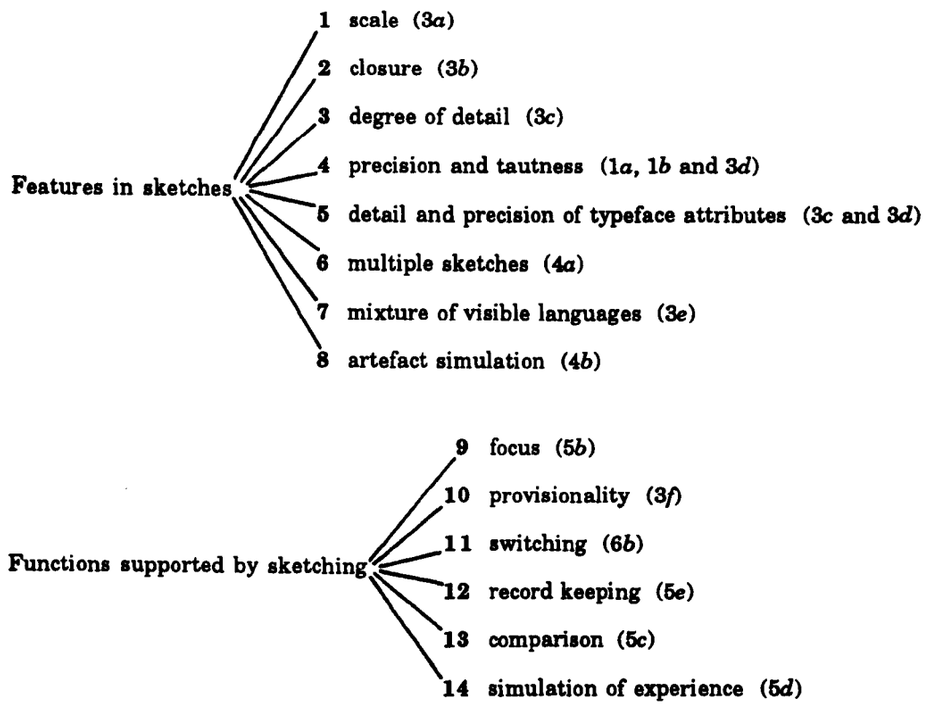
6.1 Introduction

The results of the evaluation study indicated that parts of the initial characterisation were difficult for the designers to comprehend. As observed in the summary of Chapter 5, these difficulties seemed to arise from the lack of clarity in the terms used, more than from the concepts the terms represented. There were also a few instances in which the designers explicitly stated disagreement with the initial characterisation. In acknowledgement of these results, and in recognition of the shortcomings of the first characterisation, the characterisation was reworked.

The refined characterisation, described in this chapter, is an expanded and reorganised version of the initial one. It incorporates a category providing more detail about the visual characteristics of marks, presenting that as the atomic level of sketches. The original 'features of sketches' category has been split into two, to distinguish between the features of individual sketches and those of sheets of sketches. There are two other new categories, describing the functionality required to support sketching and the capacities of the paper and pencil medium, and the contents of the pre-existing categories from the initial characterisation have been reorganised. Figure 6.1 shows the comparison between the characterisations.

a Initial characterisation of sketching

(*numbers in parentheses refer to category and sub-category in refined characterisation*)



b Refined characterisation of sketching

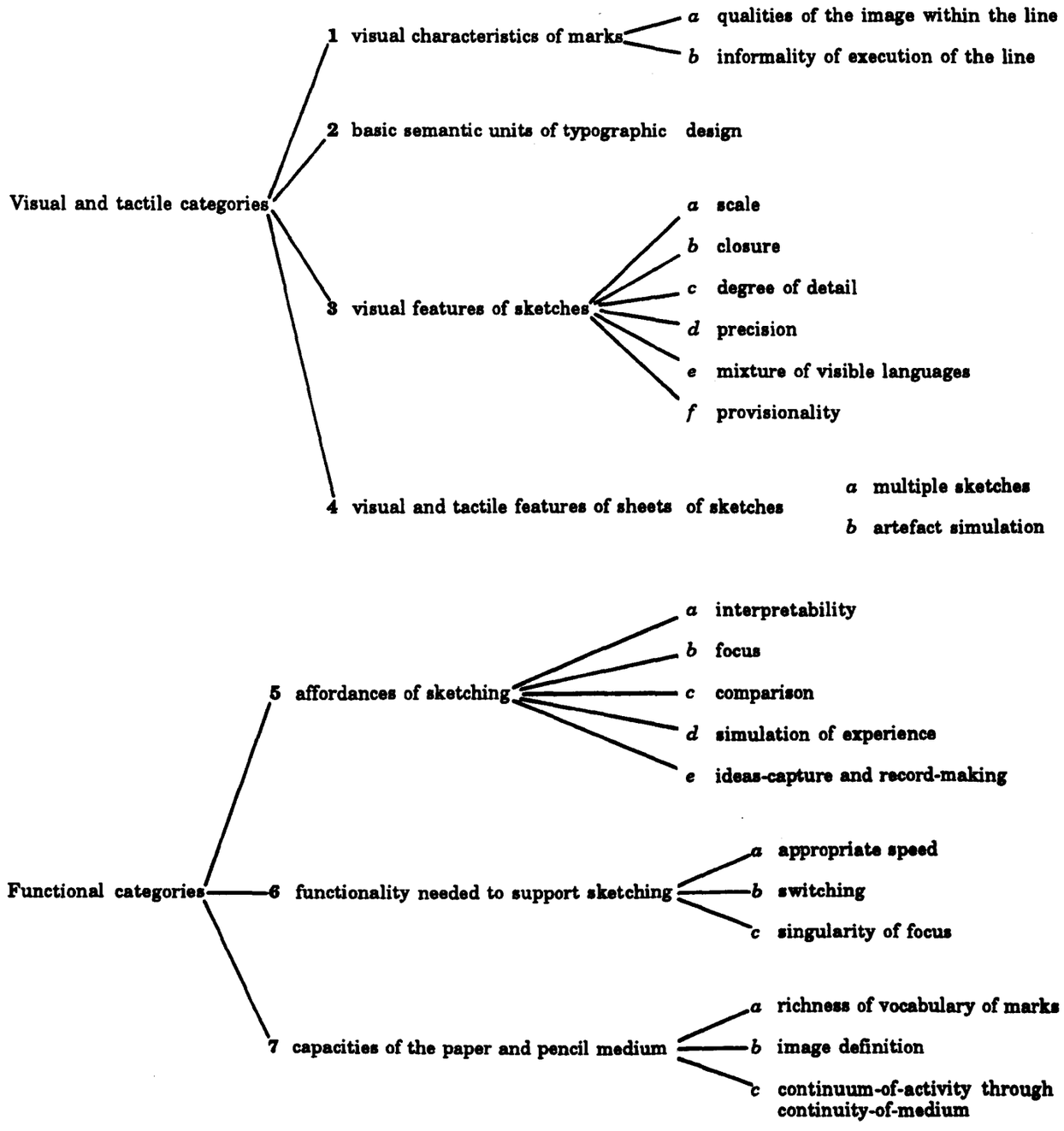


Figure 6.1 Comparison of initial and refined characterisations of sketching

a Initial characterisation, delineating eight *features* and six *functions* (Chapter 4), and including the *glossary of images* (Appendix 1).

b Refined characterisation, showing the development of both the categories and sub-categories, and the vocabulary used to describe them.

The *glossary of images* in the initial characterisation becomes category 2, *basic semantic units*, in the refined characterisation. This category enables the characterisation to be customised for specific design disciplines, through substituting the units of one discipline (such as typographic design, as here) for those of another, such as architecture or engineering design. See section 6.3 for more details.

6.2 The framework of the characterisation

The refined characterisation comprises a framework of seven categories, each of which is further divided into sub-categories or strands. The seven categories are as follows.

Visual and tactile categories

1 Visual characteristics of marks

2 Basic semantic units of typographic design

3 Visual features of individual sketches

4 Visual and tactile features of sheets of sketches

Functional categories

5 Affordances of sketching

6 Functionality required to support sketching

7 Capacities of the paper and pencil medium

The first four categories delineate in detail the visual dimensions found in sketches; the fifth enumerates and describes the design functions that sketching supports, largely through the visual qualities of the sketches; the sixth category addresses the functionality necessary to facilitate sketching; and the seventh describes the functional capacities the paper and pencil medium possesses, which enable it to support sketching.

Unlike the other six categories, which generalise across sketching in all design domains, the second category is domain specific. Hence, the semantic units noted here relate to typographic design. These units could be substituted by the appropriate units used in other design domains, such as

engineering or architecture, to customise the characterisation for those domains. This is discussed in greater detail in section 6.3.

Each of the seven categories is described in detail below and illustrated with material taken from the sketches collected from studies 2, 3 and 4.

6.2.1 Visual characteristics of marks

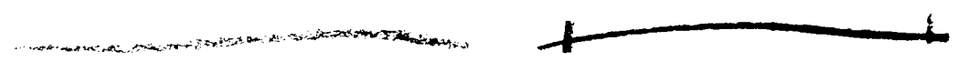
The visual characteristics of the marks form the basic dimension of sketches, constituting the essential 'sketchiness' of sketches. The qualities in the appearance of the lines combine to account for the lines', and hence the sketches', informality. The visual characteristics of the marks are divided into two sub-categories: the qualities of the image within the line itself, and the informality of the execution of the lines. These two sub-categories have several strands each, listed below:

- qualities of the image within the line, comprising:

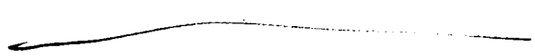
  (a) graininess within the line

  (b) smooth gradation in the width of the line

  (c) smooth gradation in the darkness of the line

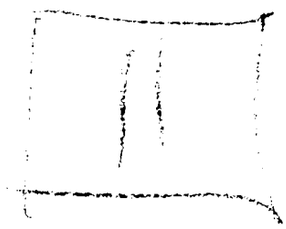
  (d) smooth gradation in the ending of a line

  (e) smooth curvature of intentionally curved lines.

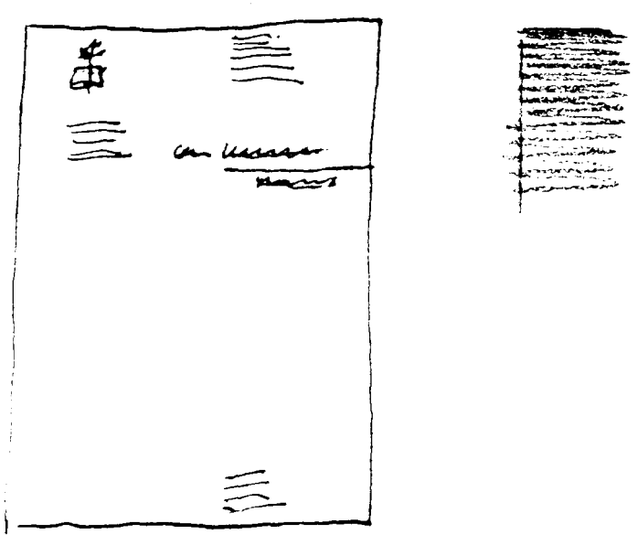
- informality of the execution of the lines, manifested in, for example:

  (f) curvature of notionally straight lines



  (g) lines intended to form 'corners' not meeting, or overshooting

  (h) notionally parallel lines lacking parallelism, and sometimes being joined as a zig-zag.



The visual characteristics of the marks are a direct consequence of the interaction between the nature of the mark-making tool(s) and the physical qualities of the surface of the substrate onto which the marks are made. Soft pencil on rough-textured paper, for example, produces grainier lines than harder pencil on smoother paper. Lines drawn with a felt tip pen have

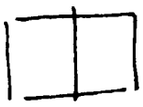
fewer dimensions in the sub-category *qualities of the image within the line* — for example, such lines tend to have a uniformity of width and darkness, and no graininess, in contrast to lines drawn with pencil. The designer's choice of both mark-making tools and substrate may be made explicitly with a particular visual effect in mind.

6.2.2 Basic semantic units of typographic design

To borrow and apply rather loosely terms from linguistics, there are basic semantic units of typographic design, which form a language common across typographic designers. The units represent the typical elements of a typographic design (columns of text, headings, illustrations), and they act as a shorthand, allowing the designer to manipulate, with low expenditure of effort, different ideas and variations on designs. The list of the semantic units presented overleaf is not exhaustive, but is intended as a preliminary guide to reading the sketches.

The units are grouped loosely according to the typographic or graphic element they represent: the whole page, a double page spread, a column of text, a single line of text, and illustrations.


represents one page or one sheet


represents a double page spread


represents a column of text


represents two adjacent columns of text


represents a column of text


represents a column of text


represents a column of text


represents a column of text

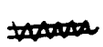

represents a column of text

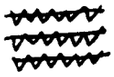

represents a column of text

represents a single line of text


represents a single line of text


represents a single line of text


represents a single line of text


represents several lines of text

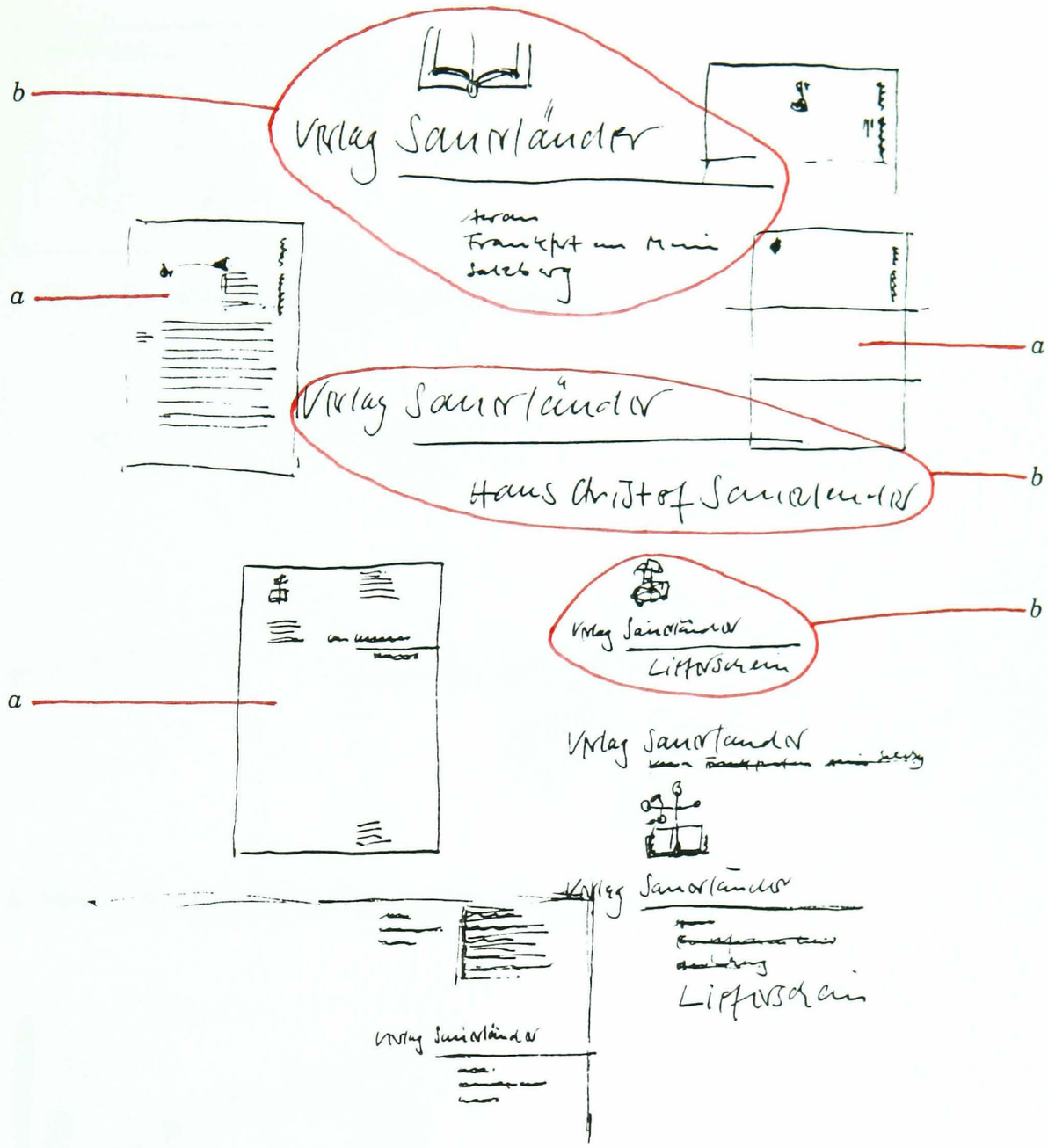

represents an illustration


represents an illustration

6.2.3 Visual features of individual sketches

The features are the next level up from the basic semantic units of typographic design, which in turn are the level up from the visual characteristics of the marks. Since all the sketches are made of marks whose visual qualities are those detailed above, by definition the features to be found in sketches are composed of marks with those visual qualities, and contain the basic semantic units. The features are:

- Scale — sketches are made at different scales. Those representing views of the whole design or complete unit of a design (such as a double page spread) may be at small scale (familiarly known as thumbnail sketches). Those representing a detail may be made at intended lifesize, or occasionally larger. Sketches made at different scales may be found on the same sheet (figure 6.2).
- Closure — the representation in a sketch may not be complete. There may be lack of closure of an element within the frame of the document under design (figure 6.3*a*), or of the frame itself (figure 6.3*b*), or both (figure 6.3*c*). Closure and lack of closure may be found in the same sketch. Lack of closure does not necessarily imply lack of resolution of the design idea. If a piece of a design is worked on in detail, it may be sketched with no indication of its relationship to the context of the whole design (figure 6.4*a*). Alternatively, the sketch of a part of a design may include enough depiction of the whole to indicate the part's position within the context of the whole design (figure 6.4*b*). Such a sketch actually implies quite strongly that the totality of the design is being considered even while the emphasis is on resolving the detail of the part taken out of context. Lack of closure can be a useful device to aid focus.



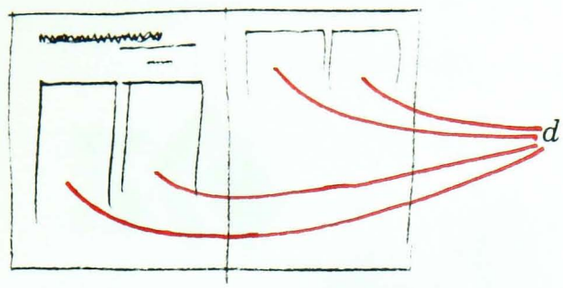
Sheet Cb5. Reduced to 64 percent of original size.

Figure 6.2 Scale

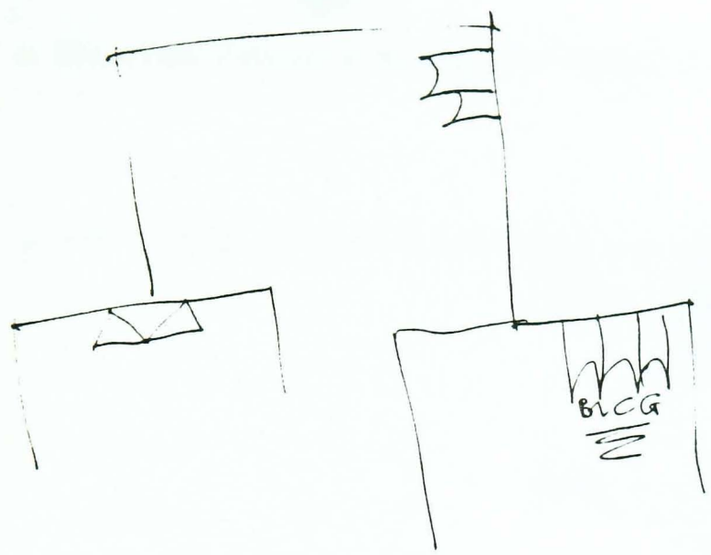
Sketches at different scales on the same sheet:

a Smallscale, overall views of the whole design.

b Larger scale views of parts of the design.



a Sheet B1. Reduced to 64 percent of original size.



b Sheet Gb4. Reduced to 64 percent of original size.

c Sheet H2. Reduced to 64 percent of original size.

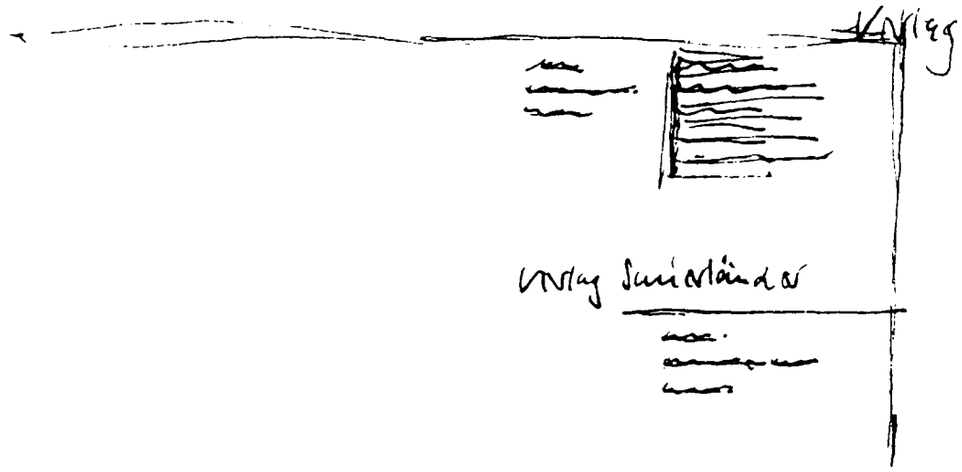
Figure 6.3 Closure

a Lack of closure of individual elements (representation of columns of text), *d*.

b Lack of closure of the document's frame.

c Lack of closure of both an element (an illustration), *e*, and of the document's frame.

a Sheet Gb6. Reduced to 64 percent of original size



b Sheet Cb5. Original size.

Figure 6.4 Closure

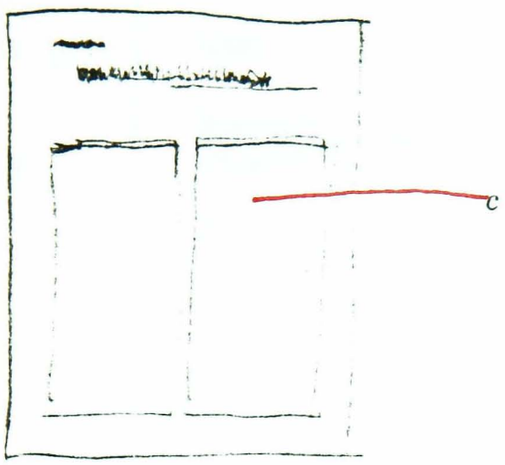
a Parts of a design with no indication of the context of the whole design.

b Part of a design including an indication of the final context (top right hand corner of a letterhead).

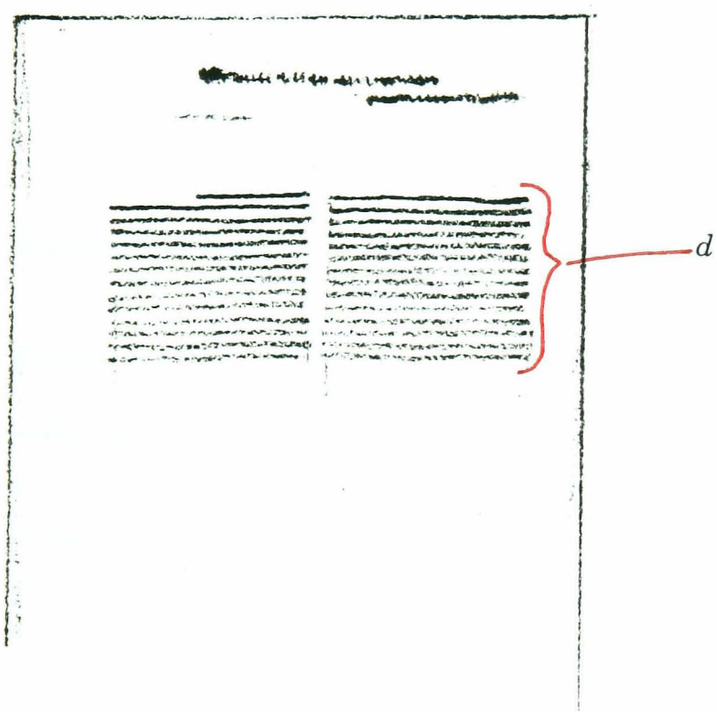
Of course, a sketch may be abandoned in mid-execution for many reasons, so it is unwise to assume that every instance of lack of closure is a consequence of deliberate emphasis on a part of the design. However, the medium lends itself to working on an uncompleted sketch, which is valuable when a part of the design is the focus of attention, and the sketches collected suggest that this capacity is frequently exploited.

- Degree of detail — sketches are made in shorthand, which does not include complete detail of the representation of the design solution. Sketches show design solutions at varying degrees of detail. For example, a rough rectangle used to represent a column of text (figure 6.5*a*) shows less detail than a series of parallel horizontal lines of the same length as each other (figure 6.5*b*). Such lines are a closer visual representation of the rows of characters that will appear on the final printed page. Different parts of the same sketch may contain different amounts of detail, both in the representation of major elements, such as columns of text, and at the micro-level of representing particular typeface attributes of individual characters (figure 6.6).

- Precision — precision is measured in terms of closeness of the sketch to the appearance of the anticipated printed artefact. Precision therefore incorporates formality and tautness of the lines in the sketch. The more informal the execution of the lines, the lower the precision of rendering (figure 6.7*a*): conversely, the more formal the execution, the higher the precision (figure 6.7*b*). A high level of precision automatically implies a high degree of detail, although the two strands of detail and precision are somewhat independent of one another, since much detail may be conveyed even at a low level of precision (figure 6.7*c*).



a Sheet B1. Original size.

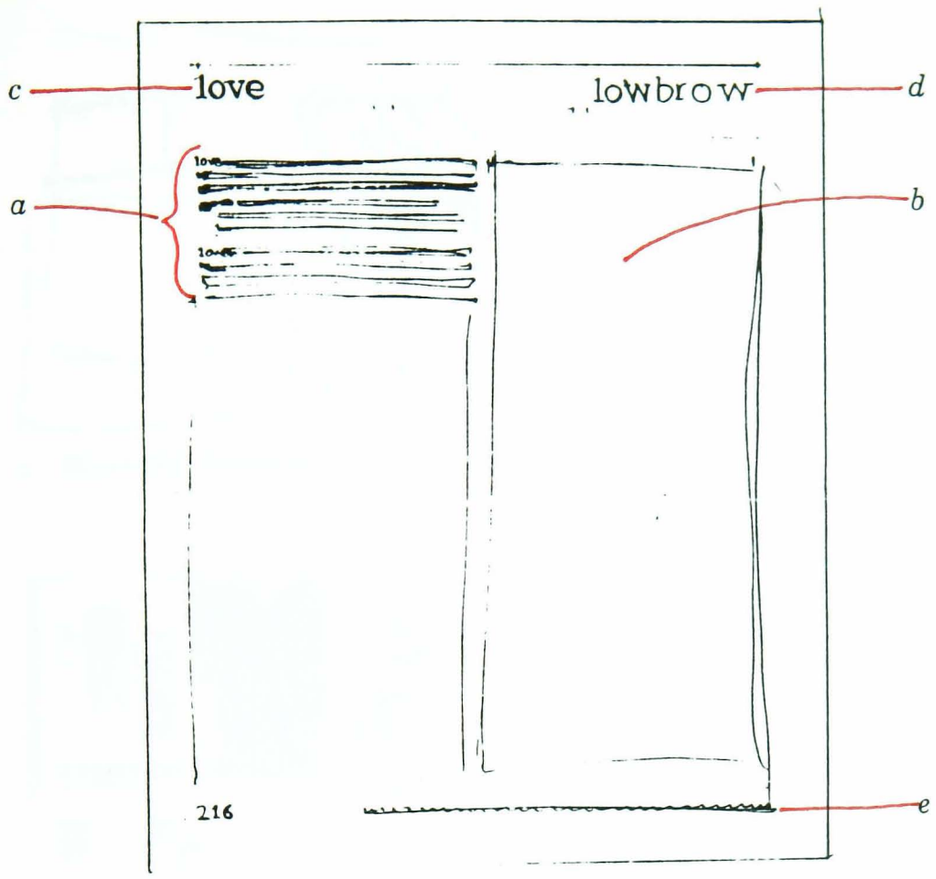


b Sheet B2. Original size.

Figure 6.5 Degree of detail

a Rough rectangles, *c*, to represent columns of text, indicate less detail about the appearance of the final document than a representation like *b*.

b A series of parallel horizontal lines of similar length, *d*, to represent columns of text, shows more detail about the appearance of the final document than a representation like *a*.



Sheet Dg1. Reduced to 41 percent of original size.

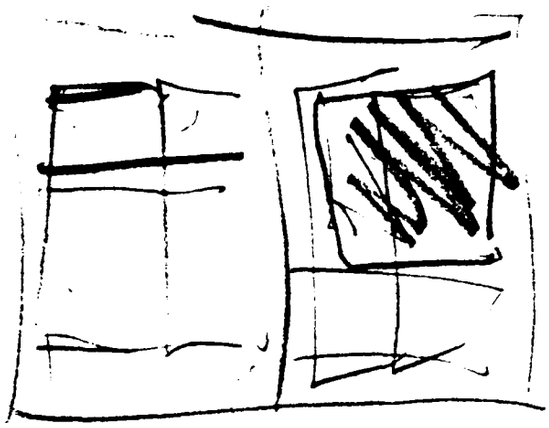
Figure 6.6 Degree of detail

Different parts of the same sketch containing different amounts of detail:

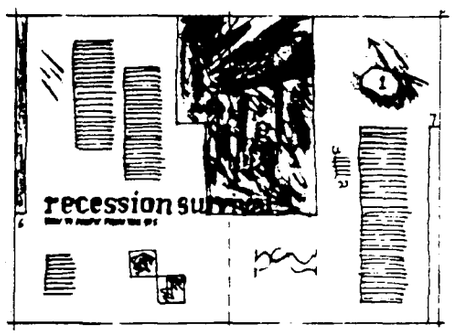
a More detail in representing a column of text than *b*.

c More detail in representing the particular typeface attributes than *d*.

e Less detail in representing a row of characters than *c* and *d*.



a Sheet A2. Reduced to 64 percent of original size.



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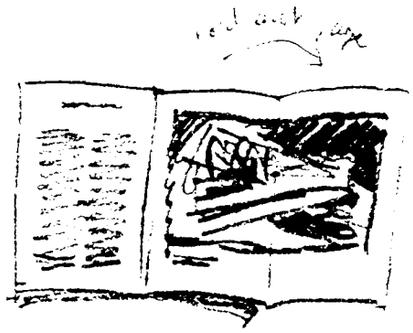


c Sheet B3. Reduced to 64 percent of original size.

Figure 6.7 Precision

a Sketch at low level of precision of rendering, showing little detail.

b Sketch at high level of precision of rendering, showing much detail.

c Sketch at low level of precision of rendering, nevertheless showing much detail.

- Mixture of visible languages — graphic imagery is the dominant visible language in typographic design sketches, but the graphic imagery is amplified by other languages, annotating the sketches. These include alphanumeric characters and symbols used in annotation (figure 6.8) and calculation (figure 6.9*a* and *b*). Visible languages appear in combination in sketches.

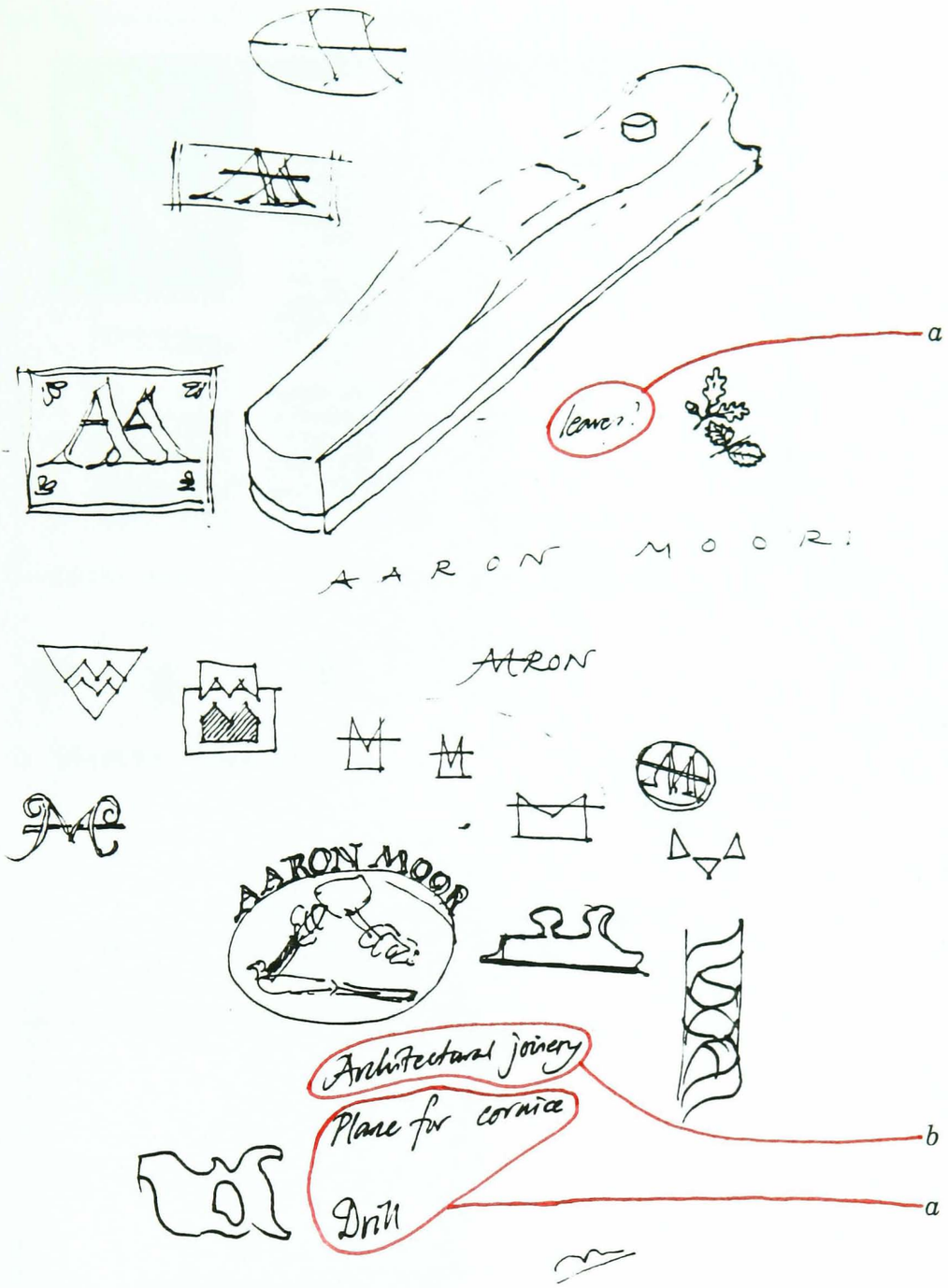
The visual characteristics of the marks and some features of the sketches combine to form the dimension *provisionality*. This can be thought of as a compound feature, since it is a composite of several features.

- Provisionality — the visual quality of the sketch that conveys an air of transience and mutability. This quality resides in the roughness and informality of the marks, combined with lack of closure, low degree of detail and low level of precision of rendering. The provisionality of the sketch reflects the fluidity of the idea it captures and, in representing it, enables the designer to contemplate the idea without making possibly premature commitment to it. Figure 6.10 shows an example of highly provisional sketches.

6.2.4 Visual and tactile features of sheets of sketches

These features relate to whole sheets of sketches rather than individual sketches.

- Multiple sketches — one sheet may contain several sketches. These may differ from one another in their formality of marks and in the combination of features they contain. The same sheet may, for example,



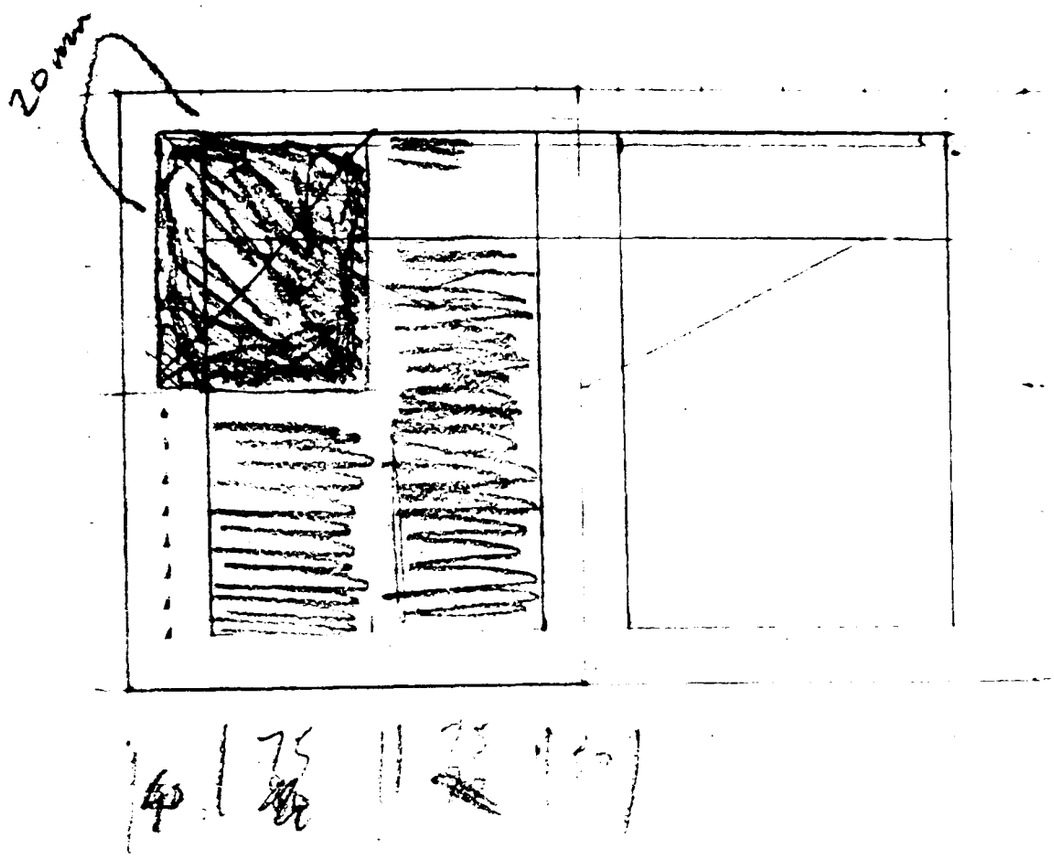
Sheet Ga1. Reduced to 64 percent of original size.

Figure 6.8 Mixture of visible languages

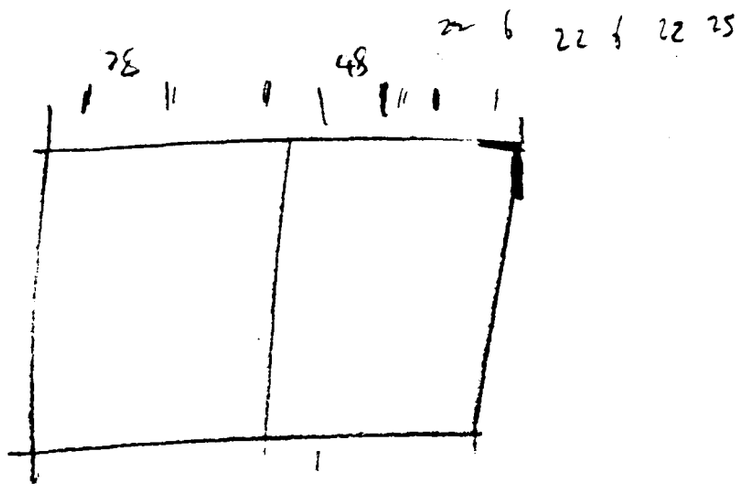
Sheet of sketches incorporating graphic imagery and written annotations:

a Note of design ideas.

b Memo about the subject matter of the design.



a Sheet B2. Original size.



b Sheet B3. Original size.

Figure 6.9 Mixture of visible languages

Sketches incorporating written calculations.

Sheet A1. Reduced to 64 percent of original size.

Figure 6.10 Provisionality

Highly provisional sketches.

contain several sketches rendered at different levels of precision, and some may lack closure, while others are more complete (figure 6.11).

- Artefact simulation — the sheet may be folded, torn, cut, glued, stapled, superimposed on another sheet, etcetera, to create a 3-dimensional simulation of the document under design.

The features found in the sketches and in the sheets of sketches operate in combination to support the functions of sketching listed below.

6.2.5 Affordances of sketching

The visual characteristics of the marks and the features operate in combination to provide the affordances listed below:

- Interpretability — the visual quality of a sketch provides it with an ambiguity that enables the sketch to represent ideas whose details are not absolute. The ambiguity gives the sketch margins of interpretation or *interpretation tolerances*. These derive from the sketch's provisionality, such that it is susceptible to a range of interpretations. For example, an empty rectangle representing a column of text leaves open to interpretation whether the text is intended to be justified or set ragged right (figure 6.12*a*). A rough zig-zag whose lines represent rows of characters is open to similar interpretation, whereas notionally parallel lines drawn with more deliberation whose ends align with one another, or not, convey more definition about the justification of the line endings (figure 6.12*b*). The higher the degree of detail and the greater the level of precision of rendering, the narrower the interpretation tolerances.

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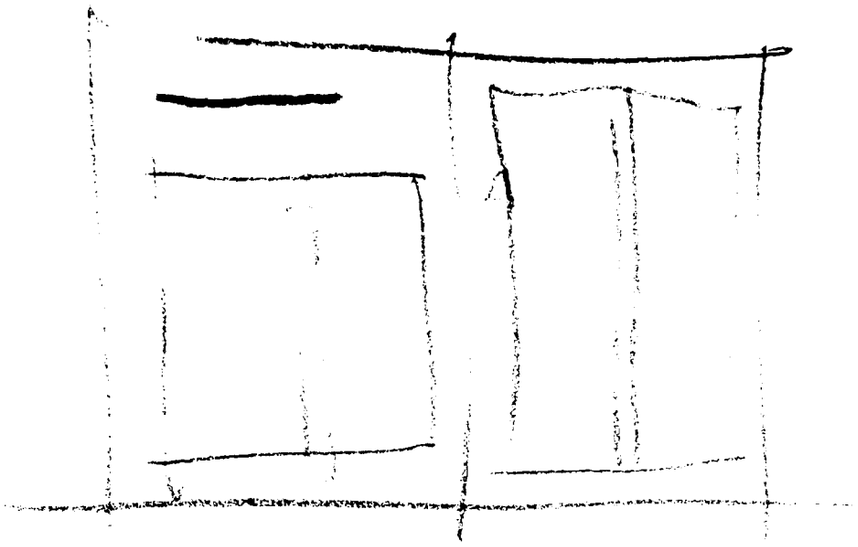
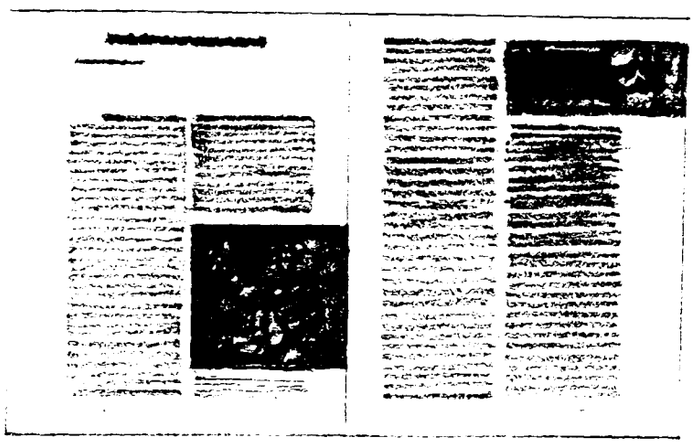
Figure 6.11 Multiple sketches

Sheet containing multiple sketches at different levels of precision, different degrees of detail, and some lacking closure.



a Sheet A1. Original size.



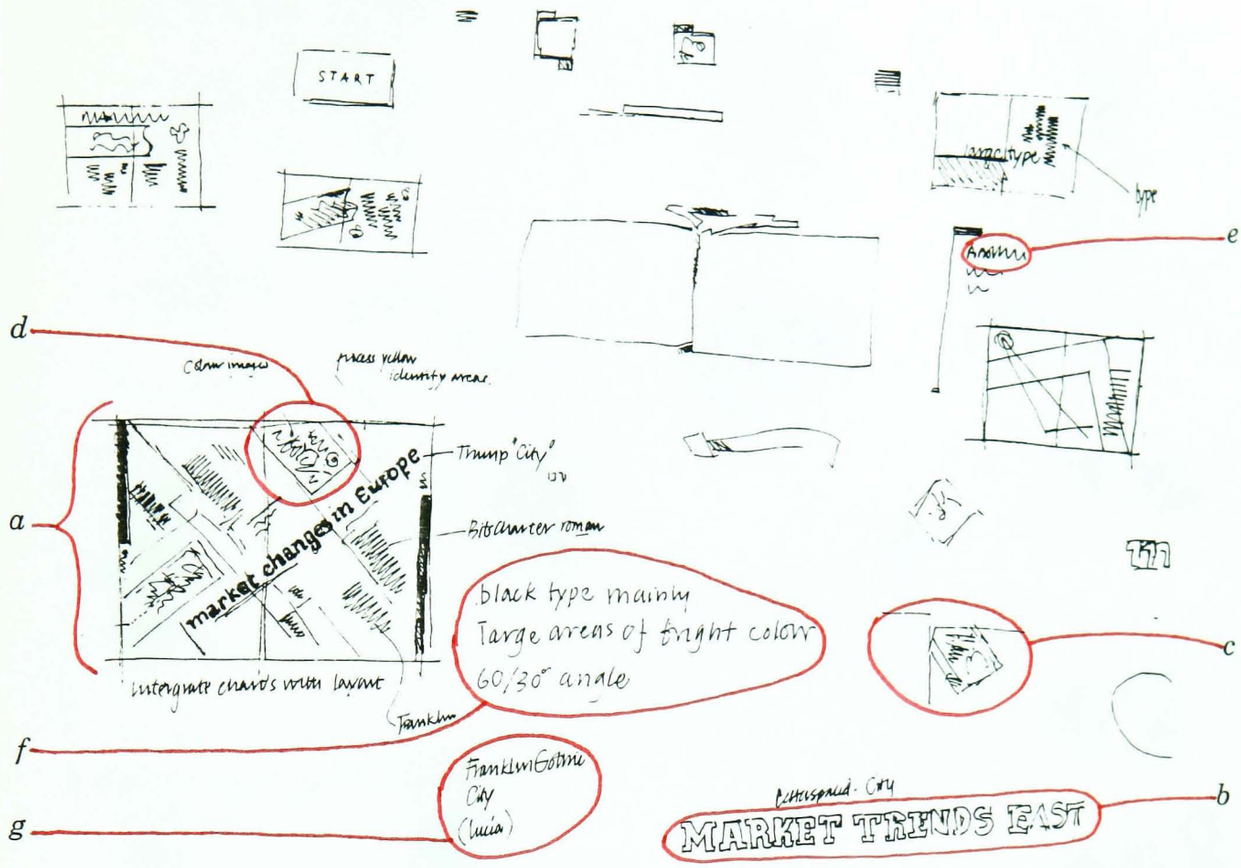
b Sheet B4. Original size.

Figure 6.12 Interpretability

a Sketch with wide interpretation tolerances:
no detail conveyed about the justification of the text columns, and the exact margins are open to interpretation, through a low level of precision of the rendering.

b Sketch with much narrower interpretation tolerances:
high degree of detail shown about the proposed layout, through a high level of precision of rendering.

- Focus — the four features, different scales, lack of closure, different degrees of detail and different visible languages, combine to enable the designer to focus attention on the whole or part of the design, as she chooses. Parts of the design may be worked on out of context, either bounded by a frame lacking closure, indicating the position of the part within the design as a whole, or without a frame at all, and to whatever degree of detail and precision is valuable to the designer at the time her attention is focused on that detail. The alphanumeric annotations allow the designer to pay attention to aspects of the design ideas that are more easily considered in that form than through graphic imagery. Examples of this kind of focus include calculations about dimensions and written notes about possible typefaces (figure 6.13).
- Comparison — multiple sketches on the same sheet in close proximity enable easy visual comparison between sketches and hence the ideas they embody. The designer may not engage in comparison consciously but the proximity of the sketches in the main field of view inevitably results in visual stimulus, which may work at a subconscious level (figure 6.14).
- Simulation of experience — the artefact simulation enables the designer to have the end user's experience of the 3-dimensional characteristics of the design under consideration. Documents are 3-dimensional tactile and physical objects, which must both be realisable in the actual world, and function in the actual world. The artefact simulation enables the designer to experience the weight of the book, for example, and the way the pages lie when the book is open, or where the fold in a letterhead sheet occurs in relation to the letterhead itself, or the way an image



Sheet H3. Reduced to 64 percent of original size.

Figure 6.13 Focus

Focus on different aspects of the design through use of different scales, lack of closure, different degrees of detail and a mixture of different visible languages:

a, *b* Focus on the whole design and a part of the design through different scales.

b Focus on the detail of typeface attributes: compare with *e*.

c Focus on a part through lack of closure, see *d* for full context.

f, *g* Focus on possible design options, including typefaces, through written annotations, a complementary visible language to the predominant graphic imagery.

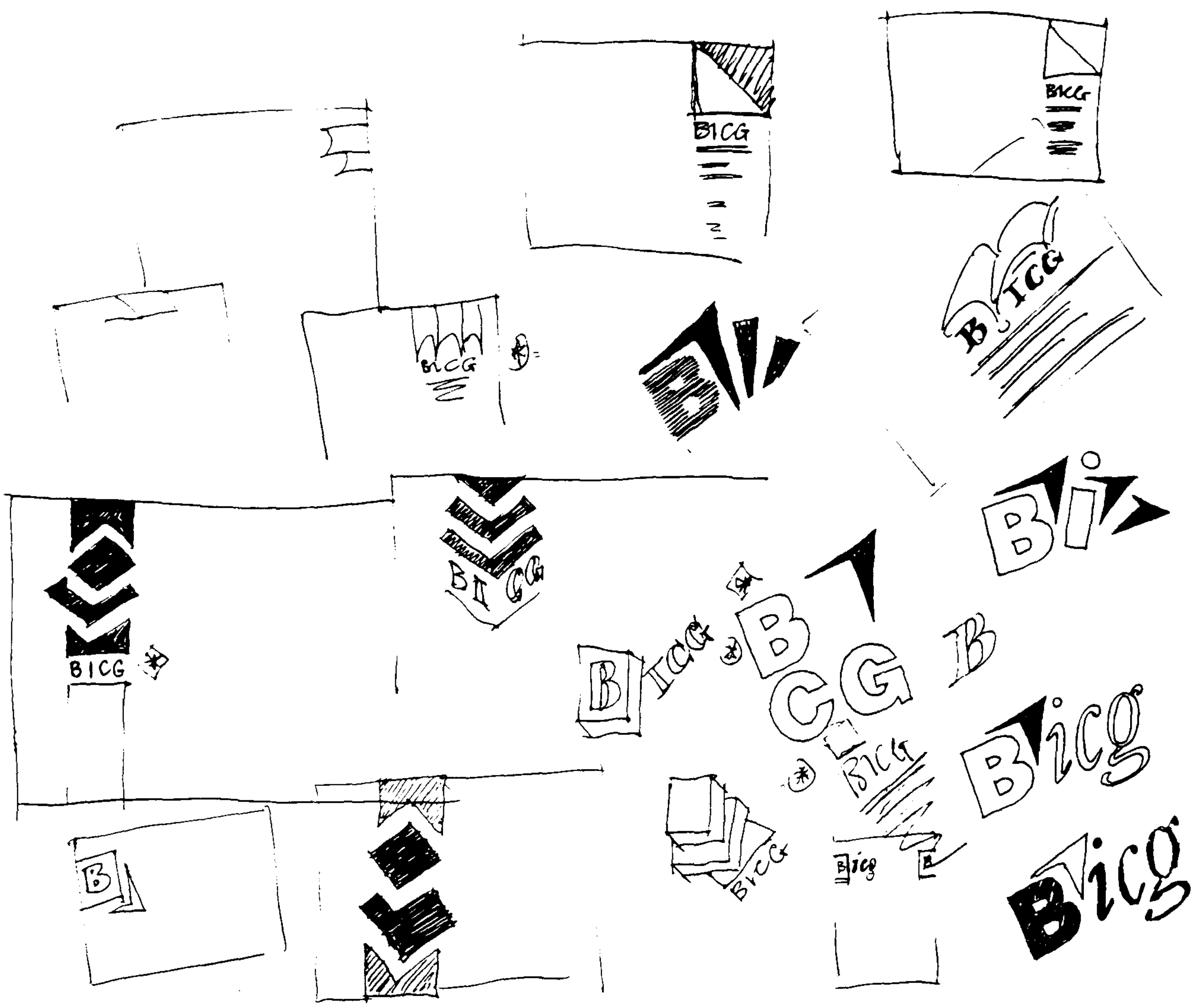


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Figure 6.14 Comparison

Multiple sketches in close proximity on the same sheet, showing variations on a theme, enable easy visual comparison between the ideas the sketches embody.

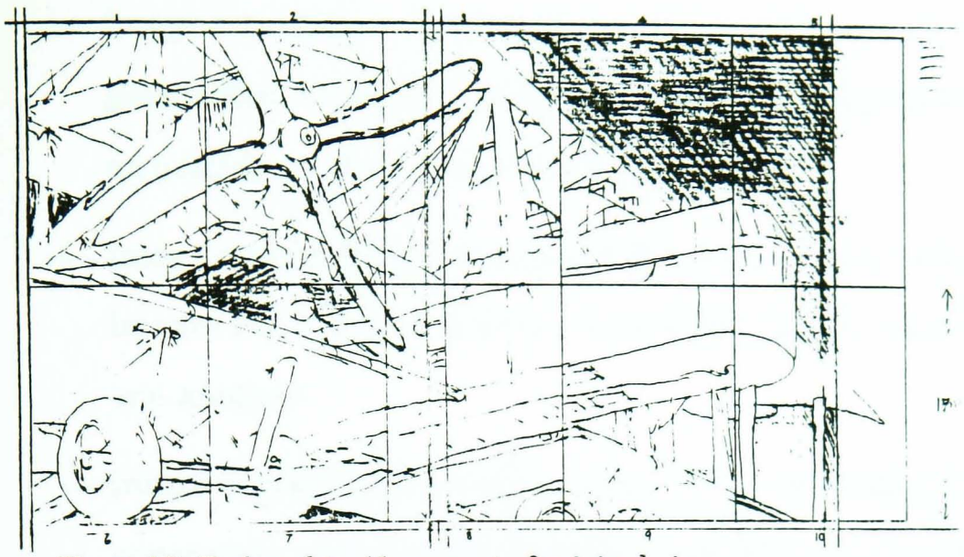
works when it is spread around the three faces of a book jacket. These phenomena cannot be derived from simply looking at a flat image (figure 6.15*a* and *b*).

- Ideas capture and record making — a sketch is an automatic record of itself, and hence of the idea it embodies. In the early stages of designing, fast capture of fleeting ideas is essential. Record making that is simultaneous with image generation is ideal, since it leaves the designer free to concentrate on generating ideas, and removes the twin burdens of remembering the ideas, and engaging in separate, explicit actions to preserve the sketches. In the artefact simulation part of the design activity, the folded, torn, glued or stapled sheet is an embodied record, and, on being handled again by the designer, the simulation acts as a kinaesthetic as well as visual reminder of the physical manipulations tried.

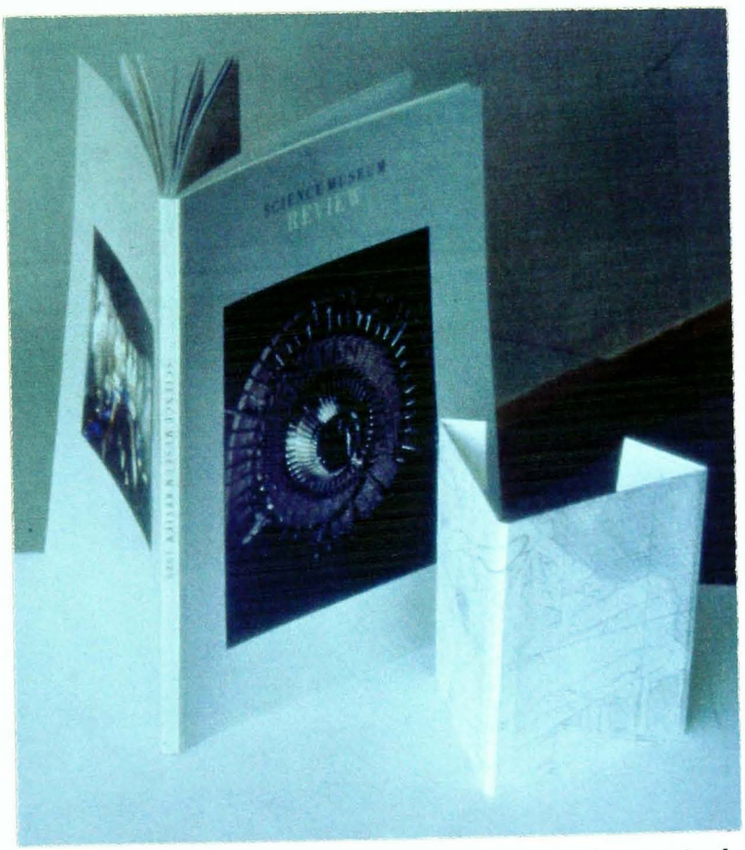
6.2.6 Functionality required to support sketching

The four categories outlined above describe the visual and tactile dimensions of sketches and sketching, and the functions those dimensions support. In addition, there are other strands of functionality necessary to support sketching. These strands are:

- Speed — not always *high* speed, but *appropriate* speed of:
  - — image generation: this may be very fast, which is valuable for capturing ideas or it may be slower, which is valuable when the designer is mulling over an idea.



a Sheet A5. Reduced to 41 percent of original size.



b Photograph of sheet A5 folded as a mock-up of a book jacket.

Figure 6.15 Simulation of experience

A 3-dimensional simulation of the artefact under design conveys tactile and physical behavioural aspects of the design. This simulation of a book jacket gives an idea of how the illustration works spread over the front, back and spine of the jacket. Shown next to a previous review in the same series to give an idea of the scale of the simulation and the final object (*b*).

— image emergence: the images emerge simultaneously with their generation, so there no time lag; the designer sees images appearing as quickly as she generates them.

— image manipulation: the ease of handling paper sheets enables images from different sheets to be placed in new spatial proximity to one another.

— image capture and record-making: this is simultaneous with image generation, and does not require any additional cognitive overhead beyond the act of sketching itself.

— switching: described in a separate subsection below.

- Switching — between degrees of detail (figure 6.16), between levels of precision (figure 6.17), between different scales (figure 6.18), between different visible languages (figure 6.19), between features, between sketches, between parts of sketches, between different sheets, between functions. In the paper and pencil medium all these kinds of switching are quick and easy, and do not require an additional explicit action in order to switch from one activity to another, or to switch between degrees of the same feature.

- Singularity of focus — in using paper and pencil the visual and physical (and hence cognitive) focus is on one surface only at any given moment. In Minneman's terms (Minneman 1991) the surface of activity and the surface of effect (the display) are one and the same. Within that surface the designer is focused visually and physically on the same minute spot (where the mark-making device touches the substrate), closely surrounded by the products of the previous areas of focused sketching activity. This provides visual stimulus on the periphery as well as that

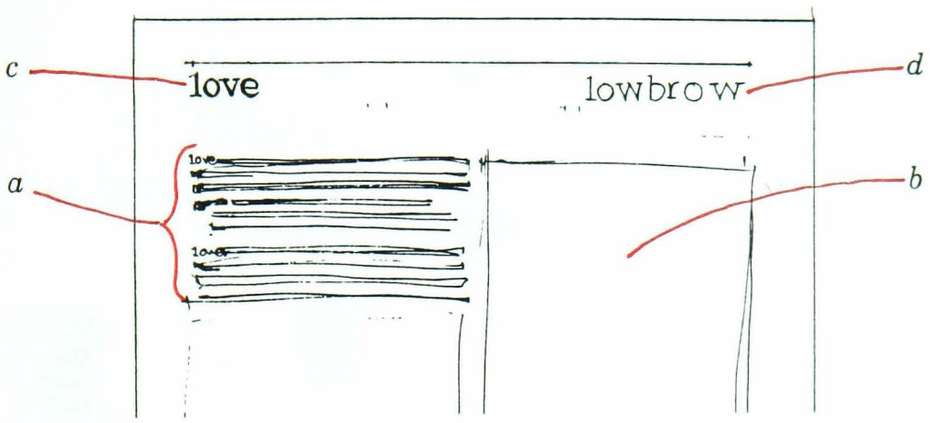


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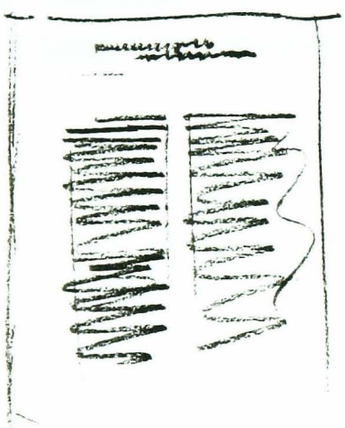
Figure 6.16 Switching

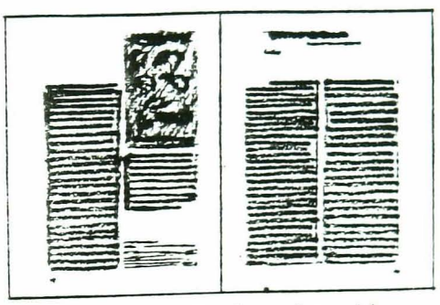
Switching between degrees of detail of representation:

a More detail in representing a column of text than *b*.

c More detail in representing particular typeface attributes than *d*.



a Sheet B4. Reduced to 41 percent of original size.



b Sheet B4. Reduced to 41 percent of original size.

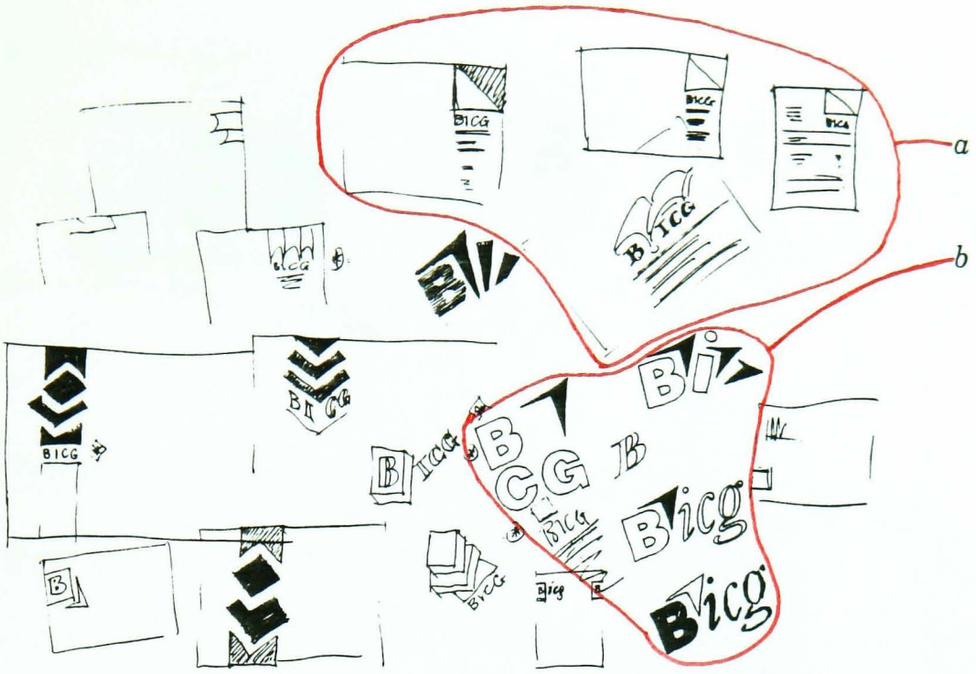
Sketches shown closer together than on original sheet.

Figure 6.17 Switching

Switching between levels of precision of rendering:

a Loose, ambiguous sketch.

b Taut, precise sketch.



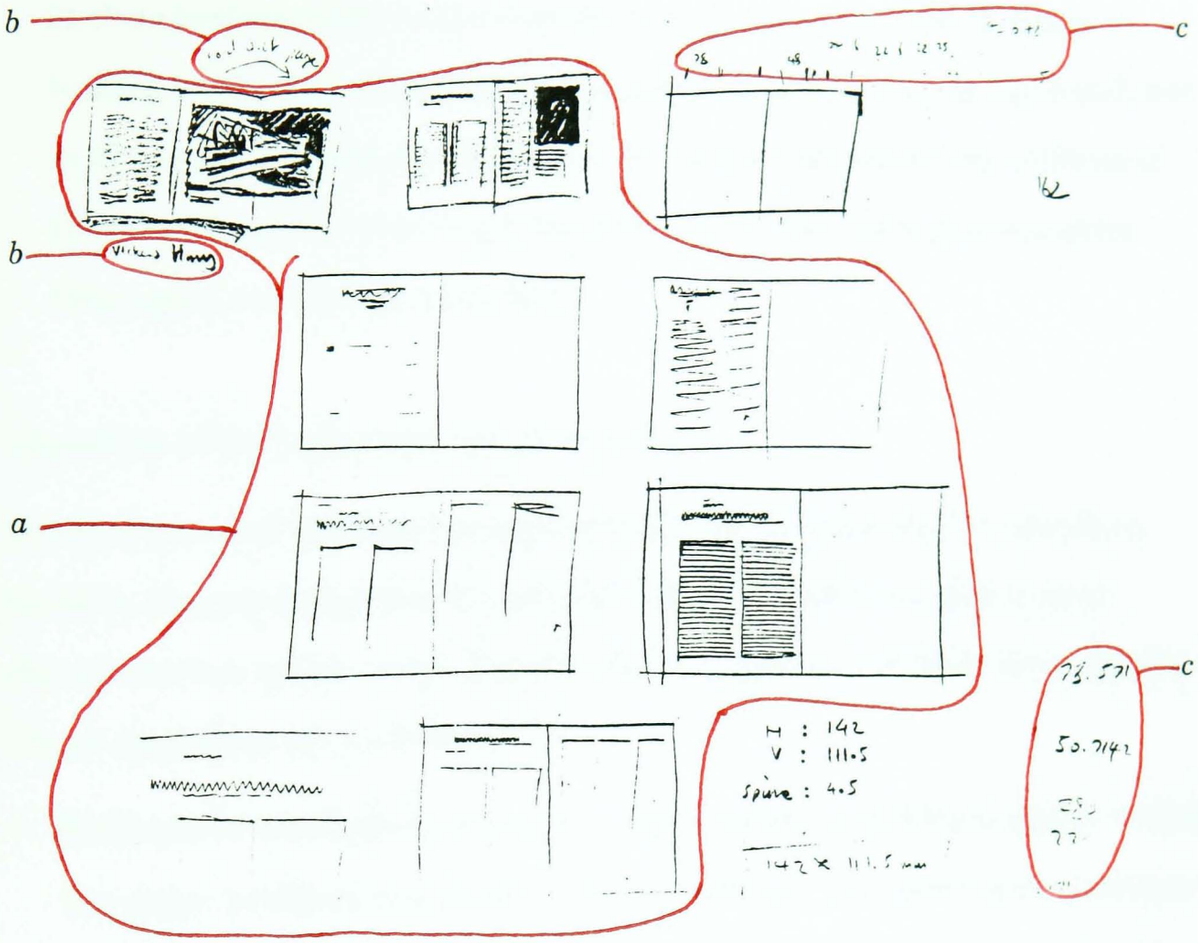
Sheet Gb4. Reduced to 26 percent of original size.

Figure 6.18 Switching

Switching between scales:

a Smallscale, overall views of the whole design.

b Larger scale sketches of parts of the design.



Sheet B3. Reduced to 41 percent of original size.

Figure 6.19 Switching

Switching between different visible languages:

a Graphic imagery.

b Written annotations.

c Calculations.

in close juxtaposition to the current work in progress. The designer is looking at the emerging image, not at the substrate, nor at her hand, nor at the mark-making device, and only becomes aware of any of these if there is a breakdown in their 'handedness', in the Heideggerian sense (Winograd and Flores 1987, 36).

6.2.7 Capacities of the paper and pencil medium

The features and functions described above are those found in sketches made in the paper and pencil medium. This medium possesses certain characteristics which make it particularly supportive of sketching activity. These capacities are as follows:

- Richness of vocabulary of marks — the variety of marks possible within the paper and pencil medium is limited only by the user's motor-sensory skill in manipulating the pencil: the medium is intrinsically capable of images with almost limitless visual variety.
- Image definition — images made in the paper and pencil medium have very high definition, limited only by the granularity of the graphite deposits on the paper, in combination with the surface texture of the paper.
- Continuum-of-activity through continuity-of-medium — the continuum-of-activity is the natural flow between making sketches on paper and physically manipulating the paper to fashion 3-dimensional simulations of the document being designed. Further sketches may be made on the 3-dimensional simulations, and the continuity is possible because the same medium — paper — is used for both 2-dimensional representations and 3-dimensional simulations. As previously observed, artefact

simulation is not strictly a dimension of sketching, but is a natural extension of the activity that sketching enables, namely the making visible of possible design solutions in order to explore and evaluate them.

In addition to the capacities of the paper and pencil medium described above, there is another valuable dimension to this medium for the typographic designer. In typographic design, unlike any other design domain (with the exception of some kinds of graphic design) the medium within which designing takes place is essentially the same as the medium in which the object will finally exist. This closeness aids in the simulation-evaluation activity that is central to designing, since the designer has immediately to hand accurate feedback about the physical qualities of paper, through handling the simulation.

6.3 Applying the characterisation to other design domains

As first mentioned in section 6.2, the refined characterisation may be customised to describe sketching in domains other than typographic design, by replacing the basic semantic units with those of the relevant design domain. To demonstrate this generalisability the following example is taken from the domain of architecture. Figure 6.20 (following page 170) is a reproduction at original size of a typical sheet of sketches produced by a professional architect in the course of designing housing (Carter 1992). Using this example, the checklist overleaf shows which of the strands identified in the refined characterisation (see figure 6.1) can be applied to architectural sketches.

Visual and tactile categories

√	1*a*	qualities of the image within the line (graininess, smooth gradations, etc.)
√	1*b*	informality of execution of the line
√	2	basic semantic units of architectural design
√	3*a*	different scales
√	3*b*	lack of closure
√	3*c*	different degrees of detail
×	3*d*	different levels of precision
√	3*e*	mixture of visible languages
√	3*f*	provisionality
√	4*a*	multiple sketches
×	4*b*	artefact simulation

Functional categories

√	5*a*	interpretability
√	5*b*	focus
√	5*c*	comparison
×	5*d*	simulation of experience
√	5*e*	ideas capture and record making
√	6*a*	appropriate speed
√	6*b*	switching
√	6*c*	singularity of focus
√	7*a*	richness of vocabulary of marks
√	7*b*	image definition
×	7*c*	continuum-of-activity through continuity-of-medium

Examples of basic semantic units of architectural design, some of which may be found in figure 6.20 are as follows:

Perspective views

 represents a window

 represents a window

 represents a window

 represents a door

 represents a door

Aerial views

 represents a toilet

 represents a bath

 represents a staircase

 represents a staircase

 represents direction and extent of a door opening

 represents direction and extent of a door opening

The strands *different scales* (3*a*), *lack of closure* (3*b*), *different degrees of detail* (3*c*), *mixture of visible languages* (3*e*), *focus* (5*b*) and *comparison* (5*c*) are explicitly labelled in figure 6.20. The *visual qualities of the imagery* (1*a*) and the *informality of the execution* (1*b*) are present in all the sketches.

The sketches also all possess the feature of *provisionality* (3*f*). This provisionality endows the sketches with *interpretability*.(5*a*). The sheet contains *multiple sketches* (4*a*), through which the architect has *captured* and hence *recorded* his *ideas* (5*e*). The sketches were made in paper and pencil, which, as described in subsections 6.2.6 and 6.2.7, enables the architect to work at an *appropriate speed* (6*a*), *switch* easily between features and functions (6*b*), *focus* on the design rather than the medium or tool (6*c*), and produce a *rich vocabulary of marks* (7*a*) with *high image definition* (7*b*).

The only strands which are not exemplified in figure 6.20 are *levels of precision* (3*d*), and those which relate to *artefact simulation* and *continuity-of-medium* (4*b*, 5*d*, 7*c*). Architectural sketches are made at different levels of precision, but those on this sheet all happen to be at about the same level of precision. Similarly, 3-dimensional models are made in architecture. However, these models are made of materials other than paper, so the continuity-of-medium is not maintained in this design domain in the same way as it is in typographic design. Hence, no instances of 3*d*, 4*b* or 5*d* are shown here, though these strands are true of architecture, and 7*c* is not exemplified, as it is only applicable to typographic design.

The sheet of sketches shown in figure 6.20 is useful as an example from a different design discipline. Although it is clearly not comprehensively representative of sketches from all other design domains, it demonstrates the plausibility of the claim that the refined characterisation applies to sketching in design domains other than typographic design. Further research in applying the characterisation to other design domains could be

Refined characterisation of sketching for typographic design

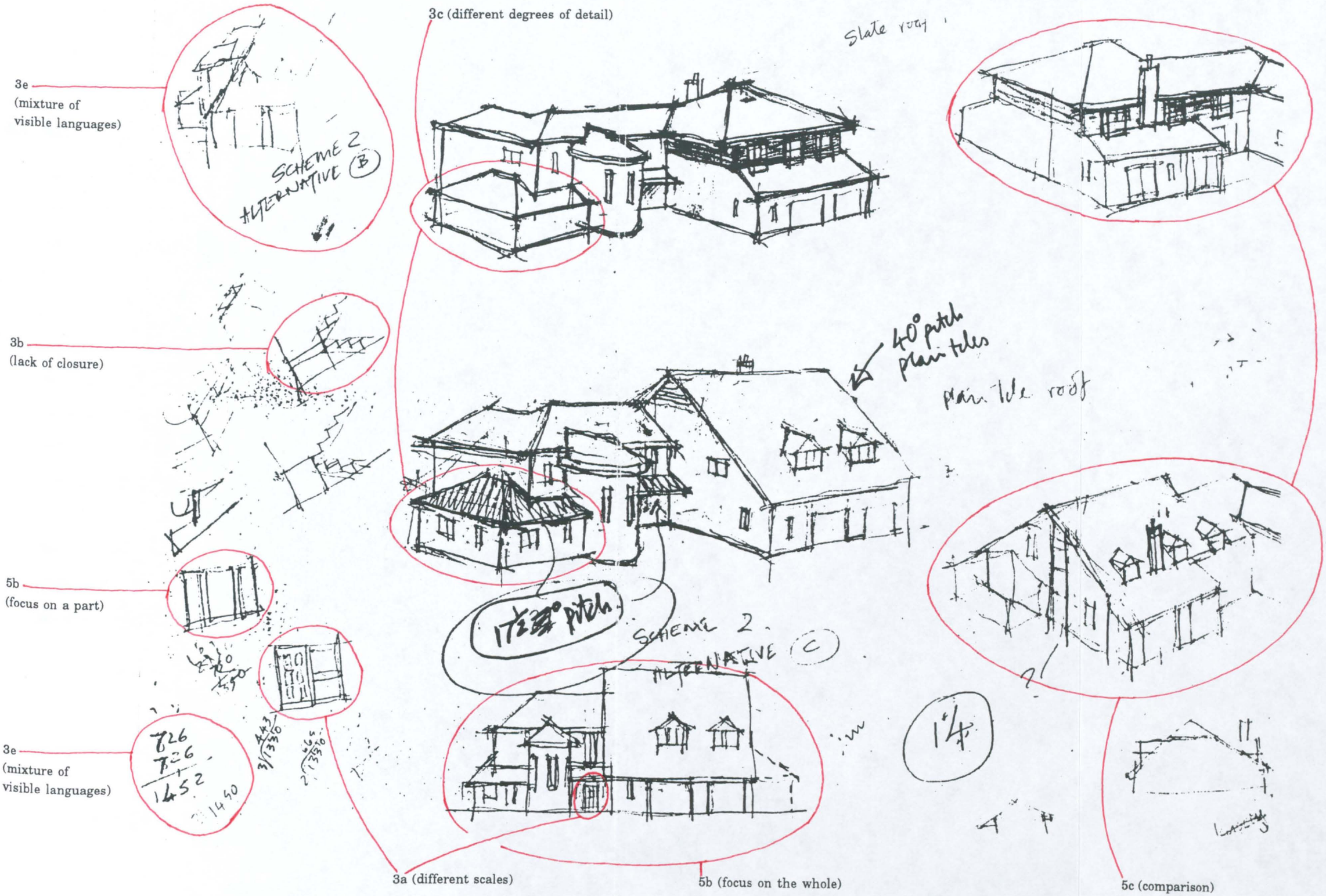


Figure 6.20 Applying the characterisation to architectural sketches

both interesting and valuable, both to refine the framework and to reveal more about the intricacies of sketching for other design domains.

6.4 Summary

The characterisation set out here demonstrates the multi-dimensional and interlinked nature of sketches and sketching, and delineates the complex, subtle interrelations between the separate strands identified in sketching for design. While the characterisation has been derived within the context of professional typographic design, the framework may be customised to apply to other design domains. The characterisation indicates the power of the activity of sketching, the consummate skill with which it is employed by professional designers, and the necessity for the appropriate flexibility and richness of the medium in which it is executed. In addition, the characterisation highlights the qualities of the paper and pencil medium that make it a particularly supportive medium for sketching. This leads naturally to a consideration of current electronic systems intended for designing, and thence to thoughts about possible future tools. These issues are dealt with in more detail in Chapter 7.

7 IMPLICATIONS FOR THE DESIGN OF FUTURE TOOLS FOR DOCUMENT CREATION

Hammers made of cottonwool or butter will be quite useless,
and hammers made of water or steam are not hammers at all.

John Searle
Minds, brains and science

7.1 Introduction

Sketching is a powerful means for assisting designing. It is a multi-faceted activity, enabling the creation and manipulation of complex, subtle visual imagery. Sketching depends on a medium that has a refined visual display, and one which facilitates the making and changing of visual imagery. The traditional medium answers these requirements through a broad range of stylus device mark-making tools (pencils of varying hardnesses, felt tip markers, ball point pens, etc.) in combination with various substrates to enable a rich variety of marks. In typographic design, the substrate itself, both marked and unmarked, has been shown to play an important part in simulating the artefact-under-design, and hence in the evaluation aspect of designing. Current electronic systems, by contrast, possess a different set of capabilities, some of which overlap with the paper and pencil medium, but most of which are more oriented towards the production rather than the design of documents.

This chapter begins with a précis of the salient aspects of sketching and brief summaries of the traditional and electronic media, following the same structure as the précis. The summaries give an overview of the characteristics of the two media, providing a concise comparison between

them concerning the respective ways in which they answer the requirements for sketching. These summaries are followed by a more detailed account of both media, using both the précis and the refined characterisation as the analytical framework. The refined characterisation provides a starting point for considering tool use in more detail, but since it was derived predominantly from a detailed study of the products of the activity, rather than the tools used to support that activity, the characterisation does not address in such detail issues directly concerned with the tools themselves. Hence the detailed account of the two media is followed by a section on aspects of tools and tool use not covered in the refined characterisation.

The differing natures of the traditional and electronic media are observed and, in recognition of their complementary qualities, means are suggested for integrating them to develop new tools. This approach enables the best aspects of both media to be exploited, thus leading to new, more effective tools for document design and production.

7.2 Crucial issues of sketching and sketching media

This section summarises the salient aspects of sketching, and the defining characteristics of the traditional and electronic media, with respect to their capacities for supporting sketching.

7.2.1 Recapitulation of the refined characterisation

In summary, there are three crucial aspects of sketching:

1 Appearance — sketches contain rich, complex, subtle imagery, much of which is common across design disciplines, and some of which is customised for specific design domains. Sketched imagery enables the designer to manipulate and evaluate design ideas easily, quickly and cheaply. This aspect relates to categories 1, 2, 3 and 4 of the refined characterisation.

2 Functions served — sketching affords capture, recording and interpretation of ideas; focus on different parts of the design; comparison between alternatives; and, for typographic design, through the continuity-of-medium, the possibility of realising and evaluating the 3-dimensional aspects of a design, through 3-dimensional mock-ups. This aspect relates to categories 4 and 5 of the refined characterisation.

3 Means of making — sketches are produced through an easy, immediate, tactile relationship the designer has with flexible, responsive tools, and with the physical substrate. Capacities necessary for a medium to support designing successfully include: richness of vocabulary of marks, including high image definition; ease and speed of mark-making; ease and speed of switching from one kind of sketching to another, including the making of 3-dimensional mock-ups; and singularity of focus, so the designer's attention may be fully fixed on the design in hand, rather than on operating the medium within which the sketches are being made. This aspect relates to categories 6 and 7 of the refined characterisation.

In subsections 7.2.2 and 7.2.3 the qualities of the traditional and electronic media are summarised, using both the three points listed above

and the refined characterisation of sketching. These summaries provide a concise means to compare the qualities of the two media and hence highlight the respective benefits of each.

7.2.2 Characteristics of the paper and pencil medium

Paper and pencil is an effective medium for supporting sketching, and hence typographic design. The strengths of this medium may be summarised as follows:

- The paper and pencil medium has a capacity for rich, complex, subtle, refined visual imagery. This imagery includes all the substrands in the first four categories of the refined characterisation: *visual characteristics of marks, basic semantic units* of the particular design domain, *visual features of sketches* (such as scale, degree of detail and mixture of visible languages), and *visual features of sheets of sketches.*
- Paper and pencil support the affordances of sketching. The subtle and varied visual imagery possible in paper and pencil affords *interpretation* (of ambiguous sketched representations), *focus* (on different parts of the design), and *comparison* (of alternatives). For more details on this see category 5 of the refined characterisation. Also, this medium enables immediate *ideas capture* and automatic *record making.* Paper is easily manipulated by folding, cutting and tearing, which makes 3-dimensional mock-ups easy to create. These help the designer to evaluate the tactile and kinaesthetic aspects of the document under design, as well as the visual aspects. In addition, paper supports the smooth transition from sketching in 2 dimensions to the manufacture of 3-dimensional mock-ups, as the same medium is used for both.

- The paper and pencil medium possesses the underlying functionality necessary to support sketching. In using paper and pencil, designers are able to work at their *speed* of choice, which may range from extremely fast, for the capture of fleeting ideas, to slow and deliberate, while mulling over an idea. This medium enables instant and transparent *switching* between all the capacities listed above, with no additional overhead of a statement of intent. The nature of the mark-making tools, and the relationship between the tools and substrate, enable the designer's *singularity of focus*, both physical and cognitive (see category 6 of the refined characterisation). In addition, the nature of the tools and their relationship to the substrate provide visual and tactile feedback for the designer about themselves, and, by extension, their capacities for mark-making.

However, paper and pencil are limited in the following ways:

- No record of the precise sequence in which marks were made/erased. While the sheets of sketches for a design contain a comprehensive record of what was sketched, providing nothing is erased, they do not explicitly record the sequence in which the sketches were made.
- No easy transition from the sketched design to the finished visual. In this medium it is slow and laborious to make highly finished visuals, which are necessary to show to clients to demonstrate the appearance of the final artefact.
- No easy transition from the design to the final artefact (e.g. book). Specifications for production (e.g. for compositors, printers and binders) must be constructed explicitly after the design is completed. Aside from

the additional step involved in producing specifications, producing the specification is itself tedious.

- No easy or quick way to generate exact copies. Hand-rendered marks, by definition, are idiosyncratic, and exact repetition of precise, formal marks is relatively slow, laborious and difficult to achieve.

This summary indicates that the richness and flexibility of paper and pencil make it ideal for sketching, by facilitating the rapid manipulation and evaluation of fluid imagery. Conversely, the same qualities make this medium unsuitable for mass production of identical copies of artefacts. Paper also lacks an inbuilt means to record the temporal progress of an emerging design.

7.2.3 Characteristics of the electronic medium

As observed in section 1.4 in Chapter 1, current electronic technology relating to designing documents may be divided into two categories. In one category there are document *production* systems, which possess many valuable features that facilitate the implementation of designs. Such systems incorporate word-processing and page formatting capabilities, and printing facilities. They are essentially a means of low resolution typesetting and printing, but they offer no support for sketching, nor, therefore, for initial designing. Examples of systems in this category include PageMaker™, QuarkXpress™ and FrameMaker™, which run on standard commercial hardware. In the other category there are numerous electronic *drawing* tools which have not yet been explicitly applied to document design, nor indeed integrated with document production

systems. These range from large, multi-user installations to jotter-sized, portable personal digital assistants (PDA's). A feature they commonly share is a stylus device for input, rather than a mouse or keyboard. These systems enable the user to capture ideas expressed in an informal written and drawn manner, and hence offer some of the functionality of paper and pencil. Examples of systems in this category include MacDraw™ and SuperPaint™, designed to run on standard commercial hardware, and systems such as LiveBoard (Elrod *et al.* 1992), Commune (Bly and Minneman 1990), VideoDraw (Tang and Minneman 1990) and the Newton™, which are based around custom-built hardware.

The strengths of the electronic medium as a means for supporting typographic design and production are as follows:

- Retention of specification. Once created in electronic form as a file in computer memory, unless deliberately altered, the specification for a document design remains intact.
- Ease and speed of production and reproduction of the final artefact. The electronic medium enables quick production of an artefact of high visual quality, once its specification is in place. This medium also enables easy, repeated reproduction of exact copies of the artefact.
- Ease and speed of change to the specification. Making changes to the specification is quick and easy, thereby enabling production of variations on the artefact.
- Memory capacity. The electronic medium is capable of recording every step the user takes in working with the system. This facility could be used to trace the development of a document's design and production.

Conversely, as a medium for supporting typographic design, the electronic medium has the following limitations.

- Fixed (single) level of formality of appearance of the visual marks. Marks made in electronic drawing systems are informal but crude, and hence lack the richness and subtlety necessary to support sketching for design. Marks made through document production systems are formal and highly finished, and hence lack the provisionality necessary to support sketching for design (see the first four categories of the refined characterisation for detailed requirements).
- Current electronic systems do not support affordances of sketching (see category 5 of the refined characterisation). The marks they are capable of making are too limited to support provisionality, and hence they do not afford interpretation. Limited screen real estate and obtrusive mode-switching prevent fluid switching between views of the document, and hence hinder focus on and comparison between different aspects. Clumsy input devices can slow down generation of the image, which hinders capture of fleeting ideas. Once the image is made the user must carry out a specific action to save it, and devise a suitable and memorable identifier for the file. This additional overhead is particularly challenging for graphic imagery, for which there is no obvious naming convention. The designer must move out of the electronic medium to construct a tactile simulation, to gain experience of the full artefact under design, and hence the continuum-of-activity through the continuity-of-medium is broken.
- Current electronic systems do not possess the full underlying functionality necessary to support sketching. Users must work at the

processing speed of which the system is capable. At different moments this may be significantly slower or faster than is comfortable. Current systems require the user to make explicit statements about switching from one mode to another (e.g. by selecting from textual menu options or making specific, additional gestures). This additional effort causes such switches to become obtrusive. Current systems cause a breakdown in the singularity of the designer's focus in two ways. In systems using stylus input devices parallax causes a distance between the tool tip and appearing image, making it harder to manipulate the tool to create the desired image. In systems driven by a mouse there is a 3-way separation between the surface of action and the surface of effect: physical separation, different planes, and different geometries. Each of these separations places additional demands on the user.

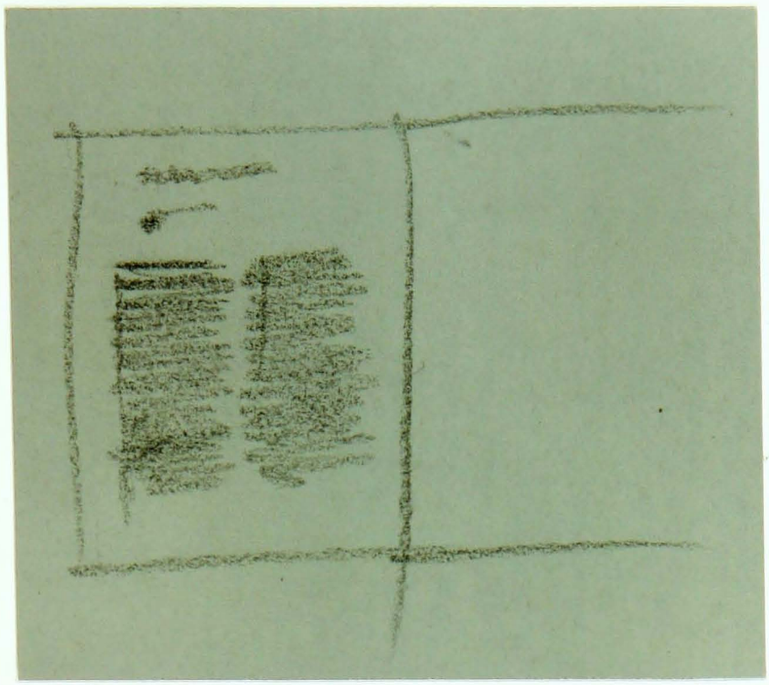
The summary indicates that, in contrast to paper and pencil, current electronic systems are poor at supporting sketching, and hence typographic design, but, conversely, are much more effective in the production aspects of document creation. Thus, the respective strengths of the traditional and electronic media make them complementary to one another. In the following sections 7.3, 7.4, 7.5 and 7.6 the convergence and divergence between the requirements of sketching and the characteristics of the electronic and traditional media are examined more closely.

7.3 Visual appearance of sketches

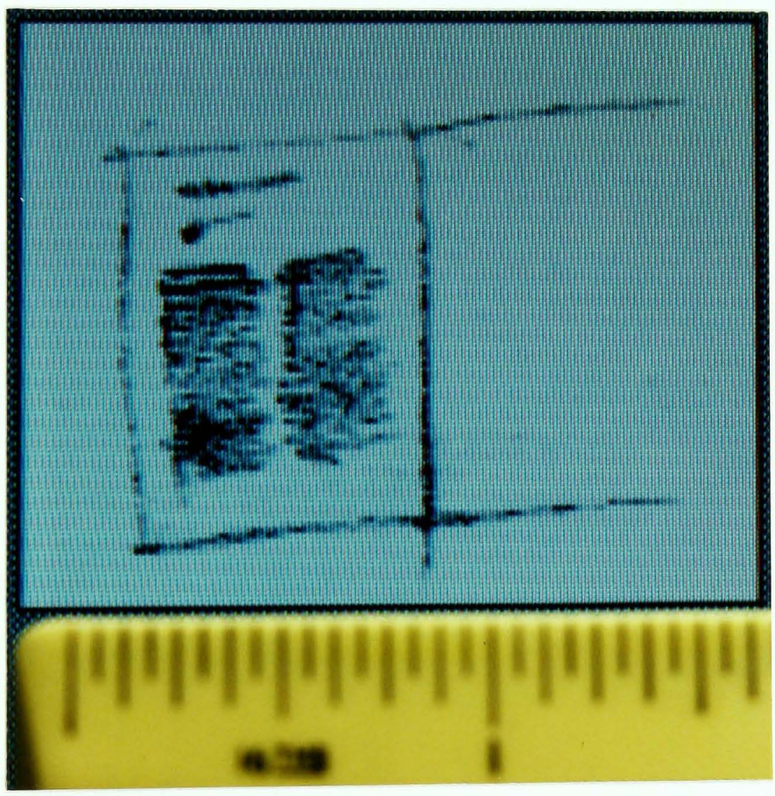
In this section the relative merits of the traditional and electronic media are considered for displaying the visual aspects of sketches (categories 1, 2, 3 and 4 of the refined characterisation), i.e. visual characteristics of marks, basic semantic units of design, visual features of sketches and visual and tactile features of sheets of sketches.

7.3.1 Visual characteristics of marks, basic semantic units of design and visual features of sketches

Much of this thesis demonstrates how rich and complex is the visual imagery of sketching in the paper and pencil medium, and how this imagery facilitates detailed manipulation of design ideas. A natural deduction from this is that a tool intended to support sketching must allow the designer to make suitably subtle and refined images. Imagery in the paper and pencil medium has continuous definition, which contributes significantly to the subtlety of the imagery in this medium. By contrast, digital imagery is rendered in discrete, uniform units (pixels), giving rise to much less subtlety. Although higher definition displays continue to be developed (for example, High Definition Television, flat-panel liquid crystal amorphous silicon displays) and further developments are likely, current electronic display media are still significantly limited in this capacity. As observed in Chapter 1, subsection 1.3.2, the rougher or sketchier an image, the higher the definition of the display necessary to do justice to it in the rendering. Figure 7.1 illustrates the visual differences between (*a*) a pencil sketch on paper, and (*b*) the same image, scanned in at 150 dots-per-inch and displayed on a 16-bits-per-pixel, 4096



a Sheet B2. Enlarged to 200 percent of original size.



b Sheet B2. Enlarged to 200 percent of original size.

Figure 7.1 Comparison of a sketch on paper and electronic display

a Original pencil sketch

b *a* scanned into and displayed on a NeXTstation Colour machine

colours, 92 spots-per-inch cathode ray tube (CRT) display (NeXTstation Colour®).

The importance of high definition display media is echoed in Elrod *et al.*'s conclusion, in writing about the Liveboard, a large, multi-user, pen-based interactive display (Elrod *et al* 1992, 605-6):

> Above all else, people would like to have better image quality on the Liveboard.

Apart from having continuous definition, images in pencil on paper also retain uniform geometry across the whole sheet. By contrast, the image on CRT displays tends to bow at the edges of the screen, and hence be distorted. This 'pin-cushion' effect is reduced in more recent CRT displays by leaving blank a band around the image area, between the image boundary and the edge of the physical screen, thus not displaying the image on the part of the screen most susceptible to this kind of distortion.. Flat panel, liquid crystal displays do not suffer from the pincushion effect, and at the time of writing offer considerably improved image quality over CRT technology. Although expensive, amorphous silicon liquid crystal displays with resolution equivalent to that of a standard office laser printer are available (Martin *et al.* 1993). This is a display technology that promises much for the future.

Since the basic semantic units of any design domain are composed of marks, the same issues observed about the rendering of visual characteristics of marks relate to the basic semantic units and visual features of sketches as well.

7.3.2 Visual and tactile features of sheets of sketches

The same issues already noted about the rendering of the visual characteristics of marks, basic semantic units of design and visual features of sketches relate to the visual features of sheets of sketches. In addition, sheets of paper have a tactile dimension that contributes to the designer's decision making. In the electronic medium the designer has no direct tactile relationship with the substrate. In working in the standard electronic medium the image is made in a form that is not directly physically manipulable (there are, as yet, no foldable glass screens). However, a printout may be made of the document-under-design, and this sheet may then be physically manipulated in the standard ways — cutting, tearing, folding, stapling, etc., and further marks may also be made by hand on the printout. The designers who have assimilated the electronic tools into their working practice do indeed manipulate the printouts like this, as observed in study 2. And it would be worthwhile to study more thoroughly these inventive ways of incorporating the current electronic tools in designing, to identify more closely what designers find helpful and restricting about them. But this ingenious accommodation of the electronic tools does not alter the fact that, in using them, the continuity-of-medium is broken. More detailed research is necessary to establish whether, and in what ways, this break affects the flow of the design process and, if appropriate, how the continuity might be re-established while incorporating electronic tools into the process.

7.4 Functions served by sketches and sketching

In this section the relative merits of the traditional and electronic media are considered in terms of the affordances of sketches (categories 4 and 5 of the refined characterisation), i.e. *interpretability*, *focus*, *comparison*, *simulation of experience*, *ideas capture* and *record making*.

7.4.1 Interpretability, focus, comparison, simulation of experience, ideas capture and record making

Because sketches in paper and pencil have a provisional quality, the sketches afford *interpretation*. This enables the designer to explore kinds of ideas without being restricted by very specific implementations of them. Because of the relative crudity of digital displays, imagery in digital media is restricted to a single level of formality of appearance. Marks displayed in electronic drawing systems are informal but crude, and hence lack the richness and subtlety necessary to support sketching for design. Marks displayed on document production system displays are formal and highly finished, and hence lack the provisionality (and thus, interpretability) necessary to support sketching for design.

The traditional medium enables the designer to *focus*, on parts of the design and the whole design, through easy switching between, for example, different scales and degrees of detail. Multiple sketches next to one another facilitate *comparison* between alternative approaches. In standard sheet sizes of paper for sketching, and all the more so if multiple sheets of paper are laid side-by-side, numerous sketches are easily accommodated next to one another. In working in this medium the

designer can take advantage of the broad field of view, glimpsing all the sheets by eye movements or a turn of the head. In standard screen displays limited screen real estate and lack of fluid switching between views prevent simultaneous viewing of many variants of a design, and hence hinder focus on and comparison between different aspects of the design. This suggests that future systems would benefit the user by having a larger display area and an easy, immediate means of switching between views.

Paper is easily folded, cut and otherwise manipulated to form 3-dimensional mock-ups, allowing the designer to *simulate the experience* of the document under design. When working with electronic tools, the designer must move out of the electronic medium to construct a tactile, 3-dimensional simulation, to gain experience of the full artefact under design, and hence the continuum-of-activity through the continuity-of-medium is broken. Further research is needed to identify exactly how this fluid continuity aids the process of design, and the findings from such research could indicate how future systems might re-establish this continuum, while still incorporating both the traditional and electronic media.

Sketches can be made extremely quickly in paper and pencil, hence enabling almost instant *ideas capture*. All sketches made in this medium are automatically *records* both of themselves and of the ideas they embody. In the electronic medium clumsy input devices can slow down generation of the image, which can hinder capture of fleeting ideas. The pen-based input device offers much greater subtlety of positioning and manipulation than the mouse, and holds much more potential for this

application. Once the image is made the user must explicitly save a file for work to be preserved, and devise a suitable and memorable identifier for the file. The demand for explicit saving of work is a disruption in the flow of creation, reinforced by the challenge of devising appropriately descriptive, memorable and distinctive file names (Carroll 1982). This is particularly demanding when the files contain graphic imagery rather than textual content, for which there are no obvious, suitable naming conventions. Tracking software, which automatically creates a record of changes to the file may provide a way to begin to answer this issue, although the conundrum of appropriate file labelling remains. Accessing the saved files later presents another challenge, especially where the filenames no longer evoke an accurate or adequate image of their content. One possible answer to this aspect of the challenge might be the use of pictorial databases, accessed through depictive means (Charles and Scrivener 1990).

7.5 Means of making sketches

In this section the relative merits of the traditional and electronic media are considered in terms of the functionality identified as necessary to support sketching, (category 6 of the refined characterisation), i.e. appropriate *speed* (of image making and image emergence), ease and speed of *switching* and *singularity of focus*.

7.5.1 Speed, switching and singularity of focus

Working in paper and pencil the designer has control over the medium, to work at the *speed* of choice to produce sketches. Depending on the individual's level of motor sensory skill and experience, the sketches may be produced extremely quickly, when desired. But the designer may also choose to draw more slowly, when contemplating rather than capturing an idea. Currently, in the electronic medium the designer must work at the speed of the system. This may be very fast, in engineering terms, although, at times, still slower than sketching by hand, and at other times so instant as to preclude contemplation. That designers sketch at different speeds, when working in a medium that allows this, suggests that either customisability of response speed, or sensitivity of the system to differing speeds of the user's actions could be a valuable feature in future systems.

The paper and pencil medium also enables quick and fluid *switching* between any aspect of sketching that is described in the refined characterisation. And in this medium there is no additional overhead required of the designer in making such switches. Current commercially available systems lack many of the strands identified in the refined characterisation, so naturally there is no possibility of switching between the strands that do not exist. In systems which do possess some of the strands, switching between them demands additional activities on the designer's part, which are not intrinsic to sketching, and which intervene in the sketching process (Bleser *et al.* 1988). To some extent the issue of switching between modes has been addressed in gestural interfaces in drawing tools and notepad computers, in which the user makes gestures with the stylus, such as tapping and drawing lines, to convey information

to the system *about* the designing activity (e.g. 'I want to draw now', 'I want to write now'). These gestures are not intrinsic to the design activity — they would not be performed if the designing were not being done in the electronic medium — but they do allow the designer to stay within, and in fact exploit, the motor-sensory and cognitive realm related to drawing. A step beyond the gestural interface for future tools would be a modeless system, that recognised the difference between writing, calculating and drawing without requiring explicit statements from the user.

The physical nature of traditional mark-making tools and the relationship between the tool and the substrate mean that the designer has *singularity of focus* while working. This term refers to the unity of the position of the mark-making device, the designer's hand and eye, and, consequently, the designer's mind: the locus of attention for them all is the same. In using current electronic tools the designer's physical and cognitive focus is dispersed, hence the singularity of focus is not preserved. The exact nature of this disparity and its effects are considered in the following subsection.

7.5.2 Disparity of focus

In using current electronic tools there are three ways in which the designer's focus is dispersed:

1 Distance between tool tip and appearing image (parallax).
2 Separation between the surface of action and the surface of effect.
3 Separation between the initial and ultimate surfaces of appearance.

The phenomenon of parallax is a significant difference between conventional mark-making tools and electronic styli. In using paper and pencil the tip of the mark-making device is in direct contact with the surface onto which it makes the mark, and the mark appears exactly where the tip of the pen or pencil ends. In using electronic styli, the tip of the device is separated from the actual surface of the display by a sheet of glass or plastic. Thus, depending on the thickness of the glass, the angle at which the stylus is held, the direction in which it is moved, and the angle of the user's view onto the surface, the position of the appearing mark may be noticeably divorced from the tip of the stylus. The size of the space between the appearing mark and the tip of the stylus may alter, in a way that seems arbitrary to the user, as any of the last three factors alters. The effect of parallax is lessened as the thickness of the glass or plastic screen is reduced, but the effect can be further exacerbated by the pen's calibration being 'off'.

An additional factor that may be disorienting for the user is the time lapse between the movement of the stylus and the appearance of the mark. This contributes to the divorce between the position of the stylus tip and the mark. Further research is needed to determine what, if any, significance there is for the user in these differences between conventional and electronic tools.

In contemporary electronic document production tools there is a separation between what Minneman calls the *surface of action* and the *surface of effect* (Minneman 1991), since the place where the mark-making device is wielded is separate from where the image appears. This is markedly true in a mouse-driven system. Where the interface is stylus-

driven, but the stylus is used on a tablet separate from the screen and no image appears directly at the point of the stylus, the principle is the same. In electronic drawing tools this separation is not present where a stylus is used directly onto the screen where the image appears, e.g. Commune (Bly and Minneman 1990), but such tools are susceptible to the problem of parallax, observed above. In this case the separation is of a different order of magnitude, but nevertheless remains to some degree.

In electronic systems oriented towards making paper documents as the final product, there is a separation between the initial surface of display (the screen where the images first appear) and the ultimate surface of appearance (the paper on which the images are printed). The term WYSIWYG (what you see is what you get) was coined to describe the visual verisimilitude between the appearance of the images displayed on screen and printout from the same file, but even so-called WYSIWYG systems do not always sustain this verisimilitude. This disparity injects another level of complexity that is not present in the paper and pencil medium. Although designers can become accustomed to these disparities, and learn to work around them by translating on the fly, their ability to adapt to tools that have introduced another level of complexity does not legitimise this additional complexity, particularly if there is no demonstrable positive trade-off involved.

Another disparity which is related to the third one listed above is the difference between the printout from the office-standard (300 dots per inch resolution) printer and that of the industry-standard (1200, 2400 or higher dots per inch resolution) typesetting device. This separation is similar to the difference between the products of the proofing press and

production press of former times. The experienced designer can become sufficiently accustomed to the particular characteristics of the differing output devices, so as to be able to accommodate to them in designing for one while using the other in the interim. However, there is no substitute for seeing the products from the respective devices to appreciate fully the differences. In some instances these differences may be so marked as to demand new design decisions.

Each of these disparities could be treated to lead to more effective future systems. Leaving aside the engineering challenges involved, the user issues are: an input device that works on the same surface and at exactly the same position as the appearing image, and matching resolution between the working surface and the final image surface.

7.6 Kinaesthetic, physical and cognitive aspects of tool use

Alongside the issues considered above, there are aspects of the tools which are not explicitly addressed in the refined characterisation. These aspects relate to the designer's kinaesthetic relationship with the tool, the physical and mechanical aspects of the tool, and their implications in terms of the cognitive demands they place on the user. These facets are considered in the following subsections.

7.6.1 The kinaesthetic relationship between designer and mark-making device

There are two aspects to the kinaesthetic relationship between the designer and the mark-making device: (1) the general degree of congeniality in handling the tool, deriving from the surface texture, shape,

circumference, length and weight of the mouse or stylus body; and (2) the relationship the designer experiences between the tip of the mark-making device and the substrate through the kinaesthetic feedback from the friction between the tool tip and the substrate.

Although mice are used as drawing tools, in conjunction with packages such as MacDraw, their ergonomic characteristics make them much less congenial as drawing tools than stylus devices. As one psychologist observed, drawing using a mouse is 'like trying to draw with a pack of cigarettes' (Olson 1990). Mice are effective as pointing devices, but are clumsy and hence restrictive as drawing devices. A mouse has no tip, in the sense that a stylus has, so in using a mouse the feedback through friction is much more dispersed, and positional accuracy is much easier to achieve with a pen tip. Thus the pen-based tool is clearly a more suitable input device for sketching.

The issue of friction experienced in using paper and pencil was mentioned by several of the designers interviewed for this research, although they universally found it difficult to express exactly what they found important about friction. The relationship the designer has with a pencil could be described as organic, in that a physical, and quite noticeable, change is made in the pencil point as a consequence of being used: the graphite rubs off onto the paper and the shape and sharpness of the point is altered. These changes are finely tuned according to the pressure and speed with which the pencil is used, and the experienced designer is able to exploit the subtle interplay of these things, deliberately using particular pressure and speed of movement to create the marks desired. To a lesser extent, similar changes happen in the tips of felt tip markers, though not in ball

point pens. Evidently, electronic styli are more like ball point pens than pencils in this respect. The feel of a plastic or metal tip against a plastic or glass substrate is qualitatively different from that of any traditional mark-making device against a paper substrate. Even though the experience of friction using electronic styli is qualitatively different from working with conventional mark-making tools, users still have certain expectations, as Elrod *et al.* observed in describing users' experiences of the LiveBoard (Elrod *et al* 1992, 605-6):

> People are also concerned about the way the pen feels. They are concerned both about its size and shape, but also about having a tip which feels 'right' as it moves across the screen surface (i.e. uniform friction of the proper amount).

Though, clearly, designers can master mark-making tools which are much more limited in their frictional feedback, there is no evident advantage in losing this dimension of the kinaesthetic experience. Pressure-sensitive electronic styli are a potentially valuable advance on their non-pressure-sensitive counterparts, although they do not address all the aspects of this tactile dimension.

7.6.2 Indications about a tool's mark-making capacities

An aspect conventional mark-making tools have in common is that their tips provide an immediate visible cue as to the mark they will make. Though it could be claimed that well-designed icons in a draw or paint palette provide the same degree of visual information about the mark that the selection of a particular icon will give, if there is only one input device, that device itself has no single, intrinsic mark-making identity. This statement is evidently true of mice. It is also true of electronic styli, which

in some instances are actually misleading, in that they appear to correspond to the 'what you see is what you get' characteristics of conventional mark-making devices such as pencils, whereas in fact they may be drawing devices for lines of different widths, none of which necessarily bears a direct relation to the size of the actual stylus tip. The appearance of a stylus tip implies it will make a mark of one particular kind while it may actually enable production of numerous different marks: the appearance of the mouse implies nothing at all about its mark-making capacity. Further research is necessary to identify whether, and if so how, these visual cues are valuable to the designer.

7.6.3 Choosing versus creating

In electronic drawing tools the form of the interface may require the user to make selections of visual effects from pre-defined options, typically from menus offering options in textual form, or palettes offering options in iconic form (e.g., of line width or style). This requirement to select from an inevitably limited set of pre-defined options precludes the designer from being fully creative in the sense demanded when using paper and pencil, and also, if the options are textual, they are in a form demanding use of a different part of the brain from that already engaged in image-making. To quote again the designer Charles Bigelow, 'the designer thinks *with* images, not *about* images', so the demand to choose between textual descriptions diverts the user's attention from making and manipulating visual imagery. Options in iconic form seem intuitively to be a more appropriate means for tool selection than textual descriptions. The need for this selection is a consequence of the mark-making device and the

marks that may be made being uncoupled from one another, as described in the subsection above. As long as the input device and the marks that can be made do not have a one-to-one mapping, as traditional drawing tools have, some form of representation of the available marks to enable their selection must be present. The alternative is to return to having a range of tools each of which has a unique relationship with a particular kind of mark. Both of these options could be pursued further in the development of future systems.

7.6.4 Style sheets and specification of document layout

In electronic document production tools the user typically controls the document's appearance through style sheets. Style sheets are analogous to specifications that designers have conventionally made for compositors and printers, but this comes *after* designing, not before. If designers attempt to design using current document production systems, they are obliged to work back to front — the user must make an absolute decision about font, typesize, interlinear spacing, measure, text depth and margins in order to be able to create any visual image, and therefore when the result appears it is already in a fixed, authoritative form, without any of the visual qualities conveying provisionality that the sketched image possesses. As a later part of an entire production process style sheets are an excellent device, but trying to use them as a means of designing is an archetypal case of putting the cart before the horse. A feature of future systems that might be useful would be an automatic production of the specification derived from the design, automatically updated as the design

was altered, relieving the designer of the demand to construct the specification explicitly.

7.7 Integrating the traditional and electronic media

In the following section the notion of integration between the traditional and electronic media is explored, observing both existing implementations, and possibilities for future developments, in the light of the findings from this research.

The traditional medium of paper and pencil provides a powerful and flexible environment for sketching. This aids the designer in manipulating design ideas and reaching design decisions. The electronic medium, by contrast, provides a complementary means of quickly producing high quality images from the specifications arising from the design decisions. Output made for this purpose can be cut, glued to another substrate, torn, folded and written on, as necessary. Printer output is valuable both as the final output of the design process and also at points during the design process when the designer is creating mock-ups. Printer output is faster to create than hand-rendered highly-finished visuals, and this makes the electronic technology a potentially powerful tool in the process of artefact simulation, as well as final artefact production. As long as the designer is aware of the visual differences between the output of different devices, and takes these differences into account in making design decisions, output from low resolution devices can be adequate for making early mock-ups.

The complementary characteristics of the traditional and electronic media suggest that the most profitable approach to building new systems is to integrate the two media, in order to exploit the best of both, and thereby enhance the document creation environment. In addition, this approach is likely to create new possibilities for ways of working, leading to novel adaptations of both media, and hence perhaps also enrich the designer's working practice.

7.7.1 DigitalDesk and derivatives

Prototype tools that integrate the traditional and electronic media are starting to be developed. A primary example is the DigitalDesk (Wellner 1993). Other prototype tools that are derivatives of the DigitalDesk technology include the DigitalDrawingBoard (Carter 1993 and Mackay *et al.* 1993), and Mosaic (Mackay *et al.* 1993).

The guiding principles of the DigitalDesk are to enhance paper documents with computational functionality rather than attempting to replace paper and its functionality with electronic imitations, and to allow the user to take advantage of familiar, physical manipulation skills in working with electronically enhanced documents. Thus, both the capacities of the traditional medium and the working practices associated with it are capitalised on and augmented (Wellner 1993). The term used to describe the approach which such tools embody is 'computer-augmented environments' (Wellner *et al.* 1993).

The DigitalDesk is a computer and image processing system which comprises a computer display projected down onto a conventional desk

top, video cameras pointed towards the desk, and an optional digitising tablet and stylus. The cameras pick up information about the user's movements and send it to the image-processing system, running on a UNIX platform. Two prototype applications for the DigitalDesk are the Calculator and PaperPaint. To use the DigitalDesk Calculator, the user points with a finger at numbers written or printed on paper to enter them into the calculator, which selects them and can then perform standard calculations on them. PaperPaint enables a form of 'select and paste', again through finger movements of the user. This selection creates an electronic copy of the paper-based image, which can then be moved about by sliding, much as a conventional sheet of paper, and copied again.

The DigitalDrawingBoard is a form of the DigitalDesk technology applied to the designer's working environment (Carter 1993). In the prototype version the computer display is projected onto an A1 (841 x 594mm) drawing board, which can be used as a conventional drawing board or as a large digitising tablet. A VideoPix board is used for digitising the image. The projector is driven by a VGA card in a SPARC II workstation, which displays 640 x 480 pixels. This gives a resolution of the projected images of about 8 pixels per centimetre. A camera mounted alongside the projector tracks events at the drawing board, and supports the transfer of images from paper into the computational environment. Both real paper sheets and electronic 'sheets' are manipulated with a stylus by gestures such as tapping. DigitalDrawingBoard was designed with graphically-oriented design such as architecture in mind. Specifically, the prototype application provides an interface for digitising paper-based sketches and applying computational transformations on the digitised video images.

Mosaic is a system based on DigitalDesk technology designed to support creating and editing of temporally-based data such as video (Mackay *et al.* 1993). The prototype version enables the user to manage the development and exploration of a video sequence through the conventional paper-based storyboarding technique, enhanced by computer-controlled video-editing equipment. Mosaic consists of an LCD projector and video camera mounted over a conventional desk with an 11.5 x 9cm active matrix thin film transistor colour LCD monitor (640 x 480 pixels, 2 million colours) fitted into the desk surface. The video camera records handwritten annotations the user makes on the paper storyboard, and the system can distinguish between handwritten notes, glyphs and numbers that mark individual storyboard elements. The elements may be manipulated by hand and the new sequence recorded and replayed by the system. They may also be saved and printed as a new storyboard.

DigitalDesk and DigitalDrawingBoard are early versions of this integrated approach, and although each has limitations (DigitalDesk is currently too slow in responding to capture and manipulate changes to sketches, for example, and DigitalDrawingBoard has low image definition) they demonstrate the feasibility of the principle of integration. Mosaic is a more fully developed prototype developed for a very specific purpose and successfully merges the conventional and electronic media to that end.

7.7.2 Document creation tools of the future

Drawing together the findings from research into sketching, observations about the complementary characteristics of the traditional and current

electronic media, and building on the augmented reality approach described above, it is possible to speculate about a document creation environment of the future, that could possess all the functionality of the traditional medium, and be enhanced by the electronic medium.

We could imagine a system in which the user sketches with the familiar, flexible mark-making tools on paper substrate, and then uses electronic means to implement the design ideas in more finished form, switching fluidly from one medium to the other and back again, as new ideas occur and need to be quickly captured and then developed further, leading to new ideas. Using the traditional mark-making tools would circumvent the challenges presented by electronic styli, described above.

The key to this approach being successful would lie in the interface demanding little if any additional work on the user's part to switch from ideas capture to implementation, thus causing little or no disruption to the creative flow. This could reinstate the continuum of activity present in the traditional medium, and enhance it by enabling the process to continue right through to production of the final artefact.

Currently it is possible for a sketched image to be scanned into computer memory, and for the resulting image to be displayed and electronically manipulated in a variety of ways, and then to be printed. However, it would be much faster, and more satisfactory from the user's point of view, if no additional stage of scanning were required. A more direct means would be if the designer sketched onto a pad of paper resting on a surface which automatically logged the marks made and automatically created a file when a sheet of paper was torn off the pad — that action could be the

cue that the work on that particular grouping was finished for the time being.

Working with paper as the main interface would provide the designer with the high image definition and engagement with the substrate needed for subtlety of visual and tactile feedback, and support all the functionality already identified as provided by that medium. If the system also had an electronic display medium of very high definition, the sketches could be translated into the electronic medium, either projected onto a surface, as in DigitalDesk, or displayed, as in the LCD of Mosaic, for real-time manipulation, and their visual richness would be preserved. This could be useful both for manipulating the sketches while they were still in sketch form, and for rendering them as more formalised images.

The working surface would need to be large enough to display multiple images simultaneously, to facilitate comparison and peripheral visual prompting. Some means of easy switching between views of an image, perhaps including enlargement and reduction, quick sliding of an image from one place on the surface to another, to achieve new spatial juxtapositions between images, could be useful. This might be achieved through finger movements, as in the original DigitalDesk.

An additional facility the electronic medium could provide would be an ingenious means by which the changes effected in the electronic display could be instantly implemented in paper form, for example, by placing a sheet of paper over the altered image and the image being conveyed through the paper onto the face-up side, ready for further manipulations of the kind already described.

7.7.3 Effects of novel tools on working practice

While respect for established working practice has been a motivating factor in the research described here, it is recognised that in introducing new tools, even those grounded in an understanding of the process the tools are intended to support, and are designed explicitly to support, working practice may be altered. This may happen for one of several reasons: as a consequence of the tool demanding adaptation by the user, even when the tool is knowledgeably designed; or through the user devising a novel way to achieve the same ends as previously, facilitated by the new tool; or through the user discovering a new activity that can be performed with the new tool that benefits the process as a whole. In each of these instances the user could be described as adapting to the tool. Conversely, the user may adapt the tool in ways unforeseen by the tool designer, to customise it to specific usage. Both these sides of co-adaption, as the phenomenon is termed by Mackay, may alter working practice (Mackay 1990). A natural, integral part of developing and testing new tools would be to study the effects and potential benefits of this phenomenon, and to incorporate the findings in the development of subsequent tools. This is referred to again in Chapter 8, section 8.5, Directions for future research.

7.8 Summary

The traditional and electronic media possess complementary qualities, with regard to document creation. The paper and pencil medium supports sketching for design effectively, whereas the electronic medium is more

effective in the production aspect of document creation. As has been shown in the preceding chapters, professional typographic designers use sketching in all the preliminary stages of design. This strongly suggests that designers need to sketch, and, hence, that in tools of the future the most suitable approach for supporting the design process will remain sketch-based.

A typology that characterises sketching for design has been developed (see Chapters 4 and 6), indicating the complexity and subtlety of the activity, and the role of the medium in which it is performed. In developing appropriate systems to support professional designers both the characterisation and the points raised in this chapter, specifically those regarding tools, need to be addressed. As a fundamental principle, integration between the traditional and electronic media is recommended as the direction to follow in developing new tools for document creation. This integration is advocated in the style of augmented reality, as demonstrated by Wellner *et al.* (1993).

8 CONCLUSION

Production-consumption. You begin to wonder whether it isn't
just a question of making one kind of garbage into another.
What bothers me though is that none of it is ever final;
you can't ever finish anything.

Margaret Atwood
The edible woman

8.1 Introduction

The subject of the research documented in this dissertation is sketching, specifically for typographic design. The main motivation for the research has been the question of what sketching is. This question is part of a larger context which includes what is important about sketching, what role does the medium in which it is performed play and what qualities are necessary in the medium, in order to support sketching. These questions arose from observing that many designers continue to sketch, using paper and pencil, even while being fluent users of electronic document production systems. This observation implied that sketching is an important activity, and that the paper and pencil medium remains compelling, despite the increasing sophistication of electronic document production systems.

The research has shown that sketching for typographic design is a complex activity, enabling the designer to capture and explore ideas and design solutions for both the visual surface of the document and its 3-dimensional characteristics. The medium through which sketching is performed needs to be flexible, responsive, and capable of a sophisticated repertoire of imagery, to represent the nuances in the designer's ideas,

and the level of commitment the designer has to those ideas. In addition, the medium needs to support the manufacture and manipulation of mock-ups of the emerging artefact, to enable the designer to evaluate its tactile and other physical attributes.

The account of sketching drawn from this research takes the form of a framework, containing seven categories, each of which is further divided into sub-categories or strands. The account of sketching derived from the research is restated in a summarised form in section 8.2. The scope of the research and directions for related future research are set out in section 8.3 .The final conclusion is presented in section 8.4.

8.2 Contributions of this research

The main contribution of the research documented in this dissertation is the account of sketching set out in Chapter 6. This account is a more comprehensive and refined version of the original account, set out in Chapter 4, and refined largely through the evaluation study written up in Chapter 5. The characterisation is significantly more detailed than previous accounts, described in Chapter 2. This account tells us more about the visual characteristics of sketches, the characteristics of the paper and pencil medium, and the functions that sketching supports in designing. The characterisation provides valuable information about why the paper and pencil medium is so compelling, and it may be used as a tool for analysing sketching further, leading to greater understanding of sketching and design.

Another contribution is the vocabulary that has been developed to describe sketching, and which reflects the more detailed nature of this characterisation.

One of the strengths of the characterisation is that the framework is robust and flexible enough to withstand new categories or strands within categories being added, or existing ones removed or rearranged, as greater understanding of sketching is developed. Another of its strengths is that it is customisable and may be applied as an account of sketching for other design domains, such as architecture. In all cases the increased understanding of sketching provides us with a means to learn more about the design process in each domain, and gives us more information for developing new tools to support the design process.

8.2.1 Summary of the refined characterisation of sketching

The refined characterisation comprises a framework with seven categories, summarised as follows.

Visual and tactile categories

1 Visual characteristics of marks
2 Basic semantic units of typographic design
3 Visual features of individual sketches
4 Visual and tactile features of sheets of sketches.

Functional categories

5 Affordances of sketching
6 Functionality required to support sketching
7 Capacities of the paper and pencil medium

The first four categories delineate in detail the visual dimensions found in sketches; the fifth enumerates and describes the design functions sketching supports, largely through the visual qualities of the sketches; the sixth category addresses the functionality necessary to facilitate sketching; and the seventh describes the functional capacities the paper and pencil medium possesses, which enable it to support sketching.

8.3 Scope of the research and directions for future research

The research documented here has focused on sketching for typographic designby professional typographic designers, leading to a descriptive framework accounting for this activity. The research could be taken further in several ways, described below.

8.3.1 Develop the account of the typographic design process beyond sketching

The articulation of the typographic design process, which was the starting point of the research documented in this dissertation, could be developed, to include the stages beyond early sketching. Using this account current document production systems could be assessed to derive a clearer picture of any mismatches between the whole design process, not just the sketching aspects of it, and the capacities of current electronic systems.

8.3.2 Expand research on sketching into its role as a communicative medium

Research into sketching could be expanded to include identifying other uses it serves in the course of the design process, particularly as a

communicative medium between the designer and client, and the designer and other artisans involved in the production of the document. Some research has been conducted in this area (Schenk 1991), but there is room for further research into this aspect of sketching.

8.3.3 Build and test prototype tools lacking dimensions in the characterisation

Prototype tools which lack one or more of the dimensions described in the refined characterisation could be constructed. These could be used in conducting experiments, in which designers were set design tasks, in order to observe how they accommodate to the tools in achieving their design goals, and thus clarify which aspects of sketching are critical, and which, if any, are expendable. (In some sense this could be said to be the position designers now work from, since current electronic tools do lack some of the dimensions identified in the refined characterisation.) The characterisation enables predictions to be made as to what effects which lacks would have.

8.3.4 Explore the effects of novel tools on established working practice

An ongoing part of developing new tools to support document creation should be continuing research into how the new tools affect working practice. Findings from such research could provide further valuable information to be fed into the iterative design cycle of new tools, as well as potentially revealing more about the design practice itself.

8.4 Conclusion

Sketching for typographic design is a complex activity, conventionally performed with responsive tools in a visually sophisticated medium. Typographic designers need to devise and assess all the aspects of a document-to-be, and by working in the paper and pencil medium, they extend sketching beyond manipulating images in two dimensions to creating and evaluating 3-dimensional mock-ups. The traditional medium supports quick and easy capture of ideas, both visual and 3-dimensional. The electronic medium offers different functionality, which is potentially valuable in addition to that of paper and pencil. Hence, the obvious route to follow is to integrate the traditional and electronic media in effective ways, to design tools that offer enhanced functionality.

Just as part of the function of a designed artefact such as a document is that it be pleasing to behold, for otherwise it makes its presence felt by jarring, so part of the function of a tool is that it be congenial to use. Fashioning tools for document creation that combine the best of the traditional and developing media is a significant social as well as technical challenge, demanding effective collaboration between practitioners from backgrounds as diverse as anthropology, engineering, graphic design, human factors and software design. This kind of multi-disciplinary endeavour is challenging, but we may hold an optimistic view of the potential of such collaboration (Wadlow 1993).

The well-designed tool is a natural extension of our human faculties, enabling the professional skilled in a particular craft to work fluidly and assuredly towards the artefact of the craft. In developing tools for future

use we may benefit, and cause the users of our tools to profit, by heeding the closing observation of the last designer interviewed in the course of this research. When asked whether there were other aspects of sketching that had not been addressed in the interview, he replied:

> Well — it's not facetious — it's the *pleasure* of doing it, in relation to the creation of the job, which I certainly wouldn't get by punching keys. Even though images may come up, rather than letterforms, it's not the same. You're removed from it.

Asked whether this was to do with the close connection the designer has with the tools and the tactile dimension, he answered:

> Yes it is. The touch of the tool on paper or the wash — the brush on the paper, you know, that sort of thing. It's very important, yes. I would feel completely cut off without being able to — you know, even if someone could convince me that it would be possible to produce something on the Mac entirely and not to touch anything but the keyboard, it would be a terrible loss.

The tools we design in the future will be worthy of their designers and users if they honour and assimilate the other aspects of human work that are every bit as important as sober industry. Humour, play and pleasure go hand in hand with the more serious aspects of creative production. Sketching in the traditional medium affords play. We will do well to design tools in which the freedom for that spontaneity is retained.

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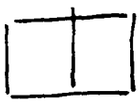
this list is not exhaustive, but is intended as a preliminary guide to reading the sketches


represents one page or one sheet


represents a double page spread


represents a column of text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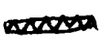
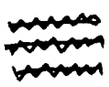

represents a single line of text


represents several lines of text


represents an illustration


represents an illustration

Dear

As you know, I am doing research into the role of sketching in typographic design. I would be most grateful if you would be willing to assist me in my research. I would like to visit you in your studio and spend some time discussing how you begin working on a typographic design job. I am particularly interested in seeing the most preliminary sketches and notes you make.

Enclosed is an example of the kind of sketches I have already collected, to give you an idea of the things I am looking for. As you will see, these are rough thumbnail sketches, rather than highly finished, refined images. Also, if you make 3-dimensional simulations of documents in the course of designing, I would be interested in seeing these as well. Again, this refers to roughly-made simulations, more than to exact dummies.

Although the purpose of my research is to investigate sketching, typically made with paper and pencil in the early stages in the design process, it is useful for me to see the finished products as well. So if you have a series of sketches, visuals, dummies and final, printed products of a particular design I would be interested in discussing the progression with you.

I would be most grateful if you would allow me to keep the sketches you show me. It is much better for the purposes of my research if I am able to work with the originals, especially in reproducing them as illustations for the thesis. However, if you have a particularly interesting and relevant set of sketches you do not wish to give away, I would be happy to make photocopies of them, rather than miss the opportunity of discussing them altogether. It is particularly important that I leave our interview with the sketches, or photocopies of them, so that I have all my data intact at that point.

I would like to emphasise that there is no issue of comparison or competitiveness, and no judgement of the quality of the design ideas or implementation involved. Rather, the point is to illustrate the kinds of sketches designers make, and the visual characteristics the sketches display. I will make every effort to preserve your anonymity, consistent with labelling your sketches informatively when they occur as illustrations in my thesis.

I look forward to hearing from you, and thank you in advance for your time and assistance.