Design Ideation:

The Conceptual Sketch in a Digital Design Culture

PhD thesis
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ABSTRACT

Design ideation, or the generating and developing of design ideas is central to designing in both education and practice. But what is the impact of digital technology on conceptual tools, notably the traditional pen and paper sketch?

Initial research, in the *Introduction* highlights how freehand drawing is under pressure from digital technology both in design schools and industry yet educators and practitioners alike seem uncertain how best to deal with the digital challenge.

The *Literature review*, in which the investigation is likened to a sprawling *rhizome*, covers both practical and philosophical concerns about conceptual tools thereby extending the notion of sketching beyond pen and paper, to what is called *sketcherly ways of designing.*

To find out how to capture designers' use of conceptual tools, the spectrum of *Design methodology* was explored in which the case study method combined with protocol study emerged as the research strategy to be tested in a *Pilot study.*

The pilot outcome set the scene for a protocol study with first-year design students which, through a series of *Ideation workshops*, illuminates how sketching together with verbalisation is a powerful combination for conceptualisation. In this, the workshop format emerged as an effective means for encouraging novice designers to develop ideation skills.

The pilot was also instrumental for conducting a *Multiple case study* comprising five second-year design students and five recent design graduates working in industry in the domains of fashion, architecture, graphics, product and general design. Using self-reporting and interviews the cases illuminate real uses of conceptual tools situated in everyday designing that reveal the multifaceted yet unpredictable character of ideation.

The *Summary and Conclusion* discuss the future role of the conceptual sketch in digital design environments and suggest how scholarship in the context of teaching and learning design can bridge the worlds of design schools and professional practice. In this, *computer-aided ideation*, CAI, emerged as a promising research field.

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PREFACE

The interest in the research field grew out of my first teaching experience as a visiting lecturer in theatre design at a time when computers began to influence studio work in design schools in a major way. Although the impact was fairly immediate in some areas, such as graphics, and gradual in others, for instance the shift from manual drawing boards to computer-aided design (CAD), the impact of the digital medium on conceptual design was a more complex, unexplored and controversial issue.

Thus I came across my first students who preferred working with digital images, rather than doing sketching. But I still wanted to see students' sketchbooks because they appeared to have advantages as a means of communicating between tutor and students revealing the development of ideas in "first person", unlike digital images which seemed "third person" and less transparent about the underlying design thinking. Indeed: "How can you be a designer without a sketchbook"? Moreover, in the context of teaching and learning in theatre design, it was tempting to make the analogy between drawing in support of design and Shakespeare as a support to actors.

However, as the Bard may appear alien to young actors, so the Renaissance drawing tradition may seem foreign to novice designers. Therefore, to expect sketchbooks all round seemed a narrow reading of the design process that may have applied to pre-computer days when tutorials at the beginning of the conceptual phase would customarily take place over some sketches or rough models

But although the digital medium questions traditional and often cherished forms of teaching and learning art and design, creative challenges from new mediums are not new. For instance, the Photo-Realist movement of the 1960s when artists derived paintings 'from photographs of reality, rather than reality directly perceived' (Walker 1998:106), with the aim of presenting paintings of 'a smart, Kodachrome appearance' (Read 1974:318). Photo-Realism also contrasted with non-figurative painters who seemed to be able take more risks. Yet, Pop-artists, who relied on ready-made images of popular culture, were innovative too. Therefore, digitisation, and similar to what happened with photography, seemed not just a technique but a creative medium in its own right with benefits to be gained once the change was made.

The college that I visited at the time took the view that "best-practice" in promoting creativity was to let the students develop their own design language through "learning journals" of mixed media, rather than insisting on traditional sketchbooks. This approach to teaching and learning had appeal in a creative environment because conceptualisation implied openness towards any methods, tools and mediums. Moreover, my experience as a visiting lecturer coincided with the debate about student learning and teacher training in higher education in the aftermath of the Dearing report (Dearing 1997) because traditionally teachers in design schools had no formal training beyond domain specific skills:

> 'It seems that design is generally being taught by designers, who may be skilful and well-informed in a particular specialist area, but this does not necessary equip them with knowledge of educational procedure' (Cross 1980:205).

This reflected my own teaching situation which suggested that specialist skills were fine for instructing, for instance, technical drawing and model making, or, say, for lecturing in colour theory or the history of design. However, domain specific professional knowledge alone seemed insufficient on design programmes increasingly situated within contexts of cultural studies and populated with students from a wide range of backgrounds who, furthermore, might be working outside traditional or specialist areas of design after graduation. For example, RIBA's Review of Education (1999) revealed that 60 per cent of students entering a course of architecture did not become fully qualified architects. Therefore, teaching design in higher education was not just about delivering information. It suggested a huge variety of creative approaches within knowledge and communication frameworks at both personal and institutional levels (Knight 2002).

Therefore, when I was offered to do a teacher certificate course, I saw this as an opportunity to gain more insight into teaching and learning in a rapidly changing design school environment where teaching was set to becoming more professional. But I also wanted to take my interest in sketching for design further. This then became my Master study on the role of the sketchbook in design schools, which, however, left many questions unanswered as to the impact of the digital medium on freehand drawing. For example, would sketching follow the route of drawing boards and become dependent on mediated digital systems. My MA thesis, therefore, opened up a still wider research field where sketching was contextualised in the post-modern, digital realm of design ideation, and both in higher education and industry.

This doctoral thesis, then, is for students, teachers and practitioners of design who are curious about design ideation and willing to explore without prejudice the future of conceptual tools in a digital design culture.

The plan of the thesis is straightforward. After the *Preface*, the *Introduction* situates conceptual sketching in current practice in design schools and industry. The first Chapter *Literature Review* explores and articulates theoretical and practical concerns of the subject in a historical and contemporary context. Then, the Chapter *Methodology*, through definitions and distinctions, progressively focuses the field of study and determines the research strategy. This leads to the Chapter *Pilot study*, in which the research approach is tested, followed by the subsequent two Chapters of *Findings* where the results are presented and discussed, culminating in the *Summary and Conclusion* including a speculative note on the future of sketching.

ACKNOWLEDGEMENTS

In the pursuit of the thesis, there are many contributors to whom I owe a great deal, and notably the many students and practitioners who took part in the protocol studies or otherwise generously shared their thoughts on design practice and thereby offered invaluable insights into ideation processes (see Appendices A, E:2, F:3 and F:4). Also, I gratefully acknowledge their contributions of rich illustrative material, which added considerable value to the enquiry.

Among colleagues and staff in the Design department, I wish to thank in particular Professor Richard Kimbell, who, as my supervisor, was encouraging throughout providing penetrating comments and thoughtful and necessary advice. Thanks are also due to Ann Schlachter, the Postgraduate administrator, for her ready support. I am also indebted to the Department for receiving a bursary, which enabled me to pursue the research full-time.

I would also like to thank Professor Martin Woolley, who read the final draft and offered valuable comments.

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RESEARCH SCHEDULE

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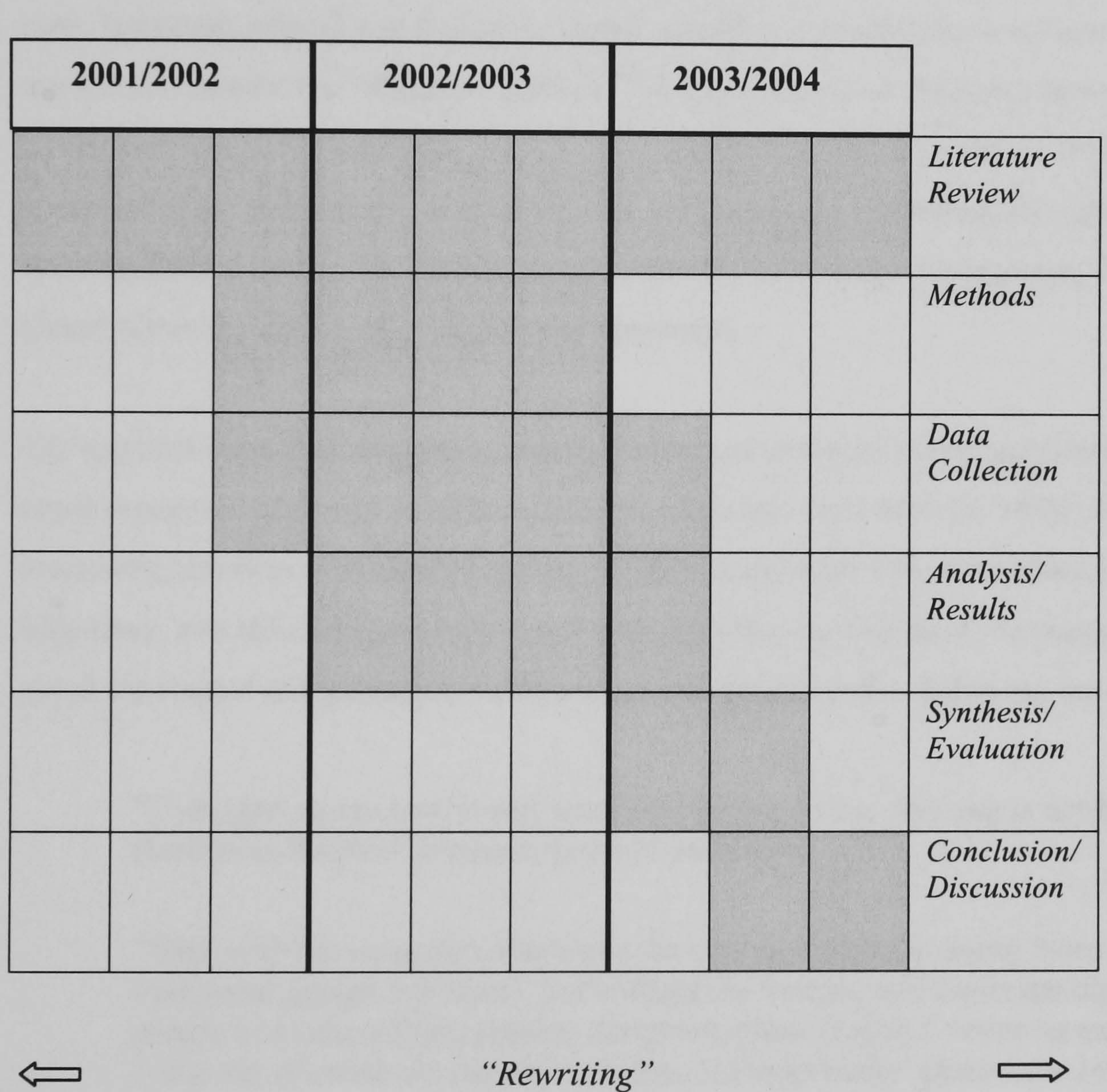
Finish: July 2004 (Academic year 2003/04)



Author's note: Doing PhD by thesis is essentially a slow and deliberate process of thinking and writing. And reading is continuance. And writing is writing, not preparing to write. Indeed, writing is largely rewriting, and 'to speak of "writing up" the results of research is to betray a total misunderstanding of how scholars work' (Watson 1987:9).

A: INTRODUCTION

Sketching in Design Schools

The practice of freehand drawing in design schools in England has diminished for some time now. However, when I was talking to design teachers at a collegiate level across domains some argued that despite the "digital revolution" there is a revival of freehand drawing, even that it never went away. For example, 'Drawing is central to all that is produced within the broadest spectrum of art and design', to quote from a DVD package promoting the significance of drawing funded by the UK Teaching and Learning Technology Programme, TLTP, (*SeeingDrawing* 2002), may support this argument.

Yet teachers were also acknowledging that advances in digital technology, combined with the rapid expansion of design in higher (tertiary) education since the mid-1990s, have seen increasing numbers of students entering design schools with little formal drawing skills. Moreover, conversations and interviews with practitioners in industry revealed their concerns about the impact of digitisation on drawing, as illustrated in the following quotes:[1]

> 'Then [pre-computers] it was an effort to draw, today drawing is not being celebrated' (Interview Richard Seymour, product designer).
>
> 'Then with the computer, there was the operator/designer doing more and more [of traditional design activities], but without the training and understanding that those other people had [illustrators, graphic designers, photographers, lettering artists etc]. So the computer allowed one person to do lots of things badly' (Interview Jeff Daniels, graphic designer).
>
> 'We got hoodwinked about computers that they could do everything. They can do everything, but they do it in different ways' (Interview David Chaloner, product designer).
>
> 'To anyone who draws cows, if all you want to is to cut them in halves and put them in formaldehyde, who cares how well you draw the cows. It's about different things'. (Interview Ron Arad, product designer).

[1] The quotes are from interview notes or verbatim records. For transcripts, see Appendix A.

The digital medium has also had a dramatic impact on the materials and tools used in the design process. For example, the computer (hard and software) has effectively replaced the following paste-ups items for graphic design (list not exhaustive): Pencils, ruling pen, technical pen, ruler, eraser, brushes, palette, paints, set squares, pushpins, dividers, compass, tweezers, inks, thinner, cotton, rubber cement, water, sand block, fixatives, cutting mat, templates, French curve, scissors, scalpel, razor blades, dust brush and masking tape. That is, twenty-eight analogue graphic tools and items were substituted with one single source of digital tools, viz. the computer, or the proverbial "designing-out-of-the-box" (Fig. A:1).

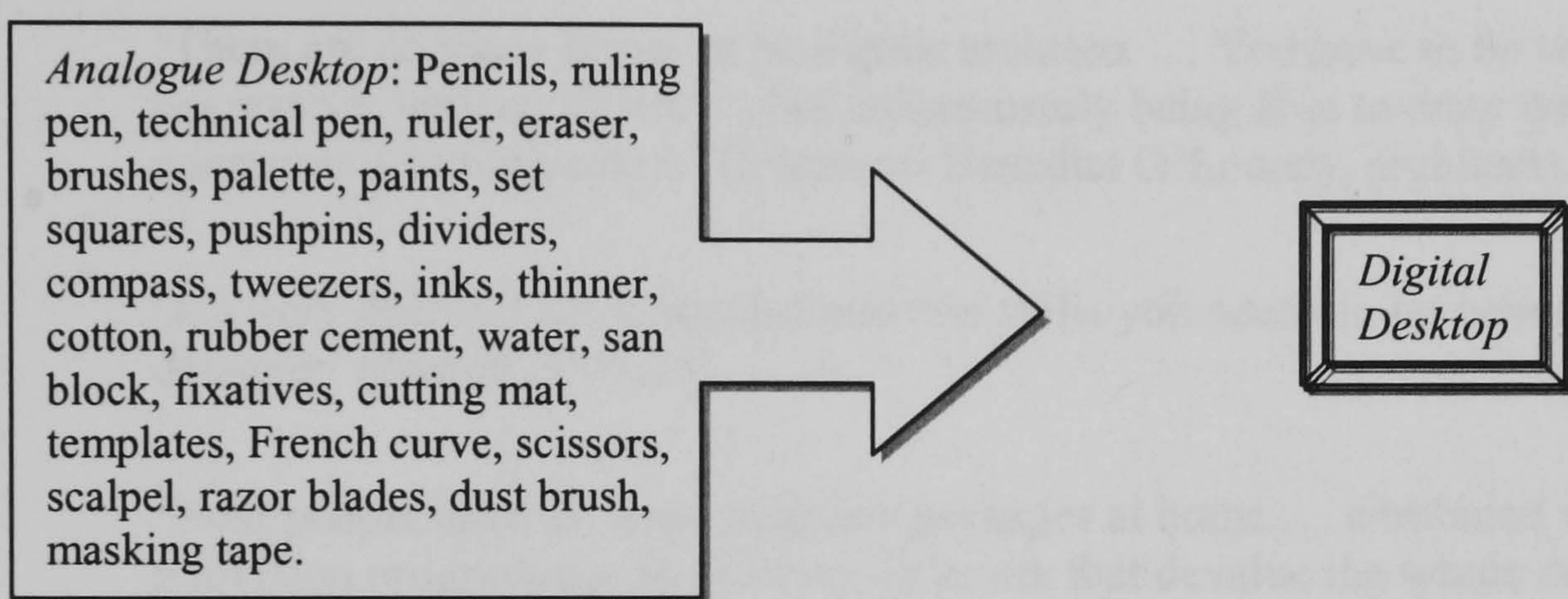


Figure A:1 Shift from analogue to digital graphic tools

Not surprisingly, and in line with the general decline in time-consuming handwork, both domestically and in the workplace, there are design students who are questioning the importance of freehand drawing in a digital image culture. Sketching, so what! Design curricula and individual tutors' attitude to drawing may also influence the role of traditional drawing. For instance, in the three design schools from which I drew participants to my multiple case study, freehand drawing skills were not formally taught (see Chapter *Findings Y1* Students, and Chapter *Findings Y2 Students and Practitioners*). The academic drawing paradigm was also challenged in 2001, when the Royal College of Art, Britain's original design school (1837), decided that drawing was a college wide resource not to be departmentalised.

Students' attitudes to drawing may also reflect how design education in England has been separated from traditional apprenticeships (and therefore teaching from design practice) becoming increasingly diverse and fragmented in the transition from analogue to digital, or virtual learning environments, VLE. Moreover, the growing numbers of students entering design schools suggest that design, as a human adaptive by-product, is becoming part of a non-specialist education like art. Or, a 'pleasure technology, like drugs, erotica, or fine cuisine – a way to purify and concentrate pleasurable stimuli and deliver them to our senses (Pinker 2002:405).

The creative industries also reflect the larger, post-modern notion of design (see Chapter *Methodology*), in which the designer is not necessarily a specialist competent in freehand drawing.

> 'There's a new breed of designers. Some of them don't /can't draw at all. They just don't have the ability. Yet that's not seen as a hindrance, and they are still "designers"' (Interview Jeff Daniels, graphic designer).
>
> 'There are so many things to be a great architect ... You have to be very tough, very aggressive, very confident ... but unfortunately being able to draw well does not guarantee a smooth career' (Interview Benedict O'Looney, architect).
>
> 'It's very difficult nowadays because the skills you need are far beyond that of just a designer' (Powell 2003:27).
>
> 'Now people have all these software packages at home ... combined with these awful television programmes about home interiors that devalue the whole design process' (Interview Pauline Muscant, interior designer).
>
> 'The proliferation of design software has led to the development of a body of people working as design professionals without any formal training. These people are the source of a lot of bad design work using computer effects in the guise of creativity' (Cleveland 2004:151).

Moreover, demands for new design skills in industry reflect changes in consumer attitudes and behaviour ("conspicuous consumption and brand awareness"), but also in economic value. For example, UK manufacturing decreased from a peak of almost 50 per cent of GDP in 1950, to around 20 per cent half a century later. But also, in the shift from manufacturing to services, from goods production to knowledge production, design curricula are being re-written and expanded not only in response to the new needs of the economy but also to the relocation of design to the university environment (Buchanan 2004). In this, the teaching and learning of traditional trade based skills, including drawing, have lost some urgency.

However, in an effort to increase awareness of drawing in education and everyday life, the UK wide *Campaign for Drawing* was launched in 2000. This initiative was based on the belief of the Victorian art and social critic John Ruskin's (1819-1900) that drawing is as essential to life as reading and writing. Yet, interestingly, Ruskin founded a school of drawing, rather than a school of architecture at Oxford, which he attempted, reflecting the intellectual distance between the worlds of "making" and "thinking", which, arguably, may still be working against teaching and learning practical skills. Therefore, the dominant verbal culture in higher education may emphasise "talking", rather than "doing" design (see also Chapter *Methodology*).

But despite the vulnerable position of freehand drawing in a digital design culture, the digital medium is increasingly influencing students' course work. That is, when computers were first introduced in design colleges, they were mainly used for word processing and graphics, whereas students now use the digital medium at the early stages of a course assignment, and whether for Internet search or, say, producing a conceptual video clip. However, so far the impact of computers on studio work in design schools has been relatively little researched, for example the Virtual Design Studio, VDS, which is a method used in architectural teaching for building virtual spaces (Kvan 2000). Yet, everyday studio experience in design schools suggests that the computer is not just a presentation tool but an exploratory medium for seeing and experiencing design in new ways. For example, a second-year student illustrated how computing discloses new work patterns and practices towards discovery (see also Coyne et al. 2002).

> 'I don't think you have that much control over the computer. It's more like you click a button and suddenly something happens and you find something new and completely unexpected and that leads you to another path' (Rachel Finer, Y2 textile design student, Central Saint Martins).

This illustrates how the digital medium can break down barriers between the "physical" and the "virtual" prompting students and educators to rethink not only ways of representing and presenting ideas but also relationships between generating ideas and final outcomes, which also have implications for teaching and learning design.

> 'As part of the art and design learning process, students produce visual research to refine and explain the concept behind the final outcome of their work. This is becoming more difficult to maintain as students see little need for manual dexterity when finished work can be created totally within a digital environment: camera, scanner, printer and computer' (Hamilton 2003:78).

These observations, then, may lead to questioning whether 'drawings are an inevitable and essential part of the design process' (Purcell and Gero 1998:399). That is, design-by-drawing (Jones 1970) might purport a generic notion of drawing based on an unstated assumption that drawing is about representations of specific physical artefacts as expressed in say, conventional working drawings and specifications for manufacture, thereby overlooking the post-modern idea of designing "without a product" (see Chapter *Methodology*). Moreover, in a digital design culture, the "inevitable" may suggest that drawing constitutes a kind of "default setting", that is, designing would typically start in the computer-aided drawing mode which may exaggerate the design process as essentially visual, rather than a complex verbal and non-verbal integrated process.

Recognising the importance of communicating design verbally, Purcell and Gero have also argued that 'the visually dominated designer may have difficulty in producing a fully resolved design' (ibid.). Therefore the lack of conceptual knowledge of the visually dominated designer might impair access to conceptually driven design processes (ibid.), which, I would suggest, characterise much of post-modern innovative design (see Chapter *Methodology*). Arguably, then, such designers may find themselves "trapped" in the digital mode, as reflected in "CAD monkeys", a derogatory term used in industry for designers who are working exclusively on screen under conditions of growing routinisation and fragmentation of design tasks.

However, the risk for designers of getting caught in what might be called the "digital visualisation trap" from lack of conceptualisation skills suggests a need for a wider, rather than narrower range of competencies, knowledge and experiences that goes beyond both analogue and digital drawing skills. The need for varied design skills is also included in the recommendation for children learning design and technology in compulsory schools in England (Benson 2002). This, then, suggests design as a continuing, life-long learning process that may challenge the traditional compartmentalisation in art and design education.

The emphasis on learning rather than teaching was expressed in the ICOGRADA Design Education Manifesto presented to the Congress in Seoul in 2000:

> 'More than ever, design education must prepare students for change. To this end it must move from being teaching-centred to a learning-centred environment which enables students to experiment and to develop their own potential beyond academic programs. Thus the role of a design education shifts from that of knowledge provider to that of a person who inspires and facilitates orientation for a more substantial practice' (in Design Issues No. 18, Vol. 2. p. 55, 2002)

Sketching in Professional Practice

To get a feel of the current state of sketching in professional practice, interviews, both formal and informal, were conducted with designers working in London's design industry, and mainly in architecture, product, and graphic design. The interviews were often combined with studio visits, which provided a rich context for the enquiry on the impact of digital technology on conceptual sketching. The quotes below are selected (purposive sampling) from the interviews (written notes, letters, emails responses and transcripts) and arranged thematically, to illuminate the role of sketching in professional practice in 2002 (for full transcripts of the recorded interviews, see *Appendix A*). However, it is necessarily a subjective selection, which depended largely on access to designers, although, at times, doggedly pursued. Yet, as an overview, it serves as an introduction to the research (see Chapter *Methodology*).

In praise of sketching

The practitioners interviewed held fundamentally positive views of freehand drawing. However, the interviews are illustrative (purposive sampling) rather than statistically significant (survey), and therefore it cannot be excluded that there might be substantial numbers of designers working in practice who are less enthusiastic about the sketch medium. Moreover, I noticed that the subject of sketching could touch a nerve in the industry.

> 'We should not let the advantages of digital media take away the advantages of our conventional tools. Most of the designers I know start with sketches. They then scan them in to the computer in order to translate them into machine specs, but still, the sketch is the superior medium'. (Email Don Norman, computer scientist).

> 'I see drawing as a core skill, but at the same time being very deft in CAD is a core skill too' (Interview Benedict O'Looney, architect, see also *Vignette* below).

> 'A sketch for me could be words, could be a diagram, it could be an abstract drawing, or a photograph. But sketch in its purest sense is the hand-drawn manifestation of an idea' (Interview David Chaloner, product designer).

> 'Sketching can also be an aid to creativity and many ideas can come from abstract doodles allowing the brain in the fingers to do the work, analogous to a musician searching for a melody' (Letter Geoff E. Kirk, chief design engineer).

> 'Let's say that rendering is dead, 3-D models are far superior and can be used to make tools [rapid prototyping], but sketching as a way of developing an idea from the beginning and during the design development is essential' (Email Jasper Morrison, furniture designer).

> Question: 'Do you encourage people to sketch, or do they just do it?' Answer: 'Uhmmm ... you have to remind them at times' (Interview Pauline Muscant, interior designer).

The case for computers

However, evidence of everyday sketching was not very visible in the studios visited because in the digital design studio traditional drawing boards and paste-up worktops have largely disappeared replaced with computer "desktops". This reflected how the design environment has shifted from freehand to screen based design, in which there is little physical space for traditional skill-based design activities. Yet, and although the ergonomics of the digital design environment might be working against analogue practices, designers have become dependent on computers for designing, particularly in large projects.

> 'Design companies could no longer function without [computers] or indeed would want to' (Letter Patricia Herbert, interior designer).

> 'All designers must have good computer skills' (Interview Matthew Wood, architect)

However, one design company (eleven textile designers) used computers for administration only, not for creative studio work, although a shift in the product range in 2003 meant that digital pattern making techniques were introduced.

> 'Drawing is separate from computers. The computer is a tool that does a certain job. It's very different from drawing' (Interview Jenny Frean, textile designer).

CAD and conceptualisation

However, computers were frequently used at the research, information and production stages of design. In contrast, most designers interviewed did not think of the computer as a conceptual sketching tool, that is, they thought that you could sketch neither imaginatively nor effectively using a current computer drawing package, CAD (the difference between drawing and painting software packages is explained in Chapter *Literature review).*

> 'Within many office situations not many people are designing. Production and assembly information is a big part of the office. The "grunt" is CAD technician. If a designer learns to use computer graphics they can easily become the CAD technician … Designing can reflect the office hierarchy; directors sketch for the design to be worked up by a technician' (Email Meirion Jones, architect).

> 'Clearly at the production and information stage, then computers are the way to go because things change all the time and computers are the easiest medium to response to these changes' (Interview Mark Stewart, architect).

> 'It is at the beginning of the design cycle that the sketch is the most useful. If I sit down in front of the screen I cannot sketch because of the limitations of the drawing packages. I can't visualise on the screen at that stage. I visualise onto the paper' (Interview Rhama Gheerawo, product designer).

> 'In our team of fourteen designers, only half of us use freehand sketching sometime at the conceptual stage of the projects' [these designers were called "originators" who worked directly with clients, the other designers and the rest of staff were in the

"delivery business"]. Also, 'CAD is used as a sketch development tool once we won a contract because it is time consuming to enter data and [CAD] cannot replace sketching' (Interview Jim Patterson, architect).

'If you can't draw, for example, a beautiful spiral staircase, you won't even be able to dream about that staircase. Yet you can use the computer [CAD] and sketch forms you could not do by hand'. (Interview Christophe Egret, architect).

'For conceptualisation, this is still only really possible with hand and brain, pencil and paper' (Email Perry King, product designer).

'We don't design with a computer to start with. We see it as a technical tool that comes after the thought and creative process. ... The freehand drawing reveals the design. First ideas ... the initial idea is still in the outcome' (Interview Pauline Muscant, interior designer).

'Using a computer at the conceptual stage of a project can severely impair a designer's ability to think and draw ... Once a concept has been committed to a computer designers are often reluctant to change - they are scared or lazy' (Letter Patricia Herbert, interior designer).

'A CAD system is fixed and is not quick enough to capture fleeting ideas but obviously provides a more powerful tool once ideas have been formed and the more formal part of production definition has begun' (Letter Geoff E. Kirk, chief design engineer).

'When I ask designer for ideas, they don't do "the quick sketch", but prefer the "verbal mode", or seem stuck with the computer drawing systems. Thus they go straight into CAD and produce, say, three "solutions" in half a day, all very similar ... It seems that if they invest so much time in the CAD mode, they feel reluctant to take risks and change the design ..."What if?" doesn't pop up on the screen' (Interview Matthew Wood, architect).

'The computer seems to encourage going straight into finished work without the critical and creative thought period' (Letter Patricia Herbert, interior designer).

Although computing is associated with constructional detailing, it could also present problems.

'When you are designing on paper you are at the same time thinking through the construction and detail full size. It is not possible to do this on a computer as it takes far too long' (Letter Patricia Herbert, interior designer).

Digital sketching

But despite the computerisation of design studios, digital tablets as an input device were not much in evidence among the practitioners interviewed. However, those few who said they did saw little difference between drawing on paper and a digital sketchpad.

> 'I sketch on my tablet exactly in the same way as on paper. The only difference is that I can put it on any computer in the office. Whatever sketch I do is saved as a JPEG and everyone can use it' (Interview Ron Arad, product designer; see also *Vignette* below).

But for most designers the digital sketch meant the scanned sketch (bit map), that is the manipulation on screen of the original sketch using software applications, such as PhotoShop™ filters (see also Chapter *Findings Y2 and Practitioners*).

> 'I scan sketches and render them [in PhotoShop™]. But you need to be able to sketch, to be able to think. It's what goes on behind that's important. Conceptualising with sketches is still more evocative' (Interview Mark Stewart, architect).

Digital imagery, therefore, tended to compliment rather than substitute freehand sketching in the conceptual phase, although one young graphic designer was reported as being against using pen and paper on principle.

> 'He believes that pen and paper just "gets in the road" and add nothing to what he would have done anyway using a computer alone ... He can't draw of course, but only because he doesn't practice. Anyone can draw. But he would just as soon find a photograph, scan it, convert it into a sketch using a PhotoShop™ filter, and say "there's my sketch"' (Interview Jeff Daniels, graphic designer).

The presentation sketch

However, digitised sketches were used as substitutes although mainly in presentations, which reflected clients' expectations of photo realistic imagery increasingly making traditional rendering redundant.

> 'We have found that for every client who wants to see "rough sketches", there are ten that, perhaps less sophisticated, want to see computer renderings' (Email Perry King, product designer).

> 'Sometimes we use early sketches for presentation but it depends on the client relationship and how well we know them' (Interview Ron Arad, product designer).

> 'We use the rendered sketch a lot. We scan the sketch into PhotoShop™ and render it. I think that hand rendering is a bit of a dying art now. Clients are used to looking at photo realistic images and sometimes they can't imagine hand-rendered images. It depends on the client, of course, but in general they appreciate [sketching]. Although I remember how we lost a project when someone drew the scheme in front of the client - obviously a PowerPoint™ client [laughs]' – 'The problem with sketches is that it can be rather individualistic, not necessarily what you want all the time [for presentations]' (Interview Mark Stewart, architect).

'Part of the rapid adoption of technology in design is due to clients' inability to decode sketches. The designer and the client can look at and talk about the same rough sketch but will "see" completely different things. So the more highly finished a visual is, the more likely it is that the same thing is being "seen" by all concerned. For me, this reached the crazy situation where some clients would only consider an idea if it was in fact completely finished!' (Interview Jeff Daniels, graphic designer).

'I suspect a preconception among clients that polished computer presentation material represents plausible solutions whereas sketches represent first thoughts in need of more work. Some designers know this and use 3-D CAD software to excite client about ideas that they will prove later'. Moreover, 'computer renderings are known fakes trying to achieve a clinical accuracy while a sketch is a suggestion that allows us to fill in the detail with our own imagination. However, as one is a presentation tool and the other a process tool it is unlikely the sketch will replace the computer rendering. This would rely upon designers having the guts to let clients use their imagination on a sketch rather than trying to dazzle them with fake reality' (Email Tim Parsons, product designer).

Sketch to communicate

Sketching was also seen as an important means of communication.

'It becomes a little bit more difficult to communicate, to engineers, to clients, if you can't draw' (Interview Rhama Gheerawo, product designer).

'You have to establish a design language early [of which sketching is a part], both in-house and vis-à-vis clients' (Interview Jim Patterson, architect).

'We don't actually have a strong corporate identity like Foster and Partners [architects] do, who control all their output. We are much more flexible. We don't really have a house-style. It can be a benefit as well as a negative. [Sketching] is more of a working practice [than a house-style]' (Interview Mark Stewart, architect).

As a means of communication, sketching was also described as 'off-screen activities', a form of meta-language in that sketching was seen as 'creativity above computer' (Interview Jim Patterson, architect). Or,

'Meta-sketching, because drawing is empirical yet also a cognitive activity ... Sometimes just six strokes are needed to express an idea' (Interview Richard Seymour, product designer).

'You can't hide, like the Internet. Sketching is honesty, close to origin. Everything is about sketching a moment, a conversation. The spoken word becomes a sketch' (Interview David Chaloner, product designer).

Sketching as skill

Although sketching was not necessarily thought of as an artistic activity, it was regarded as an aspect of drawing that could be improved through practising, from doodling to life drawing.

> 'The stuff you learn on a foundation course, for example, life drawing, still-life and objective drawing are transferable to design ... but many designers don't seem to make the difference between "the ugly sketch" and "poor drawing skills"' (Interview Matthew Wood, architect).

> 'Sketching is a talent that can be learned to a degree ... I think there's still a big place for sketching.' (Interview Mark Stewart, architect).

> 'Drawing classes help but not absolutely necessary. But for a simple perspective you need to know the conventions to understand. Everything we do is about communication, that's why it is so important' (Interview David Chaloner, product designer).

> 'The sketch is a tool – a tool that supports an idea' (Interview Jim Patterson, architect).

> 'A lot of the sketches here [in sketchbook] are "poor" [as drawings] but not "bad" [as ideas]' (Interview Christophe Egret, architect).

Thus, as part of all-round design skills, sketching was a valued and integral part of design practice, a skill that ought to be encouraged and supported in design schools.

> 'Sketching, for students, helps to organise hands and minds. It teaches 3-D skills, how to go round corners, like model making. As there is still no substitute it is clear that drawing skills must be integral to Design Education. I think that whatever the computer will be able to do this will continue to be of importance in the learning process' (Email Perry King, product designer).

> 'If we created a curriculum where drawing was as important [as the three R's], you'd get a layer of the population that would be more intuitive, more lateral thinkers, more open to unconventional things. Drawing skill is sketching!' (Interview Christophe Egret, architect).

> 'The sketch reveals the designer's "feel" for both sketching and designing, and therefore the sketch is an integrated part of design thinking ... [sketching] skills not only inform sketching but are also needed to understand design [spatial articulation and construction]' (Interview Jim Patterson, architect).

Sketch modelling

The sketch was also related to sketch modelling.

> 'What we always use in conjunction with sketching is modelling. Card-board or foam-board in sketch form. And that's almost a sketch substitute'. Also, 'Many people can't sketch so modelling is a way around that' (Interview Mark Stewart, architect).

Sketchlings

The alleged lack of drawing skills among recent design graduates entering industry was picked on by practitioners and highlighted how existing, or "ready-made" images may be used as "best fit" for ideas (see also *Post-modern design* in Chapter *Methodology*).

> 'Most [junior] designers [in the firm] have poor freehand drawing skills, both 2-D and 3-D, and don't use sketches either for self-expression or communication with others in team situations ... Without the computer they seem lost and communicate poorly in freehand drawing' (Interview Matthew Wood, architect).

> 'We had a postgraduate candidate. The work was so esoteric that we couldn't understand what on earth he was doing or what it was about. He had no sketches whatsoever. Even the computer drawings were difficult to get information from. It was not his fault, I think this is an education problem' (Interview Pauline Muscant, interior design).

> 'Their [new designers'] initial thoughts don't start at the pen and paper stage, but at the computer/mouse/graphics tablet stage. In other words, instead of having a thought and putting it down on paper, however badly or primitively, they have the mental thought and then seek to find an existing image that best equates with that thought. So their starting point is not really what they had in mind, but what they can find that already exists that is nearest to it' (Interview Jeff Daniels, graphic designer).

A generational thing?

The question whether age played a part in computer use, in contrast to sketching (see above *Sketchlings*), did not seem to matter. However, one practitioner explicitly said that there was no generation gap when it came to working with computers (see Chapter *Literature Review*).

> 'We are around 50 architects and half among those do sketching. It depends on peoples' skills. If they are not good at sketching or thinking in 3-D they quite often go to the computer to help them. And it is not a generational thing' (Interview Mark Stewart, architect).

The 3-D sketch

Yet, only a few of the designers interviewed professed to "doing sketching" on a fairly regular or everyday basis. Moreover, when recruiting, not all designers insisted on seeing candidates' sketchbooks although they agreed that the sketch often reveals more than just drawing skills, such as aptitude, 3-D thinking ability and imagination.

> 'Some people can't think in 3-D. That's a problem and sketching is wonderful from that point of view. Even a computer shows 3-D images too much like 2-D' (Interview Mark Stewart, architect).

Sketching is individual

The practitioners described the characteristics of sketching in multifarious ways.

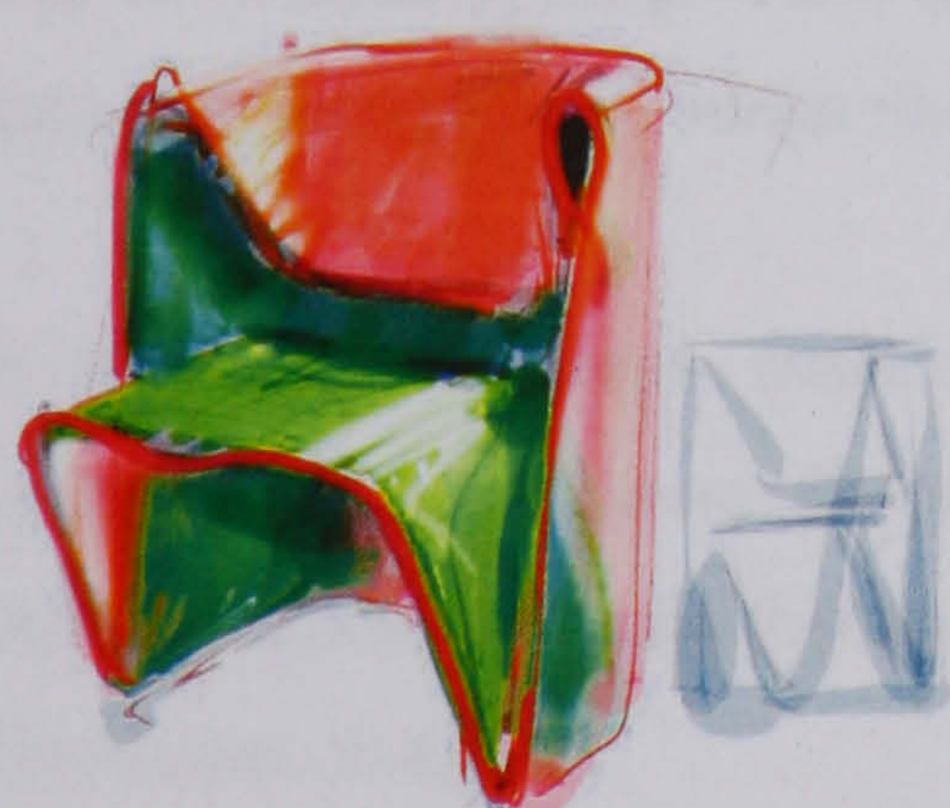
- Sketching as doodling (daydreaming), or a "pre-sketch"
- Sketching as an emotion rather than information
- Sketching as communication with team members, sub-contractors and clients
- Sketching as performance
- Sketching as discovery
- Sketching creates ambience
- Sketching is quick and loose
- Sketching is super low-tech
- Sketching is choice, not prescriptive
- Sketching a 3-D object explains basic construction better than 3-D computer images
- Sketching improves understanding of what you see (observational skills)
- Sketching helps in the understanding of scale
- Sketching skills stay (unlike computer skills which rely on short-term memory)
- Sketching delays commitment (unlike computers which are process driven)
- Sketching, particularly the conceptual sketch, is more evocative than a computer image
- Sketching with words captures content
- Sketching supports ideas and helps their development

Two Vignettes

Two designers, Ron Arad (Product design) and Benedict O'Looney (Architecture) were chosen among those interviewed to illustrate uses of conceptual sketching. For this purpose they were visited in their studios twice. (For transcripts of interviews, see *Appendix A*).

Ron Arad, who trained as an architect (Tel Aviv/London), is a London-based product designer and programme leader at the Royal College (Design Products). Now in his early 50s, he has enthusiastically embraced the digital medium. Indeed, he says that all his projects start with Painter™, a painting package (bit map), which works technically like a scanning process, for which he uses an electronic stylus for direct input on a graphics tablet (touch screen). Moreover, his laptop computer holds all his sketches and presentations, what he calls his 'archive'. 'This is part of how the computer industry appropriates language', he adds. Rare among the designers I talked to in using a digital tablet, he further claims that there is no difference between sketching on screen and on paper. 'It is just as if I had all the paints and brushes I need'. The paper metaphor, however, introduced another powerful metaphor, that is, 'the task of accounting for what happens when designers use computers', or 'the concept of a world behind the screen' (Coyne et al. 2002:276).

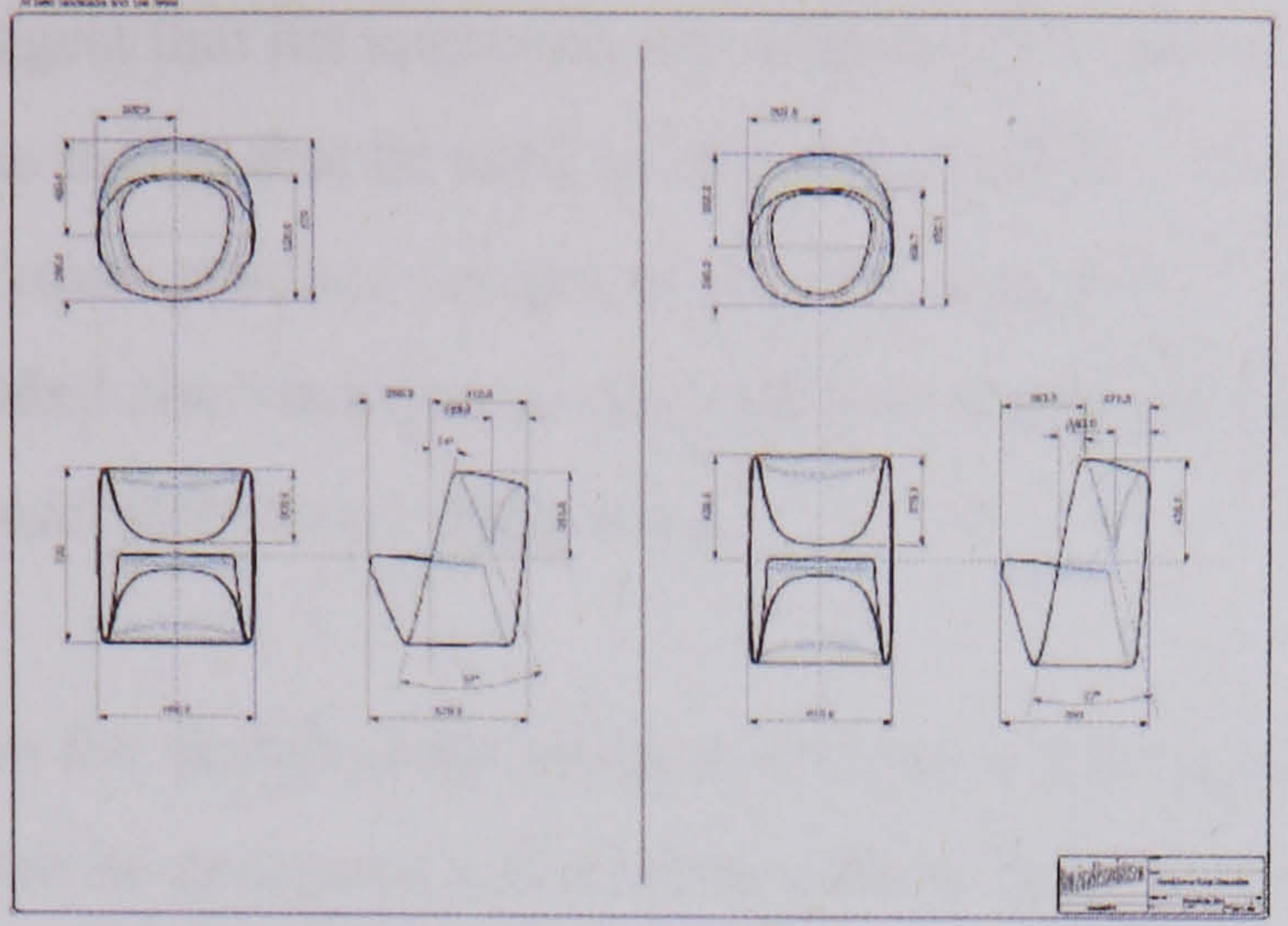
Demonstrating his approach to design ideation, Ron has chosen a rotation-moulded plastic chair, which begins as a blob on the graphics tablet and then, through a number of sketches (Illustration A:1), develops into a cylindrical form suggesting a rotation-mould manufacturing process (Illustration A:2).



Ill. A:1. Nino chair: Courtesy Ron Arad

Ill. A:2. Nino chair:Courtesy Ron Arad

Significantly, however, for detailing, his sketches, which are all saved in JPEG (bit-map) format, have to be converted in a powerful 3-D drawing package (vector). (For a distinction between painting [bit map] and drawing packages [vector], see Chapter *Literature review*). That is, the sketches cannot be exported and automatically turned into three-dimensional form by the mathematically defined drawing package. For this, he relies on face-to-face collaboration with his CAD assistant, who is in fact a trained architect and therefore not just a technician, and who translates his pixelated sketch ideas into CAD geometry (Illustration A:3).



Ill. A:3. Nino chair: CAD geometry. Courtesy Ron Arad.

Continuing his demonstration, and standing next to his CAD assistant, Ron says he is not totally happy with the shape of the back of the chair, as it has been drawn on-screen, and therefore asks the assistant to manipulate the curvature to better capture his sketch ideas. However, his words are not sufficient to explain what he wants precisely. Therefore he grabs a sourcebook ('1000 Chairs', published by Taschen) from a table next to the computer, searches for an illustration of a chair he knows he likes (a 'Windsor' type of wooden chair), and shows it to the assistant in order to exemplify, support and therefore better express his design idea. All this is done with some flair and subtlety, which illuminate the quality of their collaborative working practice.

The final CAD drawing is intended for production, and as such will be sent as a digital file directly to the manufacturer for prototyping because, says Ron, computer-aided modelling, CAM, is now so powerful that his office has expended with in-house physical modelling (Illustration A:4).

Ill. A:4. Nino chair: Prototypes. Courtesy Ron Arad

On observing the development of the chair from sketch idea to CAD geometry and rapid prototyping, I suggest that his approach seems more *pret-a-porter* than *haute-couture*. Ron acknowledges this saying that he used to make one-offs but now prefers working with manufacturers to mass-produce designs to get the costs down. This also explains his idea behind the rotation-moulded chair because in this way two chairs, rather than one, can be produced in the same mould, and therefore cutting costs.

Ron works only in the sketch mode using a software painting package (he relies on his assistant for CAD), in which he generates and develops ideas. His digital sketches, through the office Intranet, can then be downloaded to any workstation thereby disseminating his ideas to his design team to be further developed into detailed drawings. This approach, I would suggest, resembles the way an art director would work.

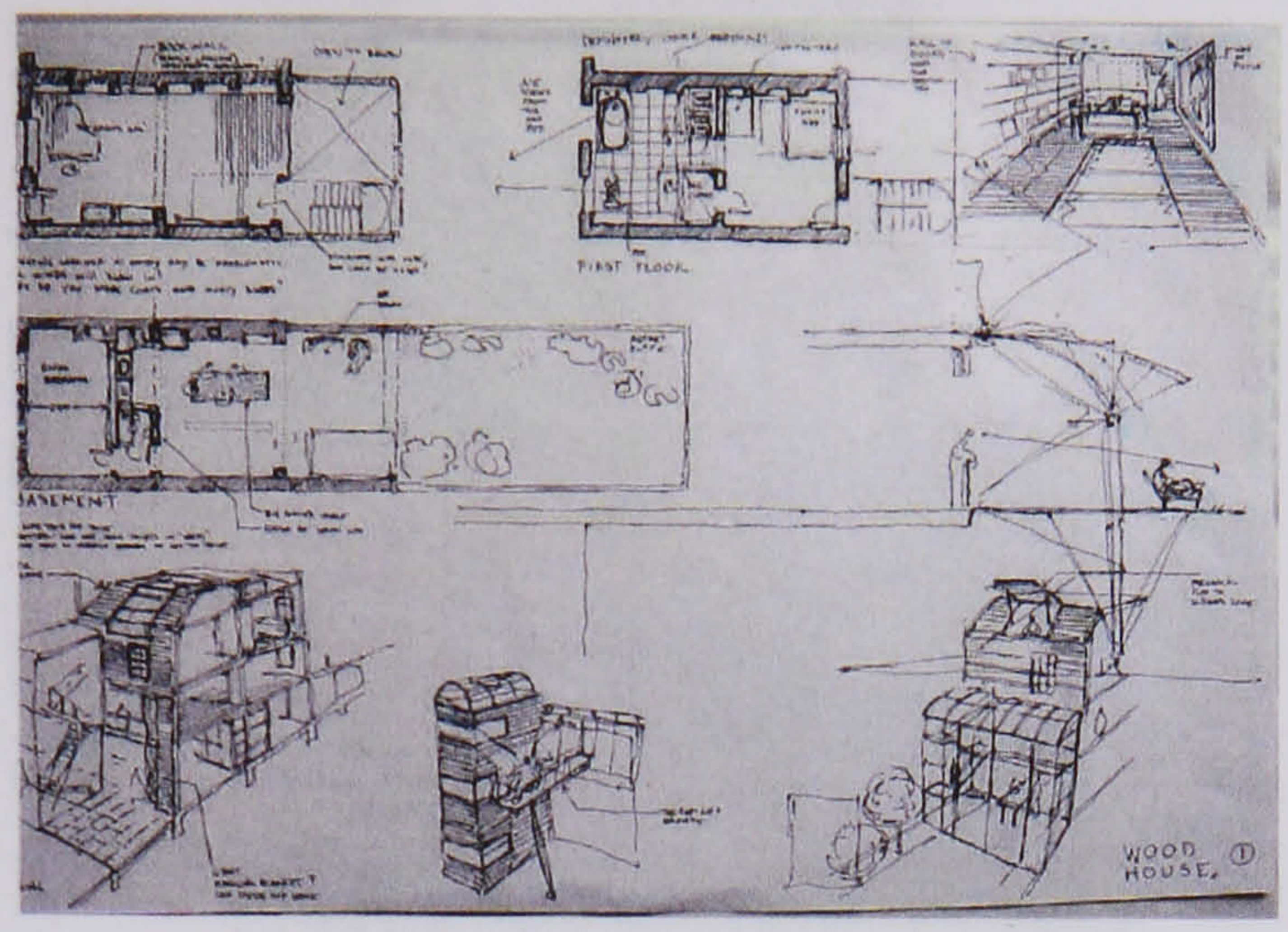
Ron says that his approach to drawing reflects his background and culture:

> 'It's part of the skills. You can have the most sophisticated 3-D software, but you have to have a mind to understand it. It is the same thing with drawing. Everything I do here [on the graphics tablet], even if I'm just doodling, for no purpose at all, even that somehow is knowing how to look at drawing'.

Benedict O'Looney is an architect in his late thirties working for Alsop Architects, an award winning London practice. He is extremely keen on freehand drawing, which he has developed persistently since his days in architecture school (Princeton, NJ). He says his drawing skills were an important asset for landing his current job because Will Alsop, the most senior partner, believes strongly in the creative power of freehand drawing and painting.

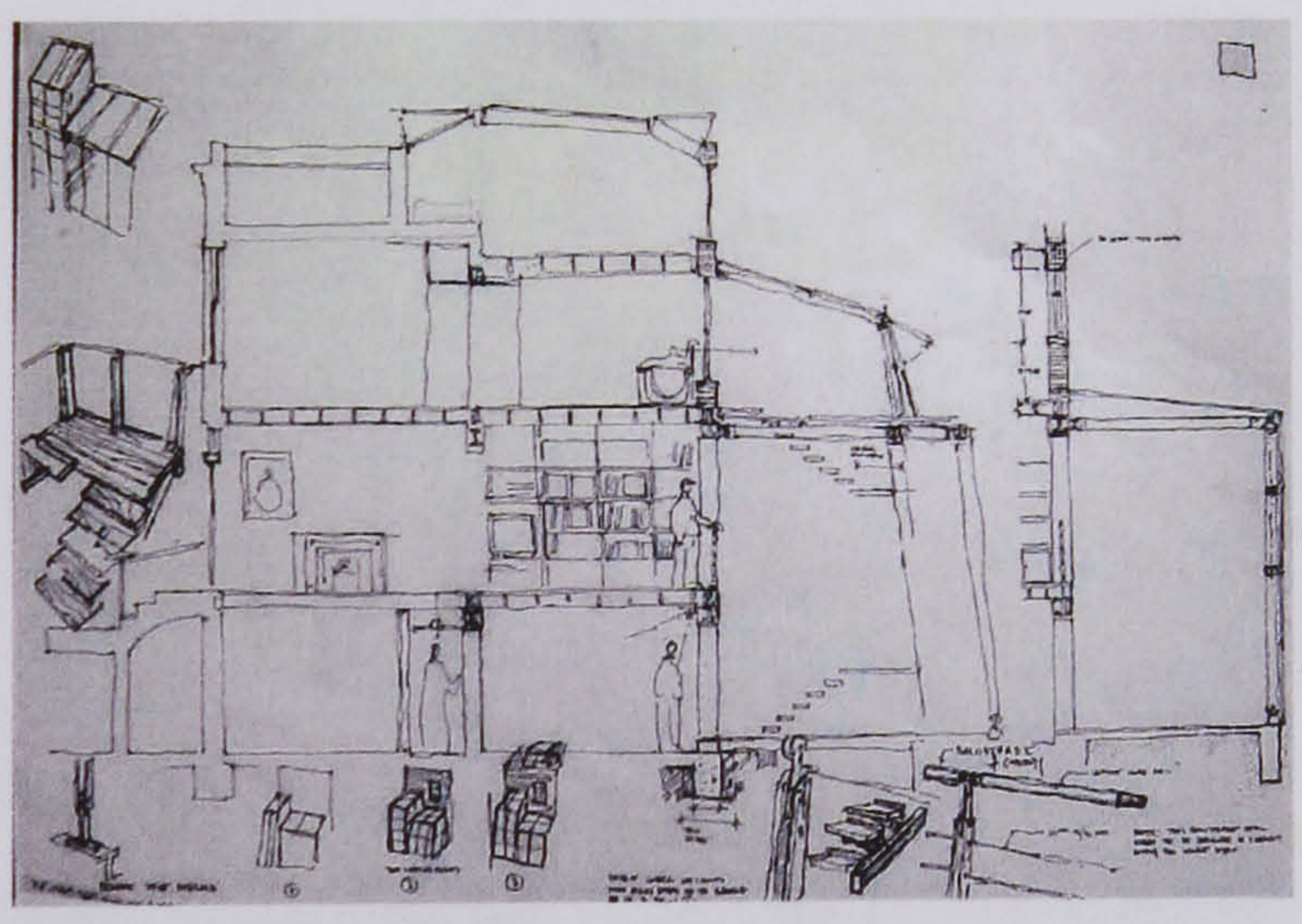
Benedict has also been teaching drawing at the Architectural Association, AA, but regrets that the number of participants in his class is dwindling from lack of student interest. His conceptual approach, however, involves both traditional (analogue) and new (digital) media, which he explains over a series of drawings for a project involving a back extension to a regency terraced house in West London. What is particularly interesting to note is Benedict's use of tracing paper for ideation, that is, to overlay a design and discover the potential for improvements over the previous versions of the design (see Illustrations A:5, A:6, A:8 and A:9). In this, computing and tracing paper, and similar to the graphics tablet, seemed 'to provide opportunities for working with layers in the design process', in what might be described as 'disclosure by *digital* provocation' (Coyne et al. 2002:282-283; *digital* my addition).

The first illustration depicts some plan and perspective sketches on tracing paper, which were done after initial client-architect instructions (Illustration A:5).



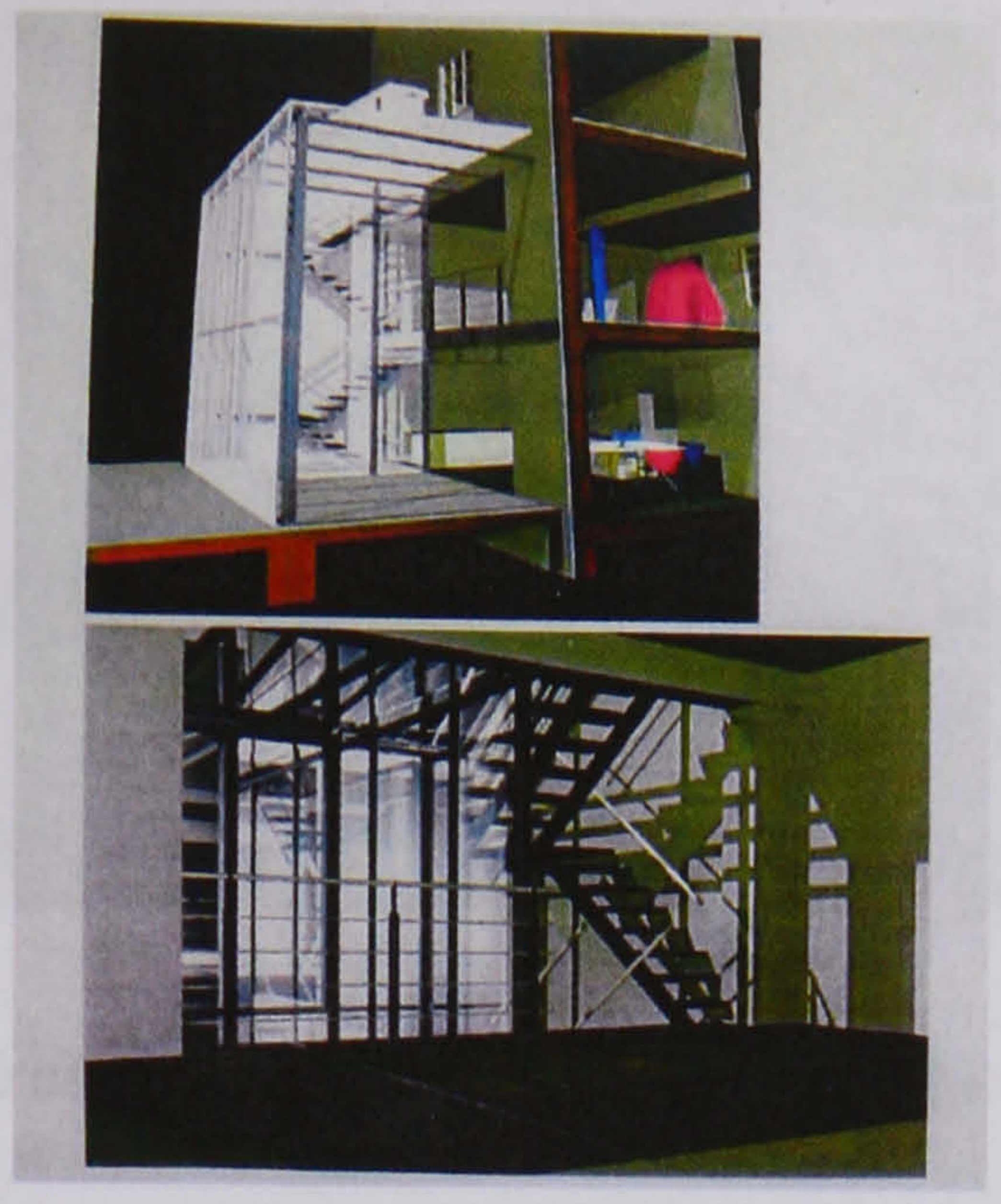
Ill. A:5. Sketch: Courtesy Benedict O'Looney

The next stage shows how Benedict made a computer section of the house and, on top of the computer outline, traced manually his ideas, including people and what things they might want to have around, such as storage (Illustration A:6).



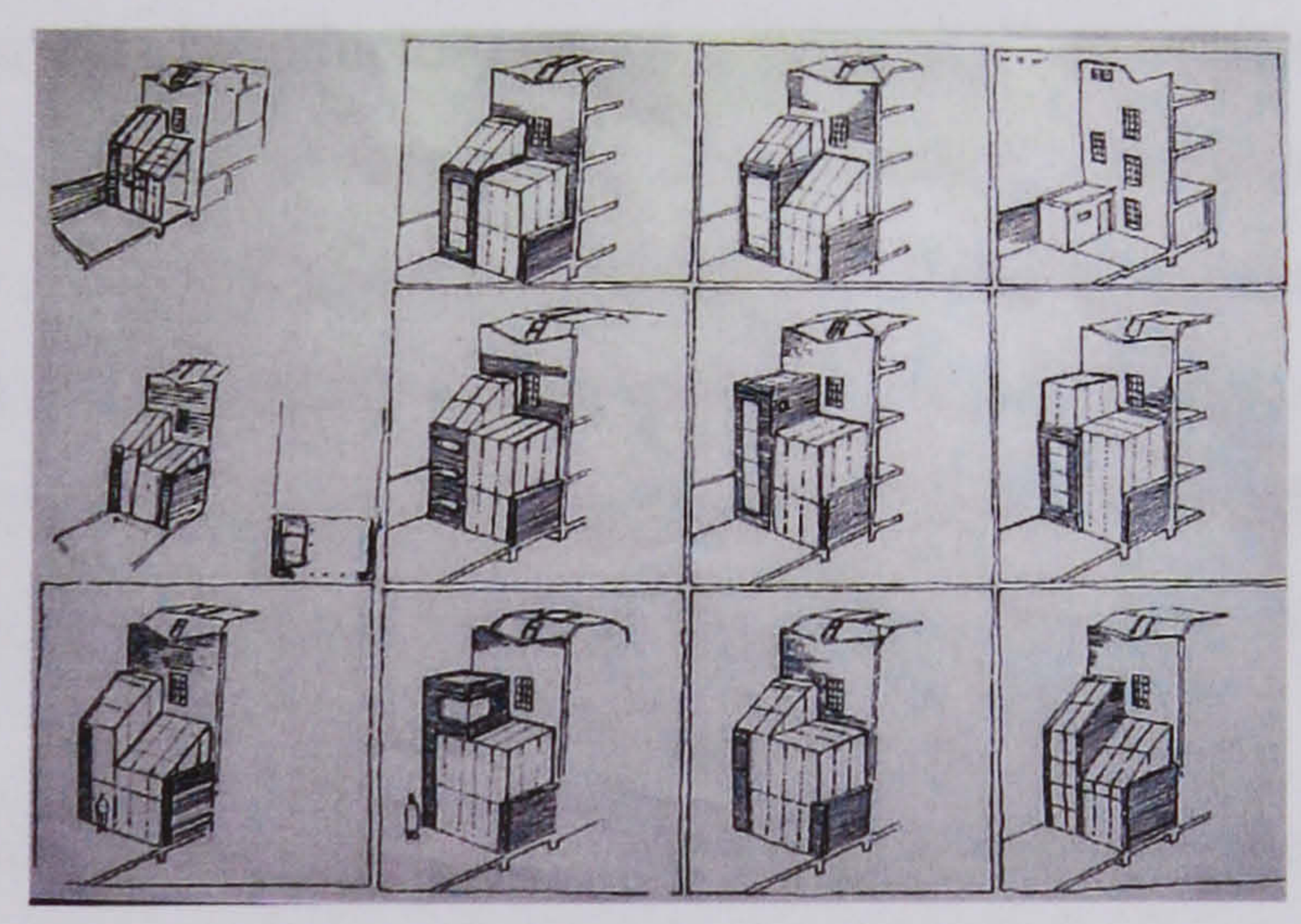
Ill. A:6. Trace overlay: Courtesy Benedict O'Looney

In the third stage he worked up a computer model (3-D package) which, based on his early sketches, shows the new spaces at the back of the building with a garden room that the client aspired to. The computer thus put some definite dimensions and special sizes of things producing a picture with bouncing light around (Illustration A:7).



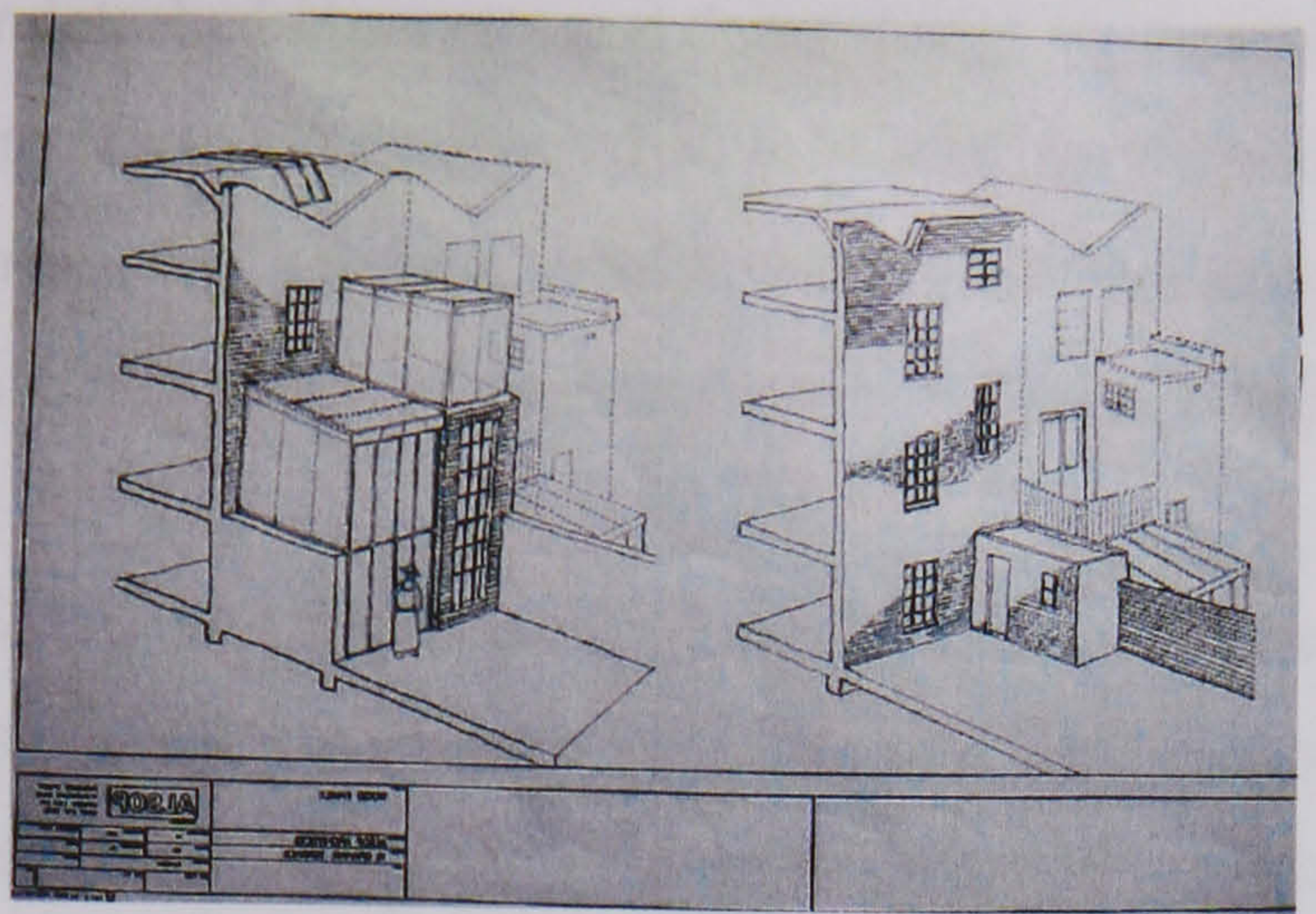
Ill. A:7 CAD modelling: Courtesy Benedict O'Looney

Having made the computer model, Benedict went back to tracing paper sketching over the computer model to make variations on a theme, to work through the ring of changes of what the scheme could possible be (Illustration A:8).



Ill. A:8. Trace overlay: Courtesy Benedict O'Looney

The final stage shows the "before" and "after" drawn by hand, tracing over the computer drawing with a technical ink pen. He comments, 'the computer drawing was important because one knows exactly how big this building is going go be. When I took this sketch to the Council planners there was no ambiguity about how big this thing was going to be' (Illustration A:9).



Ill. A:9. Trace overlay: Courtesy Benedict O'Looney

Commenting on his drawing skills, Benedict says they have improved over time. 'When I started drawing, I did life classes'. Showing me one of his travel sketchbooks, he reflects: 'the more I put into these studies, the more you see. It will probably surface in a subconscious way in some of my future work'.

Discussion

What emerged from this introductory round of "friendly" interviews and "unstructured observations" in design schools and professional practice was a strong *belief* in sketching. Yet, and although most designers said they regarded sketching as an essential part of working practice, it was not always visible in their studios. Still, sketching was generally thought of as a skill that would improve with practise, and therefore ought to be taught in design colleges (cf. lack of drawing skills, in Chapter *Findings Y2 Students and Practitioners*).

However, the interviews did not amount to a survey from which statistically generalisation could be made (see Chapter *Methodology*). Instead what emerged was a fragmented picture of at times conflicting messages. Therefore, on one hand, most designers portrayed sketching as generic to design, rather than critically assessing its role in practice, as might be the case from an academic perspective (for practical and theoretical aspects of sketching see Chapter *Literature review*. Also Jonson 2002). For example, my suggestion that sketches might be categorised according to sketch modes was criticised by some practitioners for being, for example, 'overly predictive' (Interview Christophe Egret, architect). Or, 'Academics work in a controlled way, technically they are brilliant. They know their distance. But [design] is also about passion, emotions, after everything else' (Interview David Chaloner, product designer).

These comments reflected the application gap between academia and industry, that is, between theory building by detached observers and doing design by practitioners (see Chapter *Methodology*). That practising designers had little need for a systematic naming of drawing types was also identified in a research study which shadowed designers and related their sketching to the different stages of the design process (Schenk 1989).

On the other hand, the interviews revealed that designers had been obliged to integrate freehand drawing into technological systems and that the use of CAD had become widespread. But whereas digital imagery and CAD systems were dominant, if not indispensable, in the areas of information, presentation, constructional detailing and production, the impact of digital technology on conceptual sketching was more uncertain.

Somewhat surprising was how few of the interviewed designers used graphics tablets. In fact, only three said they used a graphics tablet, one of whom actually showed me how it was being used in everyday practice (see *Vignette Ron Arad*). Therefore, it seemed that digital media complimented, rather replaced pen and paper sketching. However, the views on freehand sketching were those of senior designers with at least ten years of experience and therefore verged on the traditional. Or, 'Most of us designers came to this world through drawing with pen and pencil' (Interview Ron Arad, product designer, who, however, did use a graphics tablet; see *Vignette*, above).

The general praise of sketching, however, seemed a presumption that sketching is generic to design, which did not always match actual practice. For example, I was informally told by a designer at Foster and Partners (London's largest architecture office), that he was the only designer to use pen and paper drawing in everyday practice. Even so, that included digital manipulation of sketches for greater effect.

There were, however, advantages in talking to senior, rather than junior designers, because they had a good overview of the current state of design practice as strategic decision-makers. Typically, they were also involved in recruitment policy, which revealed, surprisingly, that freehand drawing was a desirable but not an indispensable skill when taking on new staff. Still, there was a risk, in their praise of sketching, that the interviewees might be biased towards the analogue medium, which also highlighted the weakness of relying on interviews alone when researching situated, authentic design practices (see Chapter *Methodology*). This influenced the research strategy for the multiple case study where I decided to compare second year design students with recent graduates in industry (see Chapter *Findings Y2 Students and Practitioners*).

Research Questions

Drawing, both in practice and theory, is a growing area of research (for contemporary drawing issues, see, for example, "Tracey" web site at Loughborough University, www.lboro.ac.uk). But is freehand drawing central to design in a digital design culture, and notably for concept generation? Around this theme, there emerged from the introductory study, and the literature review, a large number of issues, some of which are identified below (see also Chapter *Methodology* and Chapter *Literature review*).

As a conceptual tool, how does sketching support design activities: 1: In professional practice. 2: In design schools. a. When working individually (I-sketch). b. When working in a team (We-sketch). c. When working digitally (e-sketch). d. When working in an interdisciplinary mode. When designers have a choice of medium do they prefer analogue or digital, or mixed mediums? Is the choice influenced by convenience ("principle of least effort"), assessment, or commercial pressure (deadlines, team practices and attitudes). What are the rewards for sketching? How do individual designers perceive and react to the impact of digital technology on sketching? What roles do personal experience, skill and knowledge play in the conceptual phase of design? Is sketching a "ritual" process "initiated" by education and turned into a "tribal" activity? Does freehand sketching accelerate or slow down the digital design process? Is generative sketching a form of improvisation that can be studied and explored by designers? If so, are there lessons to be learned from, say, jazz, performance art and creative writing? Does freehand sketching have a role in avant-garde and experimental design? Is there a sketch etiquette, or sketch aesthetic? Is there a sketch ethic?

Such a range of questions reflected my initial approach to the investigation: "Let a thousand flowers bloom" (see Chapter *Literature review*). However, by necessity, in way of progressive focusing, the number of questions was narrowed down although many of the raised issues were nevertheless reflected on in the investigation as it evolved. In conclusion, then, the focal point of the enquiry was summed up in the following research questions: What is the impact of digital technology on design ideation, particularly on uses of freehand sketching in the conceptual phases of designing? Moreover, does the impact differ between design domains, and between design students and practitioners in industry? What are then the implications for design education and practice, both on a personal and a collaborative level?

B: LITERATURE REVIEW

Preamble

Literature review 'may be defined in terms of process and product' (Bruce 1994:218). It is 'a means to an end … not an end in itself' (Yin 2003:9). This review, then, seeks to provide the background to the research as well as reflect the research undertaken as a knowledge process, a process of generating, developing and refining ideas, questions and methods. As a creative process, as an individual research project by thesis, the review, in identifying strengths and weaknesses, both pragmatically and conceptually, 'plays a role in building the thesis argument' (Murray 2002:101). Moreover, this review has been defined in its purpose and meaning by extensive interdisciplinary reading, tutorials, seminars, conversations, observations and interviews in the field, at times laboriously, often serendipitously. In exploring ideation as relationships between thinking and doing the review is concerned with "thick description" rather than a behaviourist "thin description", which 'considers only the external behavioural aspects of action; thick description also includes inner meaningful aspects' (Alvesson et.al. 2000:95).

The use of metaphor may capture the intention and the essence of the review: "Let a thousand flowers bloom". Or, how the review may reflect the research as bricolage, 'a complex, dense, reflexive, collagelike creation' (Denzin and Lincoln 1994:3). Or, inspired by philosophy, by "Deleuzian pluralism", in which, by explanation and exemplification, the review can be likened to a sprawling *rhizome*: 'There is no hierarchy of root, trunk and branch, but a multiplicity of interconnected shoots going off in all directions' (Deleuze et.al. 1987:xi). Indeed, ' the act of creation' has many roots (Koestler 1964). But also, 'Connection requires a style of thought that might be called "empiricist" or "pragmatist"', that 'puts experimentation before ontology' (Rajchman 2000:6).

The sprawling rhizome, then, becomes a *leitmotif* for the thesis, in which the impact of digital technology on conceptualisation comes under technical, commonsensical and philosophical scrutiny. In this, a number of practical and theoretical issues are being explored and discussed providing an overview rather than a defined theoretical position on sketching.

Born to sketch: A brief story

To start out, sketching, in its most immediate and everyday meaning, may be characterised as loose drawing, a form of visual notes, 'the graphical equivalent of written notes' (Crowe and Laseau 1984:1). Or, a symbolic representation by designers and lay people alike for a variety of purposes, from furniture layouts to an electric circuit scheme, from street maps to a family tree (Goldschmidt 1994). In the perspective of visual anthropology and iconography (Gr. *eikon* image, and *graphe* writing), sketching can be traced from Palaeolithic cave paintings to Mesopotamian cuneiform tablets, from Renaissance linear perspective to 20th century synthesising of forms and ideas into a single digital image. Or, simplified, to trace the line along a continuum that connects drawing with substrata (Figure B:1).

Palaeolithic societies	*Renaissance*	*Post-modernism*
Cave paintings	*Drawing boards*	*Digital tablets*

Fig. B:1 Take a line for a historical walk

Therefore, from Stone Age to present-day societies, drawing in its various styles and mediums appears to be a universal human activity. For instance, depictions by today's children show similarities with graphic representations for both concrete and abstract concepts produced by different ancient cultures (Tversky 1993). Yet it is often observed that around the age of eleven or so children in the West seem to loose their spontaneity to draw and many switch off saying "I can't draw". Why? 'No Aborigine ever told an anthropologist, "Sorry Baas, I cant' draw"' (Johnstone 1981:77).

This may suggest that there is an inborn human impulse to draw as part of an early art-faculty, a preliterate form of art (Cardew 1978). However, the channelling of childhood drives depends on 'a complex interaction between the nature of society, the family, and the propensities and experience of the individual' (Schneider Adams 1996:5). For example, it has been suggested that children, if left on their own, draw from imagination, rather than nature (Fry 1937). But also the impact of language, which can be observed in how children 'never stop talking about what they are doing or trying to do: exploring milieus ... and drawing up maps of them' (Deleuze 1998: 61). Therefore the decline in the impulse to draw might be explained by how children's drawings, under the influence of adults, become dominated by the concepts of language. That is, when entering adolescence, children's drawings are expected to be intelligible, sensible and even naturalistic so as to be acceptable to the adult world. Moreover, such expectations might be accelerated by the ease and "finished" look of digital imagery. Therefore, and without going into detail about the importance of child development, the gradual shift from childhood to adulthood drawing reveals "thinking through drawing", or drawing as a conceptual means.

Emphasising underlying cultural factors, western drawing, since the Renaissance, has taken on a dual role both as a preparatory and autonomous form. In contrast, in the eastern tradition there is no break between the creation of an idea (abstract) and its execution (concrete) (Kenin 1974). In the East, therefore, the relationship between drawing and writing has remained ("the pictographic-ideographic script") whereas in the West only the word "graphic" is a reminder of the once close relationship between writing and drawing (Jaxtheimer 1974). This particular duality has greatly influenced the chronological development of drawing in the West, both technically and stylistically, from Renaissance analogue to post-modern digital drawing systems. Moreover, it suggests that the development if not origin of the autonomous conceptual sketch is western, rather than eastern, as expressed during the conceptual and schematic design phases.

The symbiosis of drawing and writing in the eastern tradition can be seen in the immediacy and rapidity of visual transcription, in which the skilful use of the brush is signified by the importance of gesture (Kenin 1974). That is, of not cramping individual style with inflexible fingers, wrist and arm, as may be the case when writing with a ballpoint pen. In this, the eastern tradition also reflects "directness of vision", exemplified by how in Japan imitation, as in objective drawing, is the basis for primary education (ibid.). Thus there may be cultural differences between eastern 'seeing form' and western 'thinking form' (Fry 1937).

The western notion of conception, of thinking form, which is based on intellectual abstraction (Cardew 1978), can be traced to medieval drawing, which was founded on concepts rather than perception, that is, the artist worked from an "idea", or an inner notion of form prior to the work (Panofsky 1968:41). Yet medieval draughtsmanship also developed the method of representation based on geometry as can be seen in the sketches by Villard de Honnecourt, the first western sketchbook on record (Bowie 1959). But as drawing was considered the work of craftsmanship representational art (naturalism) took over in the mid-13th century replacing the symbol with the picture. The medieval draughtsman, in addition to geometrical shapes, also made formal attempts at three-dimensionality although linear and atmospheric perspective was already evident in ancient Egypt and in frescoes in Pompeii. In contrast, Persian and Hindu drawings, influenced by Chinese techniques, did not pursue three-dimensional representation but rather excelled in pattern and decorative forms (Kenin 1974).

Although drawing in the western tradition essentially grew out of the Italian Renaissance, its roots can be traced back to people of ancient times. Today, then, simple line drawing on paper may reflect graphic arts found on classical Greek vases, and mathematically defined CAD systems may evoke Egyptian figurative and objective, grid-based proportional drawing. But already these ancient peoples differed in their approaches to drawing. For instance, the Egyptian painters adhered firmly to established geometric formulas yet they had not grasped foreshortening thus legs and feet, for example, are denoted in profile (Fry 1937). Still the Egyptian visual perception was closer to Plato's idea of visual art as a combination of *mimesis* (Gk "imitation") and *techne* (Gk "art" or "skill"), an ideal that contrasted 'undisciplined' Greek art with the 'law-bound' art of the Egyptians (Panofsky 1968:4-6).

The Renaissance formulation of perspective drawing was groundbreaking, or 'a special gift to the world of visual thinking' (Tufte 1997:151). However, it was also influenced by Islamic scientific scholarship, as exemplified by Leonardo da Vinci's's method of balancing the scientific element with the artistic. Yet his perspective projections were more than geometry including such effects as increasing haze with increasing distance or shadows to represent the orientation of objects (Gregory 1976:168). Similarly, Michelangelo's 'thinking' form in his cerebral yet sculpturally influenced drawings (ibid.). Significant was also the Renaissance interpretation of art that, in contrast to that of the Middle Ages, was marked by a novel externalisation of the artistic 'object' as well as by a novel personalisation of the artist as a 'subject' (Panofsky 1968:206; note 16).

Therefore the Renaissance developed both new values and techniques in drawing that paved the way for greater artistic freedom and modern media (Kenin 1974). But the Renaissance also laid the foundation of the academies in which the task of art followed the Platonic tradition of imitating reality, for example, the artist who wanted to depict a mountain landscape was advised to copy rough stones from nature (Panofsky 1968:201; note 1). As imitation, moreover, drawing has developed a digital dimension, or digital drawing.

In contrast to the Renaissance tradition, draughtsmen in the East did not develop a sharp distinction between painting and drawing, or indeed writing as their tradition was based on a pictorial language for which a rigorous training in using the brush was required. Moreover, eastern draughtsmen ignored the background plane and their drawing on vertical and horizontal scrolls refuted the view of a single perspective instead producing a kind of reversed perspective in which lines diverged rather than converged with increasing distance. The all-important linear rhythm in eastern drawing also meant that the quick and broken line found in Renaissance drawing was largely absent. Another difference was that symmetry was not always necessary. Furthermore, eastern drawings reflected Buddhist ideals of cosmic energy rather than post-medieval western emphasis on the personality of the individual (Kenin 1974).

However, *drawing-for-design*, and therefore also sketching, that is, drawing in terms of concept, form, style and technique, or 'Design-by-drawing methods' (Jones 1970), is essentially western in origin. It developed from the Renaissance drawing systems when the process of planning on paper was so closely linked to the completed work that the term *disegno* (Latin *signum*, a mark) was the same for drawing and design (Lambert 1983). Manual drawing, as a medium both for copying and creation, probably reached its peak in the engineering drawing of the 19th century. Since then, through the digital medium, computer-aided drawing systems (CAD) have developed into a truly worldwide visual design language disseminated through software. As a result, CAD and other computerised image processes have become so pervasive as to suggest 'spatial imperialism of operating systems and of interface metaphors' (Tufte 1997:150). In this global design scenario of what might be called "design-by-digital methods", we might paraphrase Shakespeare and perceive the world as a digital stage where men and women are merely virtual players.

The global impact of digital drawing systems reflects how the western tradition of drawing has both responded to and been instrumental to cultural and scientific changes throughout the ages. For example, the set-up of specialised design schools in the mid-1800s to meet industry's need meant that drawing was no longer primarily a tool for "artists' impression" as pursued in the art academies, but a means of communication with manufacturers for specifying and controlling work. In this, design drawing turned technical and became the foundation for engineering. But through 20th century modernism drawing became increasingly a process of abstraction, in which conceptual sketching was a means of generating and analysing form and ideas in the development of buildings and industrial products with higher symbolic content. Such abstractions, as expressed in the modernist slogans of "form follows function", or "less is more", reflected new ideals of value-free design and paved the way for post-war design methodologies and digital drawing systems.

This brief story of drawing may suggest that drawing in its various forms is a generic activity, an "anthropological constant" judging from the archaeology of early human imagery in its most basic form, such as cave paintings, petroglyphs and ancient pottery tokens to today's urban graffiti. But is there an impulse, or urge to draw by all that transcends time, place and culture? Lewis-Williams, in his study of pre-historic cave paintings, argues that the stone-age "artists" were ritual representatives, a privileged class representing shamanistic vision-seekers (Lewis-Williams 2002). This view echoes that of Benjamin who argued that the uniqueness of art springs from its early ritual function (Benjamin 1936).

But if the cave painters represented a kind of "artistic elite", drawing, as traditionally pursued in western art and design education, may not necessarily represent a dignified universal human activity but rather the 19th century romantic ideal of the innocent child that would need to be nurtured and educated. Yet, drawing as universal is a seductive notion and, as suggested by Coyne, 'romanticism is still with us' (Coyne 1997:135). However, if drawing historically reflects a kind of ritual, artists and designers might constitute tribes and drawing part of their tribal language. Yet, in a globalised digital design culture what happens to tribes and tribal visual language? Does the "nomadic" sketch become digitally "settled"? Such thoughts may evoke Benjamin's insight that mechanical reproduction emancipated the work of art from its dependence on ritual (Benjamin 1936). Arguably, then, digital technology *a fortiori* does not release work of art, rather it is *designed* to reproduce work of art. In this way, a new insight may be dawning: drawing through digital means is not ritual and therefore neither elitist nor tribal but popular, and therefore part of everyday design culture. Yet, designer tribalism may continue because the digital medium may exert on design new forms of cohesion, fragmentation or synthesis ("do-undo-redo") that may suggest the emergence of "cyber designer tribes" within digital design culture.

Sketching as Idea

Freehand sketching has long been regarded as an activity prevalent in the early phases of designing (Purcell and Gero 1998), and as such it has become almost synonymous with the conceptual sketch. That is, the adjective "conceptual" is an attribute that describes the sketch as a means of expressing first thoughts and ideas. In this the conceptual sketch is not just an image (outcome) but also represents an activity through which ideas can be traced (process). Therefore,

> 'the conceptual sketch is very different from the other types of drawing employed by designers, such as presentation drawing and the drawing for manufacture' (Rodgers et al. 2000:452).

This suggests that conceptual sketching goes beyond that of symbolic representation and reflects visual thinking (Goldschmidt 1994), or, 'thinking through the end of a pencil' (Purcell 1998:385). Also, conceptual sketching has been referred to as the medium of 'reflection-in-action' – 'a kind of thinking what we are doing while we are doing it' (Schon 1985:23). Sketching, then, as reflective practice implies "thinking skills" as much as "practical skills". Moreover, reflection-in-action has critical, restructuring, and experimenting functions 'that occur in the indeterminate zones of practice – uncertain, unique or value-conflict' (Schon 1985:27). Schon also links reflection-in-action with a 'practitioner's artistry' that

> 'enables some individuals to be competent in situations that do not fit preconceived categories of technique, theory or rule-of-thumb, that make up the corpus of professional knowledge' (Schon 1985:27).

However, Schon's reference to artistry seems unfortunate because it might suggest that some, but not all designers are artists too. Arguably, then, in a digital design culture, sketching as artistry might be seen as an activity for the talented few that may touch a nerve among designers (see Chapter *Introduction*).

However, 'thinking while designing is a heterogeneous process, composed of very different elements' (Dorner 1999:413). Therefore, conceptual sketching embodies both active and reflective activities of a rational, intuitive and sensing nature that can be expressed through non-verbal and verbal (spoken and written words), representational forms that may reveal insight into practice, not of a single technique or method but of diversity. This suggests that conceptual sketching is much more than arrangement of marks on paper and therefore embraces other representational forms and ways of communicating ideas, from physical to virtual sketch modelling, from music to speech and drama. Arguably, then, "sketching by other means", suggests a broadening of the conception of sketching, what I call *sketcherly ways of designing*, that highlights improvisation, spontaneity and other non-script multi-modal way of design ideation that goes beyond the "the pencil sketch" (see Chapter *Methodology*).

As an outward manifestation of an idea, however, conceptual sketching is not a modern notion. As first thoughts, it can be traced back at least to the Renaissance when sketching was referred to as *primi penseri*. Vasari (1511-74), for example, 'defined *disegno* as a visible expression of the *concetto*, ("idea"), formed in the mind', but also that 'the *concetto* itself arose from observing the visually "given"' (Panofsky 1968:82). Equally influential on later development of the "mind-to-reality" relationship as perceived by the senses was Durer's (1471-1528) belief that the purpose of "ideas" 'is to ensure originality and inexhaustibility in that they enable the artist to pour forth "always something new" from his mind' (Panofsky 1968:124). Moreover, Durer's pluralist belief resonates in one of the aims of empiricism, which, according to Whitehead, is 'to find the conditions under which something new is produced (*creativeness*)' (in Deleuze and Parnet 1987:vii).

Durer's belief that the purpose of ideas was to produce always something new can be seen as a powerful force behind western design thinking throughout the centuries, and whether in developing tools for mass production or global branding strategies. Although the notion of newness is not uniquely western, for instance a three-thousand-year-old Chinese character describes "make-it-new", the tendency in the West since late Renaissance towards the experimental and speculative in practice and theory has continued apace across a wide spectrum of societal activities, locally and globally. In this respect, digital technology too can be regarded as a manifestation of the western drive for newness. However, the blurring of the boundaries between origination of ideas and artistic production so prevalent in digital media was already described by the Baroque thinker Zuccari (1542-1609) as that between the "inner design", *disegno interno*, or "idea", and the actual artistic representation, *disegno esterno* (Panofsky 1968:85-93).

The fuzzy lines between inner and external artistic manifestations, and embraced in post-modern and post-structural discourse (Schneider Adams 1996), suggest the virtual conceptual sketch, or ideation-through-computing, what I call *computer-aided ideation*, CAI. However, virtual sketching also advances a new approach to designing in which

> 'digital artists and designers need to completely transcend the idea of the computer as a tool, with its implication that it requires only a practical and not a theoretical engagement and understanding' (Beardon 2002:174).

That is, virtual designing implies both critical and creative thinking and, for the computer to be more than just a tool, a shift from the technical aspect of computing to that of creativity. That is, non-linear and unpredictable creativity that reflects Deleuze's notion of multiplicities, or manifolds.

> 'There are lines which do not amount to the path of a point, which break free from structure – lines of flight, becomings, without future or past, without memory, which resist the binary machine' (Deleuze et al. 1987:vii, 26).

Thus philosophically challenged, conceptual sketching may suggest an act of *becoming*, rather than a state of *being*, a state of flux, rather than solid-state. In this sense, conceptual sketching becomes a free agent for ideation, free from any particular drawing systems, analogue or digital.

Computers, Authorship and Self

The obfuscation of originality and authenticity implied in the digital medium (infinite copies, instantaneous dissemination and decentralised power structures), might suggest, in designers' personal relations to their work (identity or self), in "making their mark" (original representation), that the computer is eroding single authorship. Or, how software might erase identity because, from a non-conformist perspective of wanting to change a structure that is not good, 'you don't even have an identity, since you are always entering the same system' (Penone, in Zegher 2004: 54). That is, digitisation might make the designer "invisible" leaving no signature or trace of their presence, which begs the question: Who is the "real" designer in cyberspace?

Therefore, digital technology, as an anonymous conduct of the design process (individually non-attributable software), might weaken or subvert authorship in placing the copy on par with the original. Moreover, digital reproduction and dissemination say, via the Internet, can result in unsubstantiated claims or illegal copying compared to analogue practice where, say drawing would typically, although not exclusively so, carry the signature of the individual ("original"). Arguably, however, digital technology and the Internet may build up or enhance designer identity, which suggests that the difference between the original and the copy may represent a paradigmatic shift, from modernist identity, where authorship is *constructed* through copyright, to post-modern identity *invented* through the digital medium and the Internet.

However, in response to loss of copyright, in post-modern discourse, the demand for digital authorship might reduce the digital medium to a "thing", or a "tool", rather than appreciating it as a distinct social or spatial construct in which designers, and others, fashion their own individuality. Or, clamour for authorship in a digital design culture may reflect nostalgia for design as applied art and craft in which originality, and hence authenticity rest with analogue conventions. In this, authenticity may resonate with western preoccupation with individuation and possessive authorship (intellectual property rights), in contrast to eastern thinking, where 'an independent, unique self is not emphasised' (Bernstein and Nash 1999:427).

Arguably, then, in emphasising interdependence (eastern culture), rather than independence (western culture), the digital medium might be seen as a collaborative technique or method that enhances design, both in process and outcome, rather than inhibiting individuality. From this perspective, the digital medium might render the question what is the original or a copy irrelevant. Although this proposition would be subversive to established copyright authority, the digital medium, through its networked computers, nevertheless can be appreciated, from a socio-political perspective, as a universal, post-modern means that de-emphasises the "author", or the notion of "artistic genius", for the benefit of shared (communal) projects and ideas.

Moreover, such an emphasis on collaboration rather than individuation reflects how Derrida (1930-2004) in disassembling and exposing the binary pair of opposites ("deconstructing thinking"), rejects the notion of the definite author, in the semiotic sense that the author confers ultimate meanings on text (in Schneider Adams 1996:162-178). Furthermore, to apply deconstructing thinking to single authorship in a digital design culture suggests that opposition between the analogue and the digital may turn illusory. Or,

> 'Design has been posited as neither lodged in the natural nor the artificial, but as that which has made these binary oppositions untenable' (Fry 1999:289).

However, from a post-structuralist perspective, in the realm of semiotics, conceptualisation in a digital image culture might cast authorship as a Romantic myth inflicting on art a sense of loss of "mystery". Or to paraphrase John Berger in his explaining of the difference between nakedness and nudity in the European painterly tradition, as defined by the simple naked/nude antinomy (Berger 1972:54): To draw on paper (to be naked) is to be oneself, is to be without disguise. In contrast, the digital drawing (the nude) is condemned to never be naked. To draw on screen (nudity) is a form of dress, is to be digitally dressed.

In focusing on multiple, rather than single authorship, the digital medium is challenging freehand drawing styles and techniques, in which the computer is being propositioned as a formidable creative tool: 'the computer has firmly established itself as an art and design tool with unquestionable creative potential' (Baker 1993:8). However, the universality of the computer code, as structured language, has also raised concerns about how uses of global software might foster sameness in design processes and outcomes and therefore stifle risk taking and experimentation. For instance, the computer, both as a technological and cultural force, may not allow time for the traditional, slow, careful crafting of an object, in what Norman has called 'forces that work against evolutionary design' (Norman 2000:142).

Such forces, however, may reflect technologists' attitudes to traditional design as a kind of "tribal language", which is a 'code to be cracked so to make it intelligible' (Cardew 1978:17). Accordingly, the digital process could be seen as a breaker of analogue design code that might seek to replace artisan design ways (closed or restricted) with digital (open-access) design culture. Yet, it has also been argued that the dichotomy between the analogue and the digital may be false in that 'both are guilty of totalisating their perspective, one in the formal universal harmonising, the other in universal fragmentation' (Alvesson et.al. 2000:104).

Concerns about single design authorship may partly explain why the computer has been rejected as a tool and medium for creative work for reasons such as: 1. It's too arbitrary. 2. It cannot record feelings. 3. You cannot get hold of it. 4. It is difficult and time-consuming. 5. It's not much fun (McCullough 1998:105). However, such opinions or attitudes might be seen as anti-progress, or Luddite even in a digital design culture because 'new technologies introduce new practices ... and new practices have to confront current ways of working (Coyne et.al. 2002:270). However, the attitudes may also reflect how designers have had relative little say in the development of computer technology essentially driven by scientists and professional programmers who 'know how to deal with more complex interactions and less effective displays' (Norman 2000:181).

Arguably, then, the computer raster (bitmap) and vector displays have been imposed on a designer world that did not produce it. However, grid-based displays have been used widely by artists and designers as a drawing aid throughout the centuries. For instance, the Renaissance artist drew via a latticed window, and Durer utilised a Cartesian grid, the precursor to the transparent computer grid, for image manipulation. Yet, digital technology has been driven largely by the computer industry, which suggests that uncomplimentary views of computer-aided design may reflect negative user experience of the computer as a tool, or human-computer interaction (HCI), rather than a medium. Arguably, then, it is the cumbersome interaction with the machine (tool) that is overshadowing digital ways of seeing the world around us (medium).

However, the computer as medium has also been criticised for operating virtually beyond both the "subject" and the "object" reflecting dissatisfaction with the perceived lack of "reality" of the digital medium that places the object in the "virtual world". However, such criticism is not new. It evokes the old-age ontological problem of the relationships between "I" and the "World", that is, between 'spontaneity and receptivity, given material and active forming power', what Panofsky calls the 'subject-object problem' (Panofsky 1968:51). An old problem because, arguably, a parallel to today's virtual reality can be found in Renaissance art theory where the object was removed from the 'inner world' of the artist's imagination and placed firmly in the 'outer world' (Panofsky 1968:50). Then the purpose was to legitimise Renaissance art as the genuine heir of Greco-Roman antiquity and to provide artists with scientifically grounded yet universally recognised rules for their creativity, such as the laws of perspective, and anatomy (Panofsky 1968:51).

The parallel, then, is that when the 3-D object is moved from cyberspace ("inner world") to the "outer world", say, through rapid prototyping, this may justify technological advancement based on universally recognised software, such as Virtual Reality Modelling Language, VRML, which gained ISO status in 1997. This further suggests a shift from the Renaissance analogue rule-bound universality to the digital rule-bound universality, for example, the replacement of traditional drawing boards by CAD tools.

But computer-aided design also raises the question to what degree is the designer free vis-à-vis his tool. That is, in a menu-driven system, where the parameters have been defined by the software and therefore decisions taken in advance, can the designer outwit the precursor? Or in terms of individual uniqueness, which traditionally has been regarded as a prerequisite for a work of art (Benjamin 1936), does the designer drive the computer, or is he or she driven by it. However, for designers who feel constrained by standardised drawing software, there are alternatives. For example: 1.To search for specialist software that would be more responsive to the job. 2. To think of an alternative way of doing it; to modify or abandon the project, or, 3. To learn how to program the computer and therefore to tailor a solution (Whale and Barfield 2001).

However, for designers to take advantage of these options suggest that they have a range of analogue and digital tool skills, particularly in preparation for what might be called serendipitous discovery. Because, 'chance', as Pasteur famously said, 'favours the prepared mind' (in Johnson-Laird 1993:234). But the prepared mind goes beyond tool skills. True, technical skills, by hand or by computer, may be a sufficient requirement for design situations where the problem is fairly clear-cut and in which a rational problem solving process is apt (Dorst and Dijkhuis 1996). Yet the designer's ability to structure and find a solution to ill-defined problems depends not only on external factors in the design environment but also on an inquisitive, imaginative, and critical mind, or internal factors (Lawson 1990). This suggests that the context for conceptualisation is both physical and mental, both personal and collaborative (see below, *I-sketch and We-sketch*).

The digital Challenge

The debate about the role of computers in design grew out of WWII military research and its application to industry and commerce in the USA, for example, the introduction of CAD/CAM systems in the civil aviation industry in the mid-1960s. This development also saw design methodology establishing itself as a specialist area aimed at clarifying the nature of the design activity and of the structure of its problems (Rittel 1972). The enthusiasm for design technology was, however, soon tempered by concern for its impact on creativity. For example, Alexander, one of the key design methodologists, came to argue strongly against computer graphics, the prototype for later digital technology in design, and what he perceived as its negative influence on the designer's peaceful frame of mind (Alexander 1971).

Yet Alexander also argued in favour of people designing buildings for themselves (ibid.). In this Alexander was an early advocate for *participatory design* in which professional designers seek to involve the users in the design process. Thus, since the 1970s, computer-aided architectural design (CAAD) has become a means of facilitating community-based architecture identifying specific problems and making them visually explicit through computer simulation to the non-designer public (Lawson 1990:20-21). The involvement of users highlights how design is being communicated and presented in every-day situations that takes account of differences in user and client values and perceptions of design mediums. For example, the sophisticated client may appreciate a sketchbook presentation, or even the proverbial scribbles on the back of an envelope. In contrast, for the larger audience expecting ideas to be presented as close to the final outcome as possible, the screen-projected computer rendered image (photo realism) may be more appropriate (see also Chapter *Introduction,* and Chapter *Findings Y2 and Practitioners*).

Moreover, the networked personal computer has put design firmly in the public domain serving as an empowering tool for participatory design or, rhetorically, "Design for the people, by the people". In this, the digital medium has contributed to "demystifying" design as an activity for the talented few opening up the shaping and forming of society by giving visual means to the many. Therefore, the effects of the democratic design process have made the public more aware of how their design decisions shape the future (Buchanan and Margolin 1995). This also suggests that the digital medium has opened up opportunities for students who might not otherwise gained entry to design schools. But also, in an open-access digital design culture the need for, and practice of, traditional design skills are being reassessed or put in question, hence "sketching, so what!"(see Chapter *Introduction*).

As a manifestation of the machine age turned digital, in conjunction with the growth of democratic society and consumerism, the computer has been widely accepted in sharp contrast to anti-machine sentiments of the 19th century, as witnessed by the Arts and Crafts movement. The post-modern political quest for enabling, or empowering, of getting the most out of machine technology for the common good, suggests that computers may stimulate and enlarge collaboration within as well as between community groups. Therefore, computer-aided design suggests a shift form single to shared design authorship. As multiple authorship, computing can be seen as part of the evolution of increasingly powerful and complex cultural production, or design as a social activity yielding what might be called a *Commonwealth of Design*. Because, from an anthropological perspective, 'experimenting with new technologies and new forms of social organisation ... sustains the basic directional drift of history' (Wright 2000:63). Further evidence of this drift is the Internet where the world-wide-web has become a communal force through evolving technology. Or, in the words of its prime protagonist: 'The Web is more a social creation than a technical one' (Berners-Lee 2000:123).

Although the digital medium has become an essential part of everyday designing (see Chapter *Introduction*), computer-aided design emerged on a large scale only in the 1990s. Arguably, therefore, dislike of digital technology is largely a generational issue, as observed in how young children learn new technology far earlier in life and more quickly than previous generations (although practitioners have claimed that age is not an issue in computer usage, see Chapter *Introduction*). Still, and although age-related preconceptions may play an important part in learning, there are explanations other than age why people may dislike computers, and notably poor graphic-user-interface, GUI, or system design which do not sufficiently take into account human erring. Norman has described how such system deficiencies can create a sense of helplessness of how to recall what has been learned, or, of how to retrieve information from the computer through human memory, which is essentially short-term memory, theoretical or semantic (Norman 2000). In contrast, in the context of designing, problem-solving activity depends largely on experiential, or episodic memory (Lawson 2001).

The complex computer interface, GUI, explains why mode errors are much more common when operating computers. That is, a type of slip that happens when we have formed the right goal but mess up in the performance such as a misplaced keyboard action, the wrong object moved on screen, or a desired action undone (Norman 2000:110). Such slips, however, are not the same as mistakes, which result from conscious deliberations (Norman 2000:105), but are often caused by shortcomings in human-computer interaction, HCI. Therefore, there may be a difference between what the computer is technically capable of doing and what the operator thinks it is capable of doing thereby failing the operator to maximise the potential of the computer. This further suggests that HCI may be an important factor in the development of computer-aided design for the early stages of the design process.

The shortcomings of HCI reflect command line graphic user interface with input devices such as a mouse or digital pens. But irrespective of input device, GUI, as iconography (screen icons), works basically the same way and is considered by the computer industry as a visual language with its own vocabulary and grammar. Moreover, it has been argued that computer icons are in the stylised images of the ancient ideogram and therefore universally recognisable, like icons in musical notation or as symbols on national flags, playing cards, road signs, and more recently, mobile text messaging (Caplin 2001). Consequently icon designers have claimed they can communicate the most complex of ideas in a simple way that transcends linguistic and cultural boundaries (ibid.). However, icons as a universal language may have limitations:

> 'It's a complete misconception to believe that, by removing words from the equation, graphic information becomes magically accessible to everyone, everywhere. Visual shorthand is a social construct. Our interpretation of icons and symbols depends heavily on what cultural baggage we unpack in the process' (Evamy 2003:76).

Yet, GUI lies at the heart of computing and as a result HCI has become a field of study that includes not only the design, evaluation and implementation of interactive computer systems but also surrounding phenomena such as training, working practices, management and health issues (Preece 1994:7). Therefore, HCI may highlight how we "learn" to use tools. Learning computer at an early age, then, suggests that analogue tools are no more "natural" than digital tools, and therefore the differences between "old" and "new" mediums seem more likely to reside in "culture" or "history". Arguably, then, digital technology is an evolutionary, rather than revolutionary force. If so, it compliments rather than substitute freehand modes, for example, the scanned freehand sketch.

However, it has also been argued that a shift in tool usage may affect thought processes in that attention to one aspect comes at the cost of decreased attention to others. Or, 'What a technology makes easy to do will get done; what it hides, or makes difficult, may very well not get done' (Norman 2000:211). For example, a scanned image can be digitally manipulated to the extent that it simulates sketching by hand to a high degree. Moreover, the effort, both mental and physical, for such a computer operation can be quite small. For instance, the designer can source and download images from a wide range of on- and off-line image banks (see Chapter *Findings Y2 Students and Practitioners*).

The computer, then, might be regarded as an "easy option", not only as a tool but also as a medium that shapes ways of seeing and thus influences direction of interest and attention and hence affects design intention. Therefore, in terms of both design thinking and behaviour, when there is a choice between analogue and digital imaging modes, will designers select the tool/medium that offers the best creative outcome? Or, will they go for what is the most expedient for the task in hand, in what might be referred to as "the principle of least effort"?

This is a controversial issue, because "least effort" might suggest that the digital medium is a medium of "expediency", or a "lazy" medium, rather than a medium for individual creativity. For instance, in the multiple case study the practising product designer downloaded ready-made digital images from an on-line image bank, rather than producing his own originals (see Chapter *Findings Y2 Students and Practitioners*). However, and arguably in support of the easy option, Lansdown suggests that,

> 'CAD systems make it possible to go from a vague concept to a finished presentation – possibly assisted by the fact that the designer did not have to start from a blank sheet' (Lansdown 1987:79).

Moreover, in terms of adaptive morphology:

> 'There is usually an attempt to accomplish things with the least effort and with the most successful results possible. This is the common direction of all things in a general movement toward economy' (Williams 1981:74).

However, the easy option does not seem to preclude creative use of computers because 'real computers … can stimulate arbitrary choices' (Johnson-Laird 1993:257). This suggests that the computer can be used as a tool for generating ideas, that is, computing becomes a conceptual tool, or computer-aided ideation, CAI. Arguably, then, what matters is to what extent designers use computing in the design process towards a creative result (see *Findings Y2 Students and Practitioners*).

> 'What is valuable about the creative process is that its results are judged as striking, brilliant, and not banal'. These judgements … 'depend on historical, cultural and scientific events. And they will never be predictable'. (Johnson-Laird 1993:256).

This kind of tool debate highlights the adaptive process of functioning that tells us that man's tools over time have taken a finely adjusted form.

> 'All carpenters' hammers are successful to varying degrees, but they also have many shortcomings that render them inefficient, uneconomical and, to some extent, failures'. But also: 'The differences between the magnificent tool and the mediocre tool may be slight at times and sometimes may exist more in the operator's imagination than in actuality' (Williams 1981:76).

As skilled craftsmen of the late 19the century demanded perfection in their tools the tool industry responded by producing an enormous selection of hand tools for every conceivable function (Williams 1981:77). Similarly, then, today's software suppliers have quite successfully appropriated the traditional tool forms and functions of designers. Arguably, then, as each tradesman of yesteryear thought he must use the most refined tool available from the toolmaker, so today's designer desires the latest software up-grade.

The question of creativity, however, raises many important issues that go beyond tools. For example, selective perception and attention (competing visual stimuli), according to which there might be a difference when we scan from a flat surface such as a book or computer screen, with that of scanning the complex image of three-dimensional reality. Such complexity also reflects learning that goes beyond the visual.

> 'We put together the evidence of senses other than visual: of reaching and touching, of walking into or around things, of hearing the resonance of spaces, of expecting and anticipating' (Rawson 1983:82).

The Designer and the Artist's Sketch

Sometimes sketching by designers is held to be more ruled-bound, specified by convention, or different in nature or occasion to that of the artist's sketch. That is, sketching by designers may be seen as a representation of something directed to particular everyday material purpose in contrast to the artist's sketch perceived as essentially an act of self-expression without useful purpose (although not aimless).

For example, the Bauhaus director Hannes Meyer argued that 'All art is composition and hence opposed to utility' (in Arnheim 1986:235). Or, the view of the architect Amanda Levete of Future Systems, in collaborating with the artist Anish Kapoor:

> 'Artists do have a different sensibility. It's a way of working that is much more radical. It's trying to throw out all the pragmatics. It's so easy to get trapped by the functionality, the realisability, the practical aspect of something' (in Fairs 2003:62).

However, in a historical perspective, artists' sketches cover a wide range of purposes. For example, Turner's sketches could be 'a spidery note, or a carefully pencilled architectural or landscape composition ... or a study in any medium for a projected picture' (Wilkinson 1977:7). The complex question how a given sketch relates to time and memory can be found in Van Gogh's sketchbooks. 'Is it an initial or cursory notation, a detailed preparatory drawing, a self-standing drawing? ... Or a sketch made from memory after much earlier work, or a recollection of an image?' (Wolk 1987:265).

Similarly, in the generative phases of design, when inventing objects, shapes, forms or images, designer sketches are not necessarily strictly purposeful, say, like the instructions of working drawings. Also, as external representation, or as a cognitive tool, the sketch and sketching can help memory and thinking (Tversky 1999). However, sometimes the line between sketching and drawing is fine. For instance,

> 'Careful drawing to scale is merely for convenience and elegance; a rough and distorted version, with the same letters and numerals, qualify as a true copy of the most precisely drafted blueprint, prescribes the constitutive properties as rigorously' (Goodman 1976:219).

Yet, we would normally say "to draw a cube", rather than "to sketch a cube", which suggests that although the sketch may respect certain two- and three-dimensional conventions, for example, geometrical shapes and perspective rules, sketching is more loose than drawing for production, both in execution and outcome.

But in most cases, the sketch does not define a designer's work as precisely as drawings for production or construction. Arguably, then, the designer sketch can be as self-sufficient, self-expressive and abstract as the artist sketch, in materials, techniques and graphic styles. As such the sketch has intrinsic expressive power that recognises design as 'a function of the abstract artist' (Read 1966:61), Or, as described by the architect Alvar Aalto (1898-1976):

> 'I forget the entire mass of (design) problems for a while. I then move to a method of working which is very much like abstract art. I just draw by instinct, not architectural synthesis, but what are sometimes childlike compositions' (in Hanna and Barber 2001:258).

But also, insofar as art is part of much larger signifying systems that bridge nature and manufacture (Panamarenko 2001), and when faced with the world of mass-produced objects, 'the traditional artist is being transformed into the designer' (Munari 1971:13).

In short, therefore, there seems to be more similarities than dissimilarities between artist and designer sketches that reflect how, since the Renaissance, art and design has developed a symbiotic relationship. The art-design cohabitation, although not necessarily an easy one, is often expressed in public exhibition displays. For instance, at the *Machine Art* exhibition in 1934 at the Museum of Modern Art in New York, or, the Guggenheim Museum 1998 exhibition of *The Art of the Motorcycle,* with over one hundred exhibits of motor bikes. Such exhibitions highlight how concepts of design are being formed not only by practitioners' intuitive and rational responses, but also shaped by attitudes and perceptions of curators, critics and the public at large.

Sketch Meanings

At first sight, a pen or a pencil is a simple device for producing sketches. Its effects on paper are fairly predictable (mark making) and, in this sense, the sketch represents a self-contained concept. As such it is an example of a good conceptual model (Norman 2000). In contrast, a computer is a complex device that requires instructions for the user, without them errors and confusion might easily occur. Thus, according to Norman, the conceptual model of a computer is not so obvious. But the pencil and the computer are not only different as conceptual models. They also differ as mental models, that is, people form mental models of a device through 'interpreting its perceived actions and visible structure', perceiving the visible part of the device as a 'system image' (Norman 2000:17). Accordingly, the pencil and the computer, as devices, may be described as significantly different not only as conceptual and mental models but also as system images.

The differences between pencil and computer, both as tool and medium, can also be described in terms of psychology. For example, Norman uses the term *affordance* in the context of the psychology of materials that refers to 'the perceived and the actual properties of the thing, primarily those fundamental properties that determine just how the thing could be possible used' (Norman 2000:9). Thus doors afford opening, whereas a chair affords support. In this sense, both pencil and computer mouse afford an input device for drawing. However, what is significant is that affordances give strong clues to how things operate. Thus with an ordinary pencil affordance is taken advantage of, that is, no or few instructions are needed to know how to use it (ibid.). However, in this Norman seems to assume that the pencil, rather than the mouse, is the more generic input device of the two, an assumption that may overlook the impact of learning in a digital design culture (cf. Norman's view in *Appendix A*). That is, in a digital learning environment digital input devices are introduced to children at an age when they previously would engage only with analogue means, such as crayons and pencils.

Yet these differences point to how affordance may play an important part in the designing of objects, both on and off screen. That is, constraints set by computer processes in designing on screen are different from limitations posed by pencil and paper. And not only in the physical (gestural) handling of the input device, or the tactile feel of the drawing surface, but also in their impact on ways of thinking and perceiving the design process, for instance, calculative versus experimental thinking. Yet underlying these differences may be the assumption that analogue, rather than digital modes of working are more "natural", or intrinsic to the design process, which, again, may come under scrutiny in a digital design culture (see *Findings Y2 Students and Practitioners*).

Arguably, however, conceptual sketching may transgress the rules or boundaries set by any medium, analogue or digital, that is, irrespective of medium the conceptual sketch lacks common structures or elements. Support for this view may be found in Wittgenstein, who argued that concepts depend not on common elements, but on networks on similarities that are like the resemblances among the members of a family (in Johnson-Laird 1993:244). Conceptual sketches, then, like everyday concepts, 'are not isolated, independent entities; they are related to one another', an idea that goes back to Saussure's idea of associative relationships (ibid. p.245). Such arguments may also influence how sketching might be classified as data (see Chapter *Methodology*).

To further elucidate the meanings of sketching, we may borrow from semiotics the notion of "deferred" meaning. That is, if studied in the nature of signs, meanings of sketches, like that of words, are not fixed, 'they vary according to contexts, which themselves are continually in flux' (Derrida, in Schneider Adams 1996:162). This makes sense because it is only through sketch development that the conceptual sketch is firmed up into drawings (or models) that could enter the conventions and structures of formal drawings or models, either analogue or digital. In a *deconstructivist* reading, therefore, the meaning of sketching is deferred until the sketch has been translated into the structure of detail or final drawings or models. Arguably, then, and similar to Derrida's argument that there can be now ultimate "author" who confers definite meanings to the text (Schneider Adams 1996:163), conceptual sketching does not confer definite meaning to a visual idea, and therefore cannot be fixed within closed systems, analogue (manual drawing system) or digital (CAD). Therefore, in using the analogy of Derrida's deconstruction of structural systems, in deconstructing closed drawing systems, conceptual sketching appears truly open, relativist, and therefore paradigmatically post-modern. Arguably, then, conceptualisation in a digital culture is a matter of context (meaning) rather than a question of choosing the right mix of drawing systems to suit the job in hand (Willats 1986).

Sketch Characteristics

From a perspective of both theory and practice, and exploiting background knowledge and common sense of designers, sketching can be described in a number of ways. Traditionally, then, as a tool and medium, the freehand sketch, *is* the pen and paper sketch. As such it is often characterised by its *economy* of means (low cost) and *immediacy* (single tool interface) and ease of low-level correction and revision (scribbling over, erasing or new sheet of paper). However, the everydayness of sketching also suggests *improvisation, ambiguity, uncertainty or spontaneity*, which is also reflected in everyday expressions such as "sketchy", "sketch-like" or "sketchiness". Moreover, words like vagueness, incompleteness and ambiguity are indicative of sketches as tools for thinking (Scrivener et al. 2000:465).

In emphasising the intuitive aspect of designing, Jones argues that 'tolerance for ambiguity and conflict must be high in anyone who wishes to produce anything but stereotyped designs' (Jones 1980:47). Or, 'product conceptualisation necessitates the ability of handling incompleteness, vagueness, and frequent changes in the models' (Kuczogi et al. 2002:663). Similarly, 'it is argued that uncertainty drives invention and perhaps uncertainty also drives invention in design' (Scrivener et al. 2000:481). Sketching, then, as an ideation tool, suggests multiple approaches and points of view. It becomes an improvised, tentative, speculative, or probing activity, of asking questions, from observations that most design problems are presented in ways 'that may be diffuse, ill-defined, or actually misleading' (Potter 1969:78). Or problems that can be called 'wicked problems' (Rowe 1987:41). Or, that design problems are radically different from that of non-design problems (Goel 1995:II:4). In short, observations that design problems are ill-structured or non-routine are generally accepted (Goldschmidt 1997).

However, ambiguity sits uneasily in many societal activities, for example, it has been argued that the task and mission of organisations must be 'crystal clear', or that their results 'need to be defined clearly and unambiguously' (Drucker 1993:49). Moreover,

> 'creative practice embraces ambiguity as expressing a richness of meaning, whereas technical practice will try to eliminate ambiguity' (Beardon 2002:176).

Yet, ill-defined problems imply ambiguity, which suggests that sketches, in assisting 'problem structuring through solution attempts' (Cross 1999:35) cannot be "crystal clear". Therefore, as *a transient phenomenon of deferred meaning*, the designer sketch is open to different interpretations, even misinterpretations, and therefore cannot be "assessed" for precise meaning.

> 'Sometimes effective visual notes cannot be easily read by someone other than the one who drew them. The same can be said for verbal notes' (Crowe and Laseau 1984:63).

Thus, in design team situations, where, in order to avoid or minimise misinterpretation, the intent of the one who drew the sketch ("the creator" or "ideator") may have to be made more explicit to the audience ("the critic") through added explanations, in "filling-in" through gestures, spoken or written words. This highlights sketching as communication.

Ambiguity, however, can also be deliberate, that is, when the sketch is being used as a probing tool, an invitation to an exchange of ideas, say, typically in a brainstorming session. If unintentionally ambiguous, the meaning of the sketch may even appear obscure to the sketcher only to later crystallise into a useful idea. For example, how the doodle, as a kind of "pre-sketch" in its embryonic state, may turn out "the serendipitous sketch".

As an abstract representation of something not yet realised, conceptual sketching may then become a tool for design thinking, or "thinking through sketching", a conceptual tool. In this cognitive capacity, conceptualisation suggests how designers, by themselves or together with other people, say, in a team situation, generate, develop and communicate ideas. Therefore, as an ideation model, sketching may be characterised as either: *self-referential*, or what I call *I-sketch*, a means of inner-personal communication; *collaborative*, or *We-sketch*, a means of interpersonal communication; or *descriptive,* or *It-sketch*, a means of recording low-level visual, factual information, with or without annotation or verbal support.

But, in terms of functional intention, sketching may also become a *purposeful* activity of making marks, in which divergent thinking, through progressive focusing, becomes convergent thinking, as have been explained in various visualisation models. For example, a vertically structured model adopted for engineering design graphics has identified three levels of drawing: *ideation drawings*, for generating design ideas; *communication drawings,* for sharing ideas with team members or clients; and *documentation drawings,* or working drawings, for containing specific design information (Barr and Juricic 1992). Similarly, a model in the domain of product design has categorised sketches as: *thinking sketches* used for guiding non-verbal thinking;

talking sketches used in communication between designers and engineers; and, *prescriptive sketches* used for a finished drawing (Ferguson 1992).

The difference between the ideation and visualisation models is, I would suggest, an ontological one in which the former exists through, rather than within time. That is, the ideation model inhabits a parallel universe, unlike the sequential structure (design process) of the visualisation models. In this respect the ideation model suggests conceptual sketching as a rhizomatic activity.

Although the conceptual sketch does not actually represent reality, rather a mental image of something that does not yet exist, it nevertheless represents both an idea (concept) and the manifestation of that idea (percept), or, 'a concept brought closer to actuality' (Ashford 1969:124). In this sense, the sketch is not a binary construct because 'perceptions and conceptions are not in opposition but represent two ends of a spectrum of total experience' (Crowe and Laseau 1984:104). This suggests how the conceptual sketch may be situated somewhere in-between conception and perception reflecting the dynamic relationship between concept (C) and percept (P), as represented graphically below (Figure B:2).

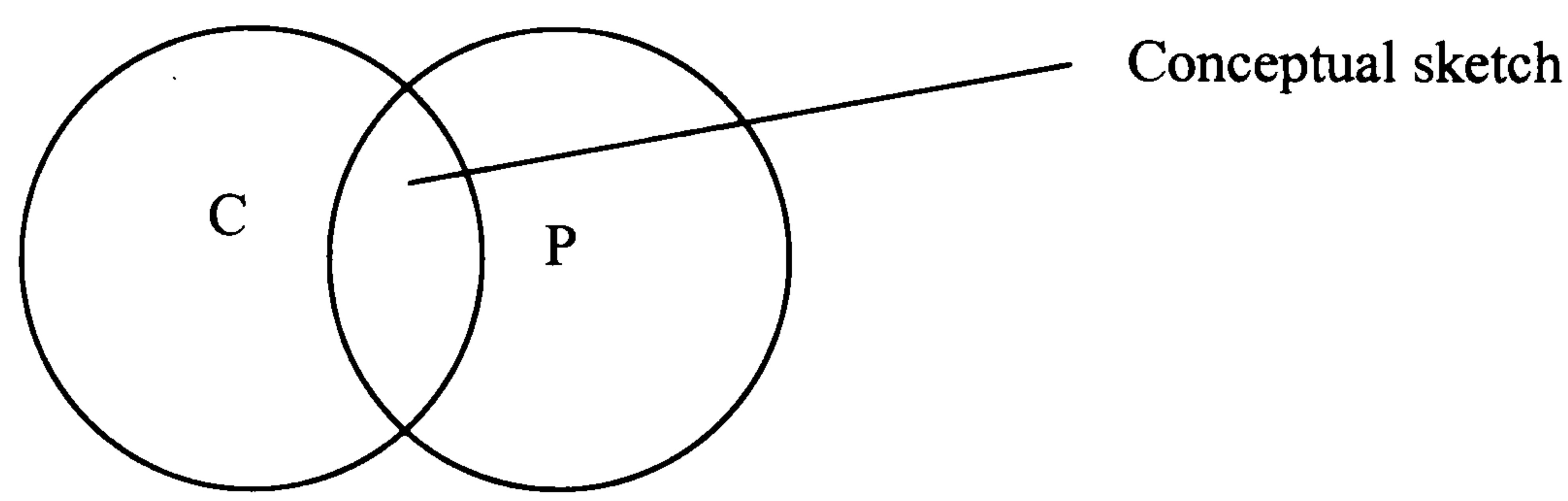


Fig.B:2 The Conceptual Sketch

Situating the conceptual sketch "in between" meaning (concept) and mark making (percept) may also reflect what Rawson has called the gap between the sign and the glyph (Rawson 1983), between "ways of knowing" and "ways of seeing". Thus depending on what we want to represent in a sketch, and if this is closer to an abstract idea rather than a recognisable object, Rawson suggests that we would draw what we "know" rather than what we "see" (visible facts). Knowing, then, might help us to communicate ideas through interpretative drawing, in contrast to seeing, when we often rely on conventions (Rawson 1983).

Moreover, from a semiotic perspective, the conceptual sketch might be read as text in which the "sketch marks" would correspond to the word ("the signifier") to convey a particular meaning of an object or idea ("the signified"). However, the word, which connects to a particular object or idea, seems a more distinct entity (vocabulary and grammar) than the sketch-mark for the construction of meaning. For example, we can readily "process" words but not sketch marks, unless these are geometrically or mathematically defined, which then might constrain ideation. Therefore, the conceptual sketch, it seems, has fewer, or rather different constraints than words. Moreover, as imagery, it can be enhanced by words, spoken or written, as in the annotated sketch. This, then, suggests that the conceptual sketch is as much about cognitional as visual relationships (knowing *and* seeing) capable of both verbal and pictorial communication (see also below *Sketching as Visual Understanding*).

However, the coming together of knowing and seeing in the conceptual sketch makes it different from objective or observational drawing. That is, in objective drawing a distinction can be made between what we know rather than what we see, which also has implications for teaching and learning drawing. Thus Edwards, in describing the relationship of drawing to visual perceptual brain processes, has argued that in order to learn to draw students need to focus on what is actually before them rather than trying to reproduce what they know in their minds to be in front of them. Therefore, beginners in drawing need to forget what they are drawing and instead focus on seeing and visualisation. (Edwards 1979).

Sketching as Hypermedia

As both a conceptual and perceptual construct, conceptual sketching serves multiple purposes in referring to non-sequential sketching events, and whether in "I", "We", or "It" modes. Such cross-referencing or linking of sketching events, and whether in an explorative, declarative or descriptive manner, resembles the non-sequential writing of hypertext. In this sense, the sketch becomes a placeholder, or connector for visual and verbal communication, and sketching the mapping of sketch events. For example, a sketch event, say, in a sketchbook, may contain shapes and ideas related, or linked to previous or subsequent sketch events and whether in that same sketchbook or in other design documents, which may reveal a sketch narrative.

Several linked sketch events stored and communicated digitally may then be described as a *hyper-sketch*, a linkage similar to that found in hypermedia. The hyper-sketch, then, as an electronic file may be linked to other media such as sound or video. Therefore, as a multi-layered repository of ideas, the hyper-sketch may help designers retrieve or recall previous design intentions which in turn may inspire new ideas because: 'Previous designs suggest possible solutions, frame works and design strategies' (Yi-Luen 2000:502). As a conceptual tool, then, the hyper-sketch may extend or amplify designers' ideation capability and overcome constraints on human memory processing power. In this, the hyper-sketch suggests a kind of meta-activity that connects design thinking in both analogue and digital mediums. Graphically, the four ways of describing the sketch may be depicted as follows (Figure B:3).

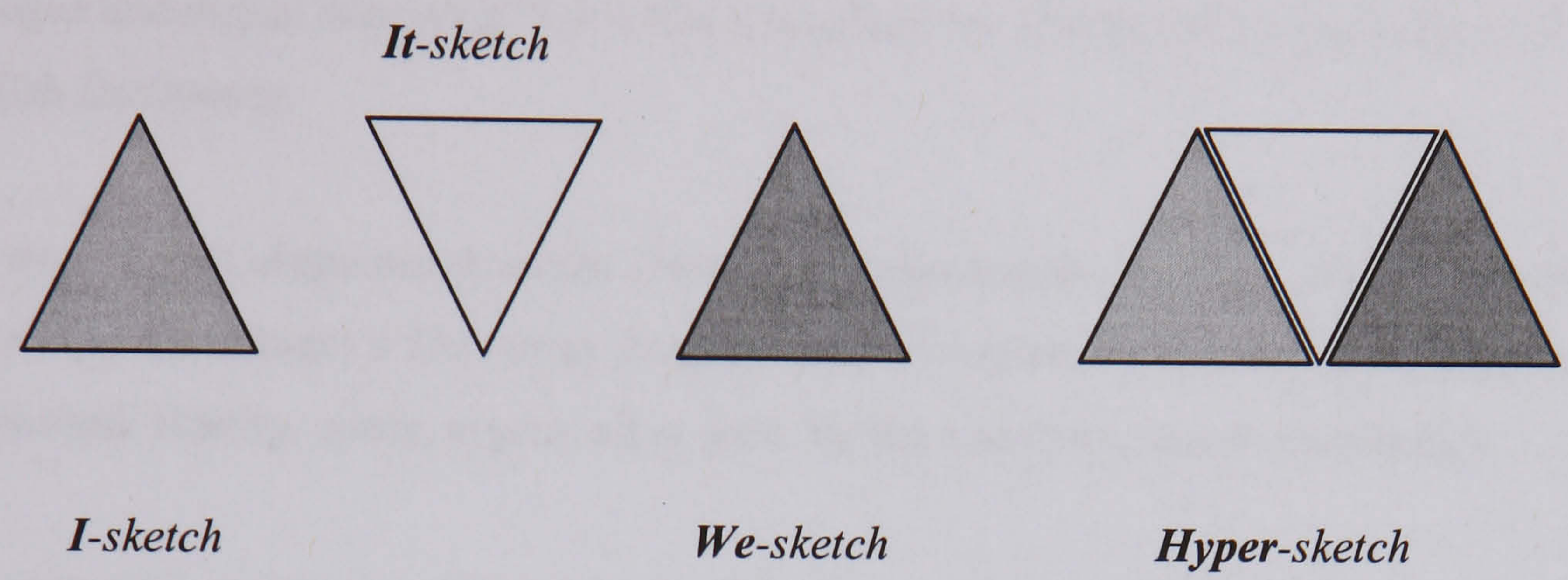


Fig. B:3 Sketch Categories

The following may further illustrate the different sketch modes, viz. "I-sketch", "We-sketch", "It-sketch", and "Hyper-sketch":

1 *The sketch as inner-personal communication* of visual thought (I-sketch)
For example, A., an architect, sketched out an idea for an interior wall in elevation. A was satisfied that the sketch represented a possible design solution (Observation recorded in Medway and Clark 2001:182)

2 *The sketch as interpersonal communication* of visual thought (We-sketch).
For example, A, the above architect, showed the sketch to B, a model maker. However, B found the sketch ambiguous in that it showed the proposed shape of the wall only in elevation. Only after A sketched out the intended wall in plan and perspective too, did the form become apparent to B, who then could proceed with the modelling task (ibid.).

3 *The sketch as observational communication* of things or facts now existing, or previously existing (It-sketch). For example, a sketch of the interior wall after it has been constructed.

4 *The sketch as narrative* of analogue and digital events (Hyper-sketch). For example, the brainstorming sketch in which the participants are linking strands of facts and ideas displayed as virtual mapping.

Sketch Etymology

Some words, like phenomenology, have great significance to their etymology. Could this be the case with the word sketch? And could etymology throw more light on the relationship between analogue and digital sketching? For a literal meaning we find the following in the *Oxford English Dictionary*:

The word sketch originates from Gr. *skhedios* = 'unprepared', thus L. *schedius* = 'hastily made'. Or, from Roget's *Thesaurus*: Unprepared, incomplete, rudimental, raw, rough and unpolished. Hastily, apace, urgent, all at once, by fits and starts, and at short notice.

"Unprepared" conjures up "improvisation" (L. *improvisus* = unforeseen), an extempore activity done without preparation. However, sketching on paper may suggest an activity made in a "prepared field," rather than in the "unprepared ground" of cave painters or graffiti artists. That is, a phenomenological distinction in which, according to the art historian Schapiro, the smooth, enclosed prepared field of paper reflects the changing nature of the figure-ground relationship, from Assyrian carved inscriptions to non-figurative painting in the 20tth century with no frame (in Schneider Adams 1996:143-148). Schapiro applies the figure-ground relationship to drawing in that he sees the prepared field as a social construct that, like language, has developed through a learning process (ibid.). As a social construct, the prepared field signifies 'social, artistic, and emotional order, whereas the unprepared field can signify disorder, lack of control, and rebellion' (ibid. p.146). In this sense, drawing might represent good behaviour through a learning process whereas graffiti on walls in public spaces would speak of rebellion. Arguably, then, sketching, as loose drawing, is conceptually closer to the unprepared field in that it allows, in Schapiro's metaphorical sense, for "rebellious", rather than "orderly" behaviour.

In contrast, computer drawing suggests an "orderly" activity in the prepared field because drawing on screen is not only part of a learning process but also a more "tidy" process than scribbling with a pencil, for instance, the screen doesn't get "dirty" in the way graphite smudges paper. This hygienic aspect of computing, that is, the digital world is physically clean compared to the manual or analogue world, 'seems to inhibit the use of the computer for sketching' (Coyne et al. 2002:272). Moreover, digital drawing as mark making is done by a pre-installed, "prepared" event-driven software program. In this instance, the software application is the pre-cursor to the cursor used for drawing on screen. The pre-cursor, then, might influence how designers go about generating and developing ideas with the help of computers.

The sketch as "hastily made" captures the proverbial scribble on the back of an envelope. Yet, for the digital sketch, *hastily* may be an inadequate description. That is, in its materiality or in its presence in the printed form the digital sketch seems to look more "polished", or "finished", or even more "authoritative", compared to the freehand sketch on paper. Arguably, then, the printout of a screen document may lack authenticity – in what might be called the "anonymity of digitisation" - yet its "finished look" may render it "authority" however spurious or superficial. In contrast, the pen and paper sketch may look authentic ("original mark making"), but, due to its sketchiness, lack "authority". Thus the speed and ease of digital reproduction poses a challenge to the notions of single authorship and originality ("indefinite originals") questioning traditional legal and psychological (perception) boundaries between new and old media.

However, the debate about the impact of technology on authenticity is not new. One example is how artists were criticised for engaging in photomontage, another is Walter Benjamin, who argued that, in the age of mechanical reproduction, once authenticity and originality are confused, the authority of the object becomes confused too (Benjamin 1936). Yet, in a digital age the confusion might be greater still:

> 'The instant access to imagery has seen a rise in the use of appropriated images in art. This is becoming more popular and it is now difficult to assess where the line lies between creativity and plagiarism' (Hamilton 2003:73).

The perceptual distinction made between analogue and digital media also draws attention to what is the significance of originality. Therefore, does the amount of skill or knowledge of any one medium influence the way we perceive originality, and therefore also aesthetics? For example, the "beautiful" freehand sketch compared with the "dazzling effects" of a computer rendered drawing. Moreover, in the shift to a digital image culture, what happens to the scholarly authority of freehand drawing, based on recognised skills and knowledge in lineage from the Renaissance drawing paradigm? Similarly, in the context of everyday design practice, how do we perceive and identify originality of visual expression in the digital studio? The impact of digital technology, then, may undermine existing authorities but also institute new functions of authority, hierarchy or power structures, for instance "cyber policing", or the formation of anti-canonical plots, such as "cyberpunk". Moreover,

> 'computing in design discloses new work patterns and practices that include new modes of organisation, new specialisms, and a certain kind of experimentation' (Coyne et al. 2002:271).

However, conversely, freehand sketching may challenge authority of a highly structured digital design environment, and therefore it may be seen as a "creative safety-valve", non-reliant on formal systems, disobedient even, an "agent-provocateur" in the world of design ideation. Sketching, then, as mentioned, may be perceived as closer to the "unprepared" field of graffiti, rather than the "prepared" field of the plane of a window, or the "window frame", as conceived in the Renaissance, and appropriated by the digital medium for the computer screen.

The notions of authorship and originality also concern the language of erasure. That is, the meaning of erasure of digital records (removal from magnetic tape or disk) differs from the meaning erasure holds in analogue media (obliterating or rubbing out marks made on paper). Therefore, when something is erased in digital media it is "wiped clean" whereas in analogue media 'it is often possible to sense the mark left by erasure' (Brooks 2000:292).

The western concepts of authorship and originality, however, are not a modern preoccupation. For example, possessive authorship was an issue among play writers in Tudor times (Loewenstein 2002). In the Renaissance, Leonardo da Vinci warned of copying as a fundamental lack of independence on the part of the artists (Panofsky 1968:205; notes 12, 14). And Durer, one of the first artists to sign his work claiming authorship took to court copyist of his work in Renaissance Venice. In contrast, as a method of study, copying was not only allowed but also recommended in the old art academies. The original therefore established its superiority over the copy, although works of art have always been reproducible, through imitation (Benjamin 1936). Arguably, however, there is no such thing as absolute original production in the sense that even the creative master depends on a tradition of art, and the copyist, even when technically more gifted than the originator, has traditionally had his character stamped with subordination and lack of freedom (Friedlander 1946:234). The concept of "plagiarism", however, did not emerge until the 19th century, when artist work was considered a thoroughly personal experience and therefore also personal property (Panofsky ibid.).

However, copying in design practice is different from the art tradition in that it typically takes the form of tracing as part of sketch development, in which single authorship can be tracked (see Chapter *Introduction*). But once the sketch is scanned into a computer, however, it may be copied and altered much more easily than on paper and subsequently its "originality" or "authorship" may get lost. In terms of authenticity, then, the scanned sketch may resemble collaborative sketching, for instance when a design team exchanges ideas using a common sketchpad. Still, the notion of authorship and originality remains controversial in new media, even ignored, and notably by graphic designers ("graphic authorship") and their clients (Poynor 2001:205), to the sometime frustration of copyright holders although, technically speaking, documents can be "electronically tagged" ("digital signature") to deter unauthorised copying. Yet, creativity or computer-aided ideation, CAI, might suffer from an inferiority complex logged in the tradition of art in that,

> 'the creative master stakes the whole of his intellectual and spiritual forces, the copyist only memory, eye and hand' ... An original resembles an organism; a copy a machine' (Friedlander 1946:236.

Further to the etymology of sketching, "unprepared" and "hastily made" may emphasise the handicraft aspect of sketching as opposed to factory methods and mechanical or digital mass-production, which involve set-up costs. However, such differences may be exaggerated, as argued by Walter Gropius (1883-1969), the founder of Bauhaus.

> 'The Bauhaus represented the school of thought which believes that the difference between industry and handicraft is far less a difference due to the nature of the tools employed than of the effect of subdivision of labour in the former and one-man control from start to finish in the latter. Handicrafts and industry must, however, be understood as opposites perpetually approaching each other' (Gropius 1934).

Post-modern art picked on the alleged opposites between craft and mass-produced commodities. For example, the pop artist Andy Warhol (1928-1987) is said to have been

> 'influenced by Bauhaus ideas about the virtues of standardisation, ideas which involved a rejection of the prejudice that hand-made artefacts were *a priori* morally superior to manufactured artefacts' (in Sylvester 1996:387).

Yet in sub-division of labour also lies the argument about the designer's control of his or her work, both in terms of creativity and production in the work place, in that computerisation, in the sense of pre-set programs and specialisation, may sub-ordinate man to the machine. For example, the argument that computerisation might marginalise freehand sketching to fit digital production. Although there is a strong economic argument for digital processes to reduce, say, lead times in product development, the analogue/digital dichotomy, however, nevertheless seems false because new technology allows designers to integrate analogue and digital mediums to accommodate both efficiency and innovation.

However, like many words found in dictionaries, "unprepared" and "hastily made" are not encoded with precise meanings. In search for meaning, then, the conceptual difference between drawing and sketching may be that drawing represents a higher level of precision and certainty than sketching which, in turn, can be characterised by its ambiguity and therefore open to interpretations. For instance, to represent unambiguously an artificial concept such as "square", 'we must know what the object really is – what its shape is – or how it lies in space' (Gregory 1976:169). From this follows that 'it is very much easier to represent familiar than unfamiliar objects' (ibid.). For the square to be a familiar object it would show the typical features of a square, that is, "rectangle with four equal sides". The need for certainty also suggests that we would typically say to "draw" a square, rather than "sketch" it.

As a representation of the unfamiliar, however, the sketch carries less redundancy than the drawing in that it does not, in the context of design ideation, contain the whole content of arguing something into existence, as may be the case with the final drawing. In this sense, the sketch is "loose" and open to more than one interpretation. In contrast, the art of the draughtsman, as pointed out by Gregory, is, largely, 'to make us accept just one of the infinite set of possible interpretations of a figure' (Gregory 1976:168).

In the context of communication, Potter uses the word "diagrams" for drawings that are 'abstract, partial, concerned to establish or convey ideas and values directly, thus having an analytical or interpretative purpose' (Potter 1969:77). This conceptual approach in search of a design solution reflects the full spectrum of how designers work, from product to system design. In contrast, in what has been called 'the natural evolution of design' (Norman 2000:142), a process in which craftspeople are engaged, and in which the objects are simple and slowly crafted, the role of sketching is often subordinated to that of actual "making things". That is, craft methods that reflect how traditionally craftsmen did not draw their work (Jones 1970). The view of the design process as a hands-on activity has been likened to hill climbing (Jones 1980), a metaphor for how the design process may be mapped along possible routes through trial-and-error.

In the context of problem solving, conceptual sketching suggests a purposeful, intentional activity. 'Whenever we design something we do so in order to get an intended result' (Pye 1964:16). In this, sketching delves into man's consciousness, into the sketcher's intent of converting physical or sensuous experiences into ideas and fuelling imagination, that is, imagination in the sense of conceiving objects or other entities not previously encountered, which is plainly possible (Maddox 1998:307). Therefore, sketching may be described as an "intentional" act (process) and the sketch the "intended" object (outcome). An example of this is a freehand sketch on paper by the architect Norman Foster, depicting an 'aerial choreography' under the heading 'The Intention!' (Raney 2001:65).

As a purposeful activity, conceptual sketching may also evoke the notion of *ad hoc* in the meaning of "for this" specific purpose. Elaborated by Jencks and Silver, *adhocism* reveals the desire for immediate and purposeful action, a kind of directed behaviour (Jencks and Silver 1972:16). If the action carries aspirations towards ends that are 'ambiguous, not fully conclusive, plural, imperfect, or sometimes unknown', this would be an example of intentional adhocism (ibid. p.110). In this sense, conceptual sketching may be described as intentional yet imperfect ways of seeing and doing, or an *ad hoc* activity or tool in design.

Sketching as Improvisation

In its popular meaning, ad hoc suggests "making do", a stopgap until a lasting solution is found to the problem. However, a more fruitful way of looking at an ad hoc activity might be to describe it as a form of improvisation. As such it has little to do with makeshift or second best but rather with drawing elements from everyday life:

> 'first, the spontaneous response to the unfolding of an unexpected situation; and secondly, employing this in controlled conditions to gain insight into problems presented' (Hodgson and Richards 1966:3).

Improvisation can also be described as a form of creation, as is the case, for instance, in musical improvisation (Johnson-Laird 1993:260). Moreover, according to Johnson-Laird, improvisationary skills, although inaccessible to consciousness in principle, can be learned:

> 'musicians learn to improvise by imitating virtuosos, and by experimenting They learn to improvise by improvising; the process takes years to master' (ibid.).

As a form of improvisation, then, conceptual sketching could be learned not formally but in a playful manner leading progressively to mastering. Such learning may take place, for instance, by watching experienced designers do sketching rather than studying formal drawing systems that can be taught explicitly and described in detail. In this way, sketching becomes experiential learning, that is learning through primary and sense experiences (Kolb 1984).

However, musical improvisation may rely on chord sequences embedded in a notational system whereas sketching does not. Yet the role of notation might be exaggerated in that what is written in the score is open to interpretation and therefore the evolution of music has been described by musicians as 'a methodical violation of previously accepted rules' (Moles 1968:105). The role of notation has also been disputed in modern contemporary dance. For example, the choreographer Martha Graham resisted having her ballets notated, a prerequisite for copyright under US law, because she regarded them as *unfinished* and altered them for different dancers (Graham 2001). Furthermore, informal, largely non-scripted ways of learning may have implications for how computers are used conceptually because, 'for the improvisatory principles to work efficiently, they should embody as little computational power as possible' (Johnson-Laird 1993:261).

Modern jazz provides a particularly instructive example of learning improvisation that rely on long-term memory and 'a set of principles that underlie the improvisatory skill' (Johnson-Laird 1993:260). Moreover, in common with occupational apprenticeships in many trades,

> 'the jazz community's traditional educational system places emphasis on learning rather than teaching, shifting to students the responsibility for determining what they need to learn, how they will go about learning, and from whom' (Berliner 1994:51).

Improvisation, then, as articulated in jazz, starts from close observations of experienced practitioners. In fact, observation is a well-established method of learning. Therefore, inspired by "jamming" in jazz, in learning how to improvise, conceptual sketching could be seen as a form of improvisation.

Sketching as Performance

In the 1960s and 1970s performance became part of the terminology and theoretical strategies of the social sciences, notably in anthropology and sociology. The term performance was also used to describe art activities, as in "performance art". Goldberg, in tracing the history of twenty-century avant-garde theatre, suggests that performance art is,

> 'the history of permissive, open-ended medium with endless varieties, executed by artists impatient with the limitations of more established art forms' (Goldberg 1988:9).

Moreover, in the context of commerce, performance has long been associated with functioning, effectiveness and profitability. Therefore sketching as performance highlights not only artistic ("subjective") aspects of design but also design as business ("objective").

As a performative, creative activity, conceptual sketching may operate both at a personal ("I-sketch") and collaborative level ("We-sketch") affected and influenced by the individual designer's personality (behaviour and cognition) and experiences (skills and knowledge), as well as group dynamics (teamwork) and the design environment at large. But also:

> 'Performance by its nature resists conclusions, just as it resists the sort of definitions, boundaries, attitudes, so useful to traditional academic writing and academic structure (Carlson 1996:189).

This suggests that sketching as performance resists conclusion: 'a designer thinking out a job will go backwards and forwards from one kind of drawing to another, testing and exploring' (Potter 1969:77). In resisting conclusion, then, conceptual sketching is not so much a recording of what is or what has been (*It-sketch*) but rather about possibilities, "what if" (*I-sketch,* or *We-sketch*), or an evocation of what might be. This may also suggest a problem solving sketch strategy for which 'search starts from any point in the problem space' (Akin 1979:205).

Conceptual sketching, however, is not necessarily situated in the problem solving space of designing because 'in design it is difficult to know what problems are relevant ... until a solution is attempted (Lawson 1990:41). Therefore sketching may have a performative role already in recognising and formulating the problem. As performance, then, sketching becomes a tool of engagement which may recall Peter Brook's exploring and discovery of theatre:

> 'I can take any empty space and call it a bare stage. A man walks across this empty space, whilst someone else is watching him and this is all that is needed for an act of theatre to be engaged' (Brook 1968).

Sketching, then, may be enough to come into design with, or "for an act of design to be engaged". Once engaged, sketching may perform a number of inter-connected, transitional acts that together would make up what I call the "Design Scene". This scene, and to continue the theatre metaphor, is a bare stage where there is no proscenium to frame "the problem". Instead, the empty space cognitively open-minded provides for various designer acts, or sub-scenes, or plots, which may be loosely labelled according to design activities, not in any prescriptive way, but rather to illuminate ways of approaching designing (Figure B:4). Therefore: the *Ideation Act* ("idea generation"), the *Problem Act* ("problem framing"), the *Testing Act* ("feasibility study"), and the *Resolution Act* ("decision making"). Sketching, therefore, may be performed in any of these acts on the design scene, which is furthermore revolving ("going backwards and forwards"), which suggests that sketching is a hybrid act, or *hyper-performance*, that is, in either analogue or digital modes.

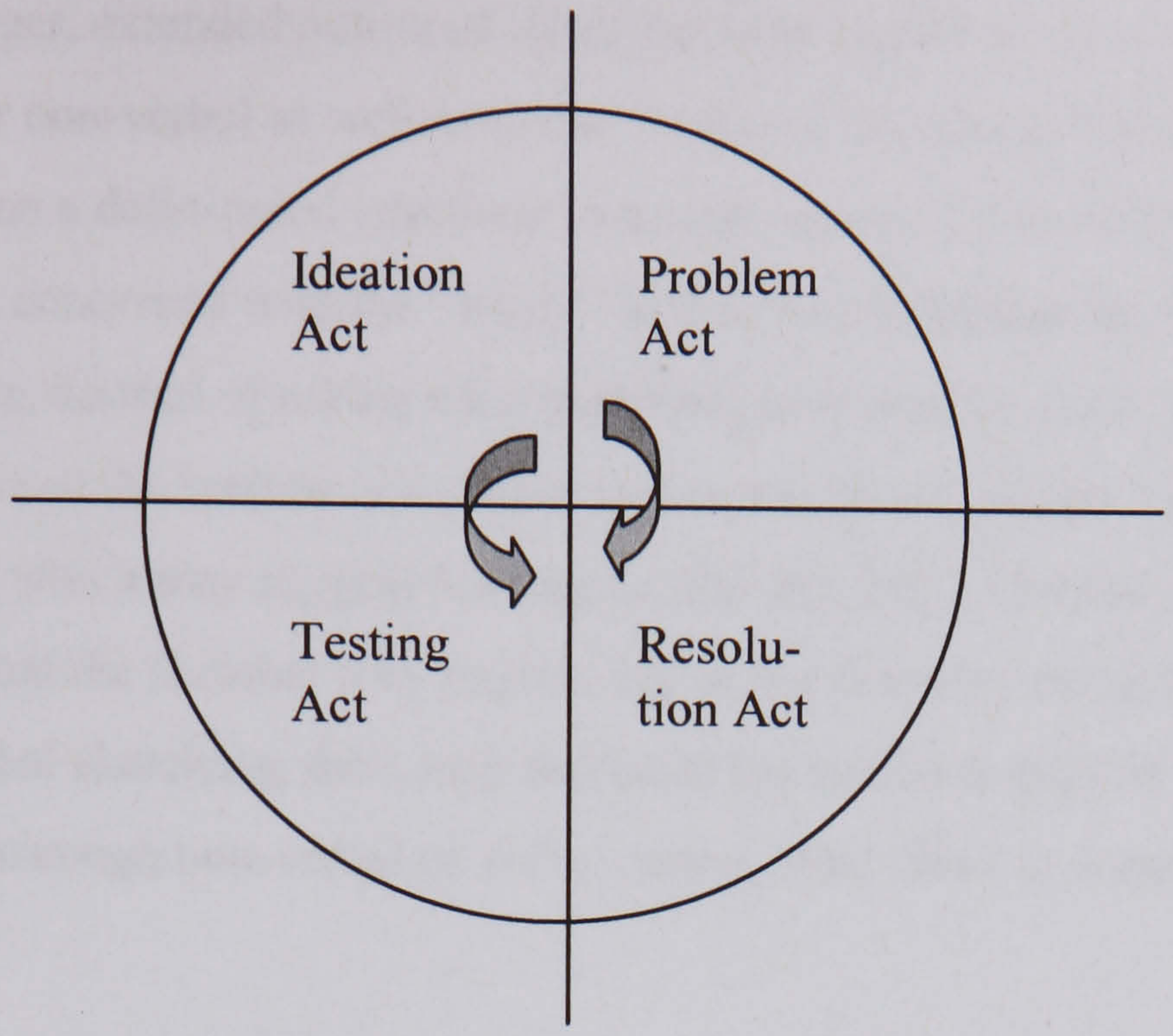


Fig. B:4 Sketching as Performance

Sketching as Definition

Academic research of the natural world strives to minimise ambiguity, say in forming taxonomies and descriptive analyses, for which explicit definitions often are needed. Such definitions state the essential properties of things applied to a given concept, in the sense that 'a good definition always unequivocally determines what objects conform to it' (Goodman 1976:129). Yet, the ambiguous character of the conceptual sketch, both empirically and semantically, with connotations of improvisatory performance, suggests it might be futile to try to redeem sketching from its uncertainty and therefore to define it. The notion of drawing is in a similar dilemma, unless drawing is referred to as a numerically based, notational scheme, for example working drawings, which have to be precise. To overcome this problem, drawing, in post-modern discourse has been "defined" in very broad terms, such as: 'making purposeful marks that have meaning' (Adams 2001:36). Or, in emphasising how drawing retains a link with its material origin, drawing has been understood as 'an extended sense of various kinds of marks and effects of contact' (Penone, in Zegher 2004:101).

Broad, descriptive terms, such as marks and contact, however, may loose their analytical power and therefore become fairly useless in describing, interpreting and evaluating phenomenon such as conceptual activities. However, in the context of formal learning and curricula, if sketching cannot be defined, can it be taught? Yet, sketching, in its intimation of play or improvisation, suggests informal, rather than formal learning for which definitions may be less appropriate.

Moreover, the larger, extended notion of sketching here argued is not confined to pen and paper but suggests other non-verbal as well as verbal modes of sketching. Therefore, in advance of a flexible, rather than a definitional approach to design research, it has been said that 'artists and designers are less concerned with the "what?" of their activities than the "how?"' (Woodfield 2001:3). Therefore, instead of asking *what* sketching is in precise terms, we might look for relationships between the various non-verbal and verbal sketch modes. Or, we may ask *when* is a sketch a sketch, which may suggest looking for the sketcher's intention or, "what if?" This further suggests that the sketcher may express his or her intention metaphorically, rather than literally. Conceptual sketching, then, may represent the symbolic play of images, which can be articulated either through non-verbal or verbal means in an effort to communicate a meaningful intent.

Sketching and Redundancy

Another way of describing sketching might be to borrow the concept of redundancy from communication theory, that is, what is predictable or conventional in a message (Fiske 1990:10). Applying the concept of redundancy, the sketch might be described as being located towards one extreme of drawing, that is, a drawing of low redundancy, a kind of drawing that is not predictable. In contrast, a technical drawing would be the opposite, very predictable and of high redundancy.

Or, to use another concept from communication theory, the sketch could be seen as a form of entropic drawing, that is, of low redundancy and therefore low predictability (Fiske ibid.). However, the concept of entropy also signifies a quantitative element of disorder in a system (Arnheim 1971:8). Arguably, then, the conceptual sketch carries the idea of uncertainty having a measure of disorder and therefore may be described as a kind of disorderly drawing. However, the sketch is not a notational system and therefore is not a quantitative measure of the degree of disorder in a system (Goodman 1976). The disorder, then, is a qualitative measure.

However, as a qualitative measure, disorder, and similar to what can be observed in