Beyond the formal/concrete axis

A study of individual difference in approach to design practice

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2006

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Submitted to the University of Glasgow for the degree of Doctor of Philosophy

April, 2006

Abstract

This thesis examines the nature of individual differences in approach to design practice, concerning a practitioner's relationship with the medium with which they work, and its role in their practice. It does so with a view to developing future digital environments for creative practice.

Most existing computer systems for 3D design and modelling have developed around the 'design-by-drawing' paradigm. Recent advances in digital technologies offer more direct manipulation of models in 3D space through touch, bringing the more immediate ways of working with materials associated with other approaches to design within the realm of digital systems. A previous investigation of an alternative paradigm for future computer systems, the working processes of designer-makers, was undertaken to better understand the role of materials within their processes. This revealed differences in individual approach: some practitioners developed their ideas using sketching, while others chose to work with materials (either to design, or making with the medium), or combined both.

Reporting on initial enquiries concerning such practitioners' preferences for working in two or three dimensions to generate design ideas, this thesis suggests that there are more fundamental differences between individuals in their relationship with the medium in which they work. However there exists little design literature to assist in this regard.

Drawing on literature on creative processes from other disciplines, including writing and computer programming, it proposes that differences exist between individual design practitioners which are more significant than variation arising from each designer's personal style, unique experience, or working context; rather they represent wholly different approaches to design, elements of which relate to the nature and extent of a dialogue between practitioner and medium. A systematic analysis of this literature suggested the formal/concrete axis is an organising principle for differences in approach across disciplines and across a number of levels of practice.

An investigation was undertaken to determine whether similar differences in approach could be observed between 3D design practitioners. Using primarily interview methods, but also set tasks and observation, three empirical studies were conducted to examine in detail the creative practices of students and professional practitioners working with three-dimensional media, both material (silversmithing and jewellery, textiles, sculpture) and digital (3D computer graphics and animation, 3D modelling, 3D immersive digital environments). The results demonstrate that important underlying differences exist between individual design practitioners, concerning their relationship with the medium with which they work, and its role in their practice. This thesis concludes that while elements of these differences in approach can indeed be mapped directly to a formal/concrete axis, others cannot, and proposes avenues for further exploration.

This examination of differences in approach demonstrates an underlying commonality between disciplines including 3D design practice, writing and computer programming as regards how practitioners work, and their relationships with the medium they work in, on or through. It indicates important aspects of working and knowing that are not embedded in the material context of practice, which should be acknowledged by theory, and could be harnessed practically in the development of future digital environments for creative practice.

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Fondly dedicated
to Mum and Dad, who only got to share the beginning of this adventure;
to Campbell, who has been a staunch and loving supporter throughout;
and to Eliza, Hookie, and Bella, who will never read this thesis but have sat on it
many times, reminding me, with plaintive miaows and gentle nudges, that
there is a Life to be Lived beyond these pages…

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Prologue: a parable of design

The father said nothing more to the child; they lay in silence through the night, while the wind brought them the smell of the pines to remind them of the Christmas tree where they would never dance again.

Once upon a time, there lived a Mouse and his Child[1].

Perhaps 'lived' is not right. Sentient, yes, but the mouse and his child moved through the world not freely, through the pulse of blood and muscle and bone, but with actions determined by and dependent upon the interaction of springs, cogs, bars and wheels. For the mouse and his child were 'wind-ups', clockwork toys that remain motionless until moved at the whim of their owner; friend or foe. This is not the place to recount their adventures, broken and abandoned to their fate in the world; Mr Hoban does that admirably in his written account of their tale. But his descriptions of their attempts to become self-winding, independent rather than reliant on others, lead us into the realm of this thesis.

Near the end of their adventures, once they have defeated their enemy Manny Rat, regained their home and gathered a family of their own, the mouse and his child finally have time to give attention to the their long held dream: to become self-winding.

'Key times Winding Equals Go,' said the child.
'Go divided by Winding equals Key,' said the father.
'That isn't getting us anywhere,' said the child. 'Let's start again...'

The mouse and his child are attempting to use Muskrat's Much-in-Little to solve their problem, a way of thinking exemplified by an acquaintance from much earlier in their adventures. Muskrat's expertise in 'figuring things out' is well known and, other than their enemy Manny Rat (an expert in clockwork as they have learned to their cost), is the only one who may be able to help them learn how to achieve their dream. When they meet Muskrat, they realise that he has a rather unusual outlook on life.

'You'll have to wind me up,' said the father. 'There's a key in the middle of my back.'
Muskrat looked at the key. 'Of course,' he said as he wound it, 'I remember now: Key times Winding equals Go...'

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[1] The story and quotations in this section are taken from <u>The Mouse and His Child</u> [Hoban 2000].

> *'You have a strange way of speaking,' said the mouse father.*
> *'I'm always looking for the Hows and the Whys and the Whats,' said Muskrat. 'That is why I speak as I do. You've heard of Muskrat's Much-in-Little, of course?'*
> *'No,' said the child. 'What is it?'*
> *Muskrat stopped, cleared his throat, ruffled his fur, drew himself up, and said in ringing tones, 'Why times How equals What.' He paused to let the words take effect. 'That's Muskrat's Much-in-Little,' he said. He ruffled his fur again and slapped the ice with his tail. 'Why times How equals What,' he repeated. 'Strikes you all of a heap the first time you hear it, doesn't it? Pretty well covers everything! I'm a little surprised that you haven't heard of it before...'*

But when the child tells him of their dream to become self-winding, and asks for his help, Muskrat explains that his mind is now on 'higher' things.

> *'I'm afraid that's a little out of my line,' said Muskrat. 'Oh, I've tinkered with clockwork now and then, but I have long since gone beyond the limits of mere mechanical invention. That's applied thought, you see, and my real work is in the realm of pure thought. There's nothing quite like the purity of pure thought. It's the cleanest work there is, you might say.'*

The workroom where he now does most of his thinking reveals the stark contrast between these activities.

> *An oilcan and a ball of string lay among mussel shells and the forgotten nibbled ends of roots and stalks beside a small terrestrial pencil-sharpener globe; a BONZO Dog Food can stood filled with salvage from the bottom of the pond: rusty beer-can openers, hairpins, fishhooks, corroded cotter pins, tangles of wire, drowned flashlight batteries, a jackknife with a broken blade, and part of a folding ruler. Near it sprawled improvisations of discoloured pipe cleaners, tobacco tins, old fishing-licence badges, draggled wet- and dry-fly feathers, coils of catgut, jointed lures that bristled with hooks and staring eyes – all the neglected apparatus of past experiments in applied thought...*

However, Muskrat is drawn back into applied thought when he inadvertently learns that he now has a reputation as someone who can't 'do' anything, unlike the Beavers. To demonstrate that his capabilities are undiminished, he decides to 'do something': "something big, something resultful – something, in short, that will make both a crash and a splash and show the pond how truly much is meant by Muskrat's Much-in-Little".

> *'First,' said Muskrat, 'we must define the problem; that's how you begin.'*
> *'Suppose we say, then, that the problem is to fell a tree... Now, who fells trees? Beavers... The teeth of beavers are of the proper size, shape, and sharpness for cutting down trees.... When a beaver gnaws at a tree for a period of time, that tree will fall.' He picked up a withered brown arrowhead stalk and chewed it reflectively. 'So we may now reduce this data to the following much-in-little-... Beaver plus Teeth times Gnaw times Time times Tree equals Treefall,' said Muskrat...*
> *He drew himself up and launched himself anew upon his thought. 'Let us now disassociate the tooth from the beaver,' he said.*
> *'How his mind soars!' exclaimed the fireflies all together, and intensified their light...*
> *'You've got to be able to make those daring leaps or you're nowhere,' said Muskrat. 'Where was I?'*
> *'Disassociate the tooth from the beaver,' said the mouse father.*

> *'Yes,' said Muskrat, 'and consider it simply as* any *tooth of the proper kind, or as we might say, Tooth^K.'*
> *'Tooth^K,' said the mouse child.*
> *'Tooth^K times Gnaw,' said the father.*
> *'Tooth^K times Gnaw times Time times Tree equals Treefall,' said Muskrat. 'Wait – it's coming to me now!' The fireflies has dimmed a little; now they kindled up again. 'I've got it!' shouted Muskrat.*
> *'What?' said the mouse and his child together.*
> *'X!' said Muskrat, 'X!... It needn't be a tooth at all! Anything of the proper* k, *which is to say size, shape and sharpness, will do it.' He limped to the broken piece of slate, hastily rubbed it clean with his paw, wrote XT=T^F, and sat back, rocking on his haunches. 'X times Tree equals Treefall,' he said huskily and crooned beneath his breath a little song of triumph... 'There's very little to it, I'm sure, once you've got the X, and I'm off to find one now.'*

Muskrat agrees to address the problem of self-winding once the tree has been felled.

> *'That's not pure thought, you know; that requires some tinkering. I can't consider the Hows and the Whats of your clockwork without taking you apart; and I can't take you apart until we've finished our work here.'*

However, the tree felling ends up being crashful and splashful beyond Muskrat's wildest imaginings, due to the unwelcome reappearance and unwarranted interference of Manny Rat at a crucial point in the project. The mouse and his child are swept away in the flood of a broken dam, and have to overcome many more trials before they can address the problem again. We rejoin them, frustrated in their own attempts to apply Much-in-Little to their problem.

> *Their old rusty motor lay on the platform before them as step by step, wheel by wheel and cog by cog they reasoned their way through the clockwork that had driven them on their journey out into the world. The sunlight faded into dusk, then darkness rose up with its myriad voice below the red glow in the sky. Night passed into silent morning and the dawn; the Dog Star flashed and glimmered. The mouse and his child, beaded with dew, watched the sun come up, and wondered when they should achieve the daring leap of discovery and the X of self-winding.*
> *Another day passed, another night without success, and on the following morning they were no nearer to a solution than they had been when they started.*

It is their old enemy Manny Rat, subdued, toothless and (apparently) having learned his lesson, who finally gives them their freedom.

> *'Spring times Cog...' said the child.*
> *'Times Cog times Wheel, said the father, 'and still no X.'*
> *'Excuse me for saying so,' said Manny Rat, 'but vere are fings vat simply cannot be figured out.'*
> *'Reasoning won't do it all', he said. 'You have to have a feel for fings.' He put down his wire, picked up two motors from the spare-parts can, and hummed abstractedly to himself as he inspected them. 'Going and ungoing,' he murmured, and followed the coils of the steel springs caressingly with his paw. Then he sat down with the motors in his lap, and still humming, retraced the sequence of the gear trains.*

'Ungoing into going and back again,' muttered Manny Rat, and tried to sense how energy released by one spring could be made to wind another spring. The hours passed unheeded; twilight came again, and evening. The guardian uncles, relieving one another in regular shifts, had rotated five times through their roster...

'And vis goes here,' said Manny Rat, 'and now we attach vis...' Almost against his will he saw his own paws find the answer that would make the triumph of his enemies complete... He reached for the pliers, and made connecting rods from wire so that he could rearrange the gear trains. Then he saw his paws couple the two motors together and wind one up. As the first buzzing spring uncoiled it clickingly wound up the second one, which, running down, rewound the first.

So it was that the mouse and his child became self winding, that they might unassisted walk the boundaries of the territory they had won from Manny Rat.

1. Introduction

In his account of the Mouse and his Child, and their attempts to become self-winding, Hoban describes two quite different approaches used in trying to achieve this goal. Muskrat's Much-in-Little is characterised by abstract, rational thought applied to an objective analysis of the situation. Manny Rat's approach is intuitive, drawing on concrete and tacit ways of knowing, and grounded in the materials of the situation. While Muskrat's Much-in-Little is a somewhat extreme version of the application of abstract thought (everything is reducible to an equation!), nevertheless Hoban's description of two quite distinct approaches, different at a number of levels, and largely relating to the protagonist's relationship to the material context, reflects the concerns of this thesis.

This thesis proposes that similar diversity can be observed in the approaches that design practitioners use within their working processes. It argues that differences can be observed between individual practitioners which do not arise solely from the personal and situational context within which the practitioner is working, rather that they represent wholly different approaches to design, reflecting different relationships between individual design practitioners and the artefacts and media with which they work within their creative practice.

Initial analysis of the literature suggests that these differences can be characterised as two contrasting approaches lying at each end of the formal/concrete spectrum, with characteristics similar to the approaches of Muskrat and Manny Rat described above. Subsequent investigation argues that, while it is a useful device from which to start examining individual differences in approach to design practice, a distinction along this single axis does not fully describe the variation that can be observed, which implies a more complex interaction between a number of different dimensions of variation. The thesis concludes by proposing avenues for further exploration.

This research concerns the nature of individual differences in approach to design practice. I use the term 'design practitioner' to refer to someone who not only designs, but also makes; it is intended to include those who would describe themselves as 'applied artist', 'maker', 'designer-maker', or 'craftsperson' but also a broader spectrum of those who design and also make, but who might not identify with terms which usually imply a close relationship with physical materials. In this research it is three-dimensional design

practice with which I am most concerned. I use the term 'artefact' to denote the physical manifestations of a designer's processes, including sketches, models, etc.

This thesis constitutes a process of mapping territory, both theoretical and practical, within which further exploration can be focused. It uses methods and instruments designed to elicit information on differences: between individuals, between theoretical positions, and between other phenomena. It examines the same activity in different contexts, and different activities in the same context. It includes reviews of the literature (both contextual and theoretical); a systematic analysis of selected literature to derive a comparative framework as the basis of empirical work; and three empirical studies, mostly interviews, but also set tasks and observation. It also offers a bridge between two research communities which still seem to be largely separate: 'traditional' design research, which focuses largely on design-by-drawing and formal design methods; and research into the working processes of practitioners who not only design but also make.

This chapter begins by describing the motivation behind this research: both the immediate concern, the search for a cohesive explanation of the differences between individual design practitioners, in terms of the artefacts they work with in their creative processes; and the broader contextual motivation, how a better understanding of these differences might inform the development of future digital environments for creative practice. It then introduces the different elements of the research, and their purpose and role in defining and exploring the territory of the research, summarised in its thesis:

> *that individual practitioners experience different relationships with the artefacts they create and work with in their processes, and that elements of these differences can be attributed to the nature and extent of a dialogue between designer and media*

Difference as a focus of enquiry

The motivation for this research arose from the fusion of a number of strands of thought. These emerged both from my own experiences as a student practitioner, and from a previous piece of research - <u>An Investigation into Interaction with Computer Systems for 3D Design and Modelling, in terms of Interface and Process</u> [McLundie 1998] - which was motivated by the apparent lack of use of computer systems within the crafts/applied arts: I had come to study at Glasgow School of Art from a computing science background, and had been aware that while computer systems were used in other areas of design, they were (at that time) conspicuous by their absence in the crafts/applied arts. The overall aim of that research was to investigate the possibilities for incorporating some of the tactile, manipulative aspects of the way designer-makers work with materials, within the context of the design process, into future computer systems for 3D design and modelling. This included a comparison of the ways designer-makers interact with

material within the design process, with the ways existing computer systems for 3D design and modelling allowed the user to interact with the digital 'material' within the design process. A number of designer-makers were interviewed on aspects of their design processes, and the role materials played; subjects included jewellers, silversmiths, ceramicists, a blacksmith, and a glassmaker.

At that time I was looking for characteristics of 'the' designer-maker approach to creative practice: an approach typified by a close relationship with materials. However, my interviews with a range of designer-makers revealed a spectrum of approaches, ranging from design-then-make, to design-through-make, to make-as-design. While some practitioners developed their ideas using sketching, others chose to work with three-dimensional artefacts or used a combination of both. This suggested that the role of materials in different practitioners' processes might not be the same, and required further investigation.

These findings resonated with as yet unarticulated ideas that had arisen from my own experiences. As a student on the B.A.(Hons.) Design course in Silversmithing and Jewellery at Glasgow School of Art, I began to notice differences between my own approach, and that of some others in my class. I had no sensation, as some of the practitioners interviewed in the present research describe, of being able to see images of objects quite clearly in my head, as if they were in front of me. I often found that ideas came more readily when I had materials to work with, rather than through sketching: in many cases it was not until I actually sat down with materials that ideas seemed to flow.

This contrast in approaches can be seen in the following example, where the project brief was to create a piece of jewellery out of a specified amount of gold: one small piece of gold sheet, and a short length of gold wire. (Because of its cost, we were 'lent' the gold for this project, on the basis that it would be returned for melting down and reuse. Each student had to pay for any discrepancy in weight between the gold handed out and the gold handed back. This emphasises the care with which the gold had to be worked; even the filings from sawing the metal were collected for return.) One of my fellow students worked out exactly the dimensions of the material she would have to work with, and designed a pair of earrings within these limitations, which she then made. I took a different approach, inspired by the commonly-quoted belief that if you hammered out a small piece of gold sufficiently thinly, it would cover a football pitch. Using copper to experiment with different ideas, then silver to make a prototype of the final 'design', I developed a bangle with a simple catch, which takes advantage of the length, strength and springiness of metal (particularly gold) when it is mechanically rolled very thinly (Figure 1).

Figure 1: Gold project – presentation drawing of bangle as made from gold sheet (40mm x 15mm x 0.9mm) and wire (100mm x 1.5mm diameter). (M. McLundie)

There also seemed to be quite clear differences between individuals' approaches to producing the body of work for the Degree Show: those who were design-led, and those whose work was driven by, and based around, the exploration of particular techniques and processes. These differences were apparent both in my own group, and in student groups from previous years.

These personal observations also suggested that there may be important differences between individual design practitioners, relating to the artefacts they create and media they use within their creative processes.

The rest of this chapter introduces the different elements of the research, and their purpose and role in defining and exploring the territory of the research. Each section here corresponds to one chapter; a more detailed 'map' of each chapter is given in the Annotated List of Chapters (p. vi).

Digital technologies and design (Chapter 2)

Although my understanding of the creative processes involved has developed since I began the research for this thesis, the broad contextual motivation for this work remains the same: to bring a deeper understanding of the working processes of creative practitioners to the development of future digital environments for creative practice.

The focus of this research is the relationship between an individual designer and the media with which they work; it is not concerned with other ways in which computers might support designers, such as knowledge support systems, or by supporting collaborative working. It is not concerned primarily with ways in which creative practitioners are using existing digital technologies in their material practice, rather on

systems being developed using new technologies specifically to support artists and designers, particularly in the early stages of design.

Many recent developments in digital technologies to support creative practice focus on replicating and extending the ways in which creative practitioners currently work with materials, or in harnessing the potential benefits that can arise from combining the capabilities of computer systems with the traditional skills and working methods of artists and designers. A lot of projects still favour the 'design-by-drawing' paradigm: research into more intuitive methods of creating virtual design representations tends, though not exclusively, to emphasise sketching, or the use of sketch- or gesture-based interfaces to create three-dimensional form; similarly, many research projects which address computer support for conceptual design focus on sketching, even for the creation of three-dimensional virtual objects. Systems that draw on alternative approaches to design often reflect the belief that 'hands-on' access to materials is very important to makers/creative practitioners, and should be replicated when developing new digital environments for design: this thesis challenges and clarifies this viewpoint, by analysing more closely what it is that may be important in the relationship between a practitioner and the medium with which they work.

This thesis demonstrates, through an investigation of diversity in design practice, that this relationship encompasses important aspects of working and knowing that are not embedded in the material context of practice. Systems which focus on simulating ways of working with physical materials through touch may therefore be missing out on other aspects of a practitioner's approach which are at least as important. This does not mean that the ways in which we interact with computer systems cannot be improved; a number of practitioners and students interviewed during this research commented on aspects of the software interface which they found frustrating. But while the goal of designing interfaces to make them more intuitive for creative practitioners (and indeed all users) is commendable, it is not merely a matter of reproducing the ways in which creative practitioners currently work with materials: the role of the medium in one individual's practice may be quite different than in another's; individual practitioners will approach and use a digital medium in different ways; and what one practitioner may find frustrating about working with a medium may be someone else's creative springboard.

Diversity in design practice (Chapter 3)

This research focuses on an individual designer's relationship with the artefacts they create, and how the interaction between the two contributes to, influences or comprises the design process; it is particularly concerned with the diversity that can be observed in

design practice in this respect. It is not concerned with what might be termed 'design processes' (e.g. the patterns of and relationships between analysis, synthesis and evaluation, or divergent and convergent thinking in a practitioner's process), or 'creative cognition', nor does it explicitly examine the role of haptic (tactile, kinaesthetic or proprioceptive) feedback or tacit knowledge in practitioners' processes. Although these aspects may be an element of the individual differences in which I am interested, they are not the territory of this research.

While much research has focused and continues to focus on 'design thinking', there has been a growing interest in the 'external representations' with which designers work. A review of the literature demonstrates that artefacts are considered to play an active role in a designer's process, and that design is viewed as a process of incremental transformation, facilitated through or revealed by engagement with the artefacts a designer works with in their design process. Moreover, artefacts can be seen to play an interactive role, allowing the designer to have a 'dialogue with themselves' about the design situation.

Existing research in this area has been concerned predominantly with two-dimensional artefacts, including drawings, diagrams and sketching. A smaller number of studies have examined the role of three-dimensional or material artefacts within designers' processes, and even fewer are concerned with differences in the way that 2D and 3D artefacts might support designers' processes. In the realm of this thesis, very few studies have investigated differences between individual designers that relate to their use of artefacts within the design process. 'Traditional' design research in this area has focused mainly on design-by-drawing, and on formal design methods, less on other areas of design which do not fit this model. Many studies are broadly concerned with what is to be learnt about "designing as a basic human capacity" [Pedgley 1999], viewing it as a single process to be discovered. Most studies look for consensus, rather than diversity, and the experimental approach used in many is less likely to reveal differences in approach, especially where there are differences which may be most clearly observed in the wider spectrum of practice. However, comparisons within and between a number of case studies of individual designers in the literature revealed quite different personal approaches to design, relating to the roles of sketching and drawing or working with materials between different individuals' practice. These findings strengthen the position of this thesis: that clear differences in approach can be observed between individual designers, which are worthy of further investigation.

This review highlights the importance of placing the relationship between design practitioner and artefact at the core of this research, and of using a method of enquiry which enables individual differences to emerge.

Difference as a means of enquiry (Chapter 4)

A number of factors have therefore prevented much existing research from observing the natural diversity in practice, and the dimensions of its variation. One of the challenges in starting to explore this area was that there appeared to be a number of possible interdependent factors involved in this diversity, at different 'levels' of process. One approach to examining this diversity would be similar to the experimental studies above: constrain the context to look at each of those factors, while eliminating the influence of the others. However in this situation it was not clear at the beginning what factors to constrain, and what the interdependencies might be. The alternative selected for this research was to choose a method which allows the situation to be examined as a whole, and enables an investigation into what some of the interdependencies might be. It uses a comparison of the differences between individual instances as a means of developing a descriptive model of an underlying phenomenon. This method is underpinned by three related principles: the comparative framework; the comparison of the individual against the collective; and the added insight from comparing phenomena which are similar-but-different. It has similarities to the phenomenographic approach described by Marton and Booth [Marton & Booth 1997].

The rest of Chapter 1 illustrates how this approach has allowed the research to move from an initial position of exploration and uncertainty to its thesis:

> *that individual practitioners experience different relationships with the artefacts they create and work with in their processes, and that elements of these differences can be attributed to the nature and extent of a dialogue between designer and media.*

Different dimensions? (Chapter 5)

Earlier in this chapter, I described how the starting point for this research was the differences I had observed within the group of designer-makers during a previous investigation where, while some practitioners developed their ideas using sketching, others chose to work with materials (either to design, or making with the medium), or used a combination of both.

As there was little design literature to assist in this regard, an exploratory study was conducted with four groups of undergraduate Silversmithing and Jewellery students in the form of a one-day workshop focusing on preferences students might have for using different 'types' of artefact for generating design ideas, e.g. drawing as opposed to

materials, two-dimensional as opposed to three-dimensional. This study used the creation and examination of artefacts as its primary means of data generation and analysis. The participants were asked, through a series of short exercises, to use words, mark-making and materials to respond to a selection of words, mark-making outcomes and objects, then to generate design ideas.

Within the limitations of the original analysis of the data, no clear conclusions can be drawn that the primary differences between individuals related to a preference for working in 2D rather than 3D. What became apparent during the study was that striking differences could be observed *within* as opposed to *between* media type. A number of recurrent differences emerged from the collective examination of all the artefacts: regarding the relationship between the student and the source object, a subjective or objective approach towards the object; the extent to which the materials play a background or foreground role in the artefact; and within the design exercises, the extent to which the 'design' is derived by the student and then expressed in the media, or is derived through working with the media.

These findings suggested that design practitioners may well use the same media quite differently; that for some participants, materials seemed to play a much more significant part in *all* their responses than others; that a 'blunt' comparison between 2D and 3D may therefore be of little value; and that in subsequent studies it would be not only necessary but valuable to look beyond these original categories to examine more closely the variety of ways in which individual design practitioners perceive and relate to the artefacts and media they use to support their processes.

Reflection, negotiation, mediation: concepts of dialogue in design
(Chapter 6)

Although few studies of three-dimensional design have examined differences of this nature, there are commentators from computer programming/epistemology (Turkle & Papert) and writing (Chandler) who discuss differences in individual approach which resonated strongly with the tentative ideas arising from the above study and the observations from my previous research. These differences in approach can broadly be described in terms of the nature and extent of a dialogue between practitioner and medium.

To distinguish these commentators from others who also describe the relationship between practitioner and medium in terms of dialogue, a comparative review was made of a range of commentators from design, computer programming/epistemology and writing who propose alternative models of the creative process and the relationship

between practitioners and artefacts, or alternative explanations of differences between individuals, using contrasting metaphors of dialogue between practitioner and artefacts: reflection, negotiation, and mediation.

The differences in approach described by Turkle & Papert and Chandler can be described in terms of a formal/concrete axis as an organising principle across disciplines and across a number of levels of practice. This review therefore suggests that differences may exist between individual design practitioners which are more significant than variation arising from each designer's personal style, unique experience, or working context; rather they represent wholly different approaches to design, elements of which relate to the nature and extent of a dialogue between practitioner and medium. (Within this thesis, different commentators use the term 'style' to refer to different things: when I use it in the context of a designer's 'personal style', I am not using it in the sense of an approach or process as in 'learning style', 'intellectual style', 'programming style'; rather I am referring to those personal attributes of a piece of work which make is recognisable as created by a particular practitioner. Different approaches and ways of working may contribute to this 'style', but do not constitute it.)

Dimensions of difference (Chapter 7)

An interview study was made of two groups of student 3D design practitioners, one working with physical media, the other with digital media, to establish whether the differences between practitioners identified in these other fields of practice could be observed within each group, and whether the same spectrum of individual variation was seen in each group. (If similar differences in approach were observed in both groups, a comparison of how each type of approach manifests itself in the material and digital environments could provide additional insight into elements of this relationship, arising from the similarities and differences between these two environments.)

A comparative framework was derived from a systematic analysis of the literature discussed in the previous section which suggested the formal/concrete axis as an organising principle for differences in approach across disciplines and across a number of levels of practice. This framework is presented in terms of two distinct and contrasting approaches which represent two ends of a spectrum; individual practitioners may appear at one end of the spectrum, or somewhere in between. In a preliminary analysis, each individual's approach was categorised using this comparative framework, and an assessment made of the distribution of the approaches within each group. Certain limitations with this analysis mean that it can only be relied upon to give a broad indication; however different approaches, broadly in line with those in the comparative

framework, could be observed within both groups with a similar spread of approaches within each group.

A second stage of the study involved both an examination of the collective variation within each group across a number of 'dimensions of difference' which emerged from the data, and a comparison of these dimensions between groups. (The term 'dimensions of difference' refers to distinct observable differences in aspects of practice; taken together these may indicate more fundamental underlying variation between individuals.) In both groups, a number of dimensions of difference can be observed which appear to be in line with the original framework. The dimensions emerging from the groups therefore seemed to be broadly in line with those embodied in the comparative framework; however, how these different dimensions logically related to one another within an individual's approach did not appear to be completely described by the two-dimensional nature of the framework, or by the formal/concrete axis it embodies.

Practitioner interviews (Chapter 8)

Additional insight into these matters is provided by a study of three practitioners who have what at first appeared to be quite similar approaches in terms of the original comparative framework, but where further examination revealed distinct and significant differences.

This interview study of three 3D practitioners who have an established material practice and a substantial body of work in digital practice aimed, by drawing comparisons between each practitioner's approach to material and digital practice, to gain insight into key elements of their relationships with the medium they use and the artefacts they create. For all three practitioners, their digital practice has allowed them to push the boundaries of their practice in ways that would not otherwise be possible, and to pursue work, themes, and objects that exploit the unique possibilities of the digital as a medium.

For each practitioner interviewed in this study, their approach to the medium is in line with (and largely derives from) the approach they used in the physical environment. The three practitioners' approaches are broadly similar: they are all actively engaging with the medium, and using its inherent qualities, rather than using it to represent or simulate reality; they are all exploring the digital medium in very different ways from its conventional use; and what might normally be considered limitations actively contribute towards their developing practice. Yet a more detailed examination revealed distinct and significant differences between what, in terms of the original comparative framework, had at first appeared to be quite similar approaches; these differences concerned the role of the medium within each practitioner's practice, whether their approach could be

characterised as a dialogue with or through the medium, and whether the medium was closely identified with the 'self' or viewed as 'other'. These subtle yet significant differences between practitioners confirm that in the investigation of a practitioner's approach to and relationship with their medium it is necessary to carefully examine a number of different aspects.

The comparison between material and digital environments revealed interesting aspects of this relationship that might otherwise be overlooked. For these practitioners, the lack of being physically 'hands on' with the medium or working with physical materials was not significant; other things, such as achieving a sense of 'immersion' characteristic of a maker's relationship with their materials, were more important. The practitioners worked with digital media in ways usually attributed much more to physical media, emphasising the limitations of some conventional conceptions of digital media. Comparisons between practitioners showed that what one practitioner highlights as differences between the physical and digital media they are using may be quite different from what another practitioner would be aware of. These latter points lead to one of the most important conclusions to be drawn from this study: that the characteristics of a medium are not absolute, resulting from notional inherent properties, rather they are defined through a practitioner's relationship with the medium.

Discussion (Chapter 9)

This research draws a number of conclusions about the nature of the relationship between practitioner and medium, and more particularly about differences between individuals concerning their relationship with the medium and its role in their practice: firstly, that the characteristics of a medium are not absolute, resulting from notional inherent properties, rather they are defined through a practitioner's relationship with the medium; secondly, that an individual practitioner will relate to/approach different media in similar ways; and thirdly and most importantly, that there are significant differences in the ways that individual practitioners relate to the medium with which they work, and its role in their practice. It concludes that while elements of these differences in approach can indeed be mapped directly to a formal/concrete axis, as described by the comparative framework derived from the literature, others cannot. However, even though the framework does not completely explain the diversity that can be observed within the data, it is clear from the findings of the various studies that individual differences in approach can be observed between individual practitioners; that aspects of these differences do concern a practitioner's relationship with the medium; and that elements of these differences can be attributed to the nature and extent of a dialogue with the medium. The studies therefore do support the original thesis:

that individual practitioners experience different relationships with the artefacts they create and work with in their processes, and that elements of these differences can be attributed to the nature and extent of a dialogue between designer and media

However, they also suggest that there may be additional elements which contribute to individual differences in approach which require further investigation.

This examination of differences in approach has demonstrated an underlying commonality between disciplines including 3D design practice, writing and computer programming as regards how practitioners work, and their relationships with the medium they work in, on or through. Its findings have implications within a number of different areas including the design research community, creative practitioners, those involved in the application of digital technologies in design and creative practices, programming and writing. Further comparison between disciplines provides additional insights into the variation that can be observed in individuals' practice.

There are two main directions in which the research undertaken for this thesis could usefully be extended: firstly, towards a greater understanding of individual difference between design practitioners, by further analysis of the connections and correlations between the dimensions of difference within individuals' processes; and secondly, towards the development of new digital environments for creative practice, focusing on those important aspects of working and knowing revealed by this research that are not embedded in the material context of practice.

Critique (Chapter 10)

The research undertaken for this thesis has three main limitations: the extent of analysis of the data undertaken to date; the limited range of instruments used in the empirical work; and a lack of external validation of the analysis. In particular, the existing analysis of the data has not yet been able to explain just how the collective 'dimensions of difference' observed within the groups relate to one another within an individual's practice. A further, more detailed, examination of this data would enable a clearer understanding of the relationships between the dimensions within individuals' processes to emerge.

The main strength of this research is the breadth of elements which contribute to its findings, which mitigates some of these drawbacks. The broad foundation of the theoretical basis of the work adds to the weight of argument through comparisons between different disciplines. In particular, the comparative framework derived from the literature provides a strong external element of comparison within the research, which counters to an extent the current lack of external validation. Although the variety of

instruments used on this research was small, nevertheless the range of areas within which these instruments were used was broad: the research contains both theoretical and empirical elements; it has involved a range of participants; although interviews were the main instrument of data collection, the research has also involved more empirical techniques; it has examined a number of different phenomena. This variety within the design of the research has contributed to its strength as support for the thesis has come from these different quarters, thus broadening the basis on which the thesis is grounded.

In summary, although the research in this thesis has certain limitations, it has provided a substantial foundation from which to proceed. As a first stage of research in this area is has mapped out a territory, both theoretical and practical, within which subsequent investigations can be focused. It has identified ways in which the findings may impact on a variety of audiences, and it has proposed directions in which further research could usefully be pursued.

Conclusions (Chapter 11)

This thesis demonstrates that important underlying differences exist between individual design practitioners, manifesting in their relationship with the medium with which they work, and its role in their practice. It concludes that while elements of these differences in approach can indeed be mapped directly to a formal/concrete axis, others cannot, and proposes avenues for further exploration.

Although the underlying dimensions along which these approaches differ have yet to be fully determined, this examination of differences in approach demonstrates an underlying commonality between disciplines including 3D design practice, writing and computer programming as regards how practitioners work, and their relationships with the medium they work in, on or through. It reveals important aspects of working and knowing that are not embedded in the material context of practice, which should be acknowledged by theory, and could be harnessed practically in the development of future digital environments for creative practice.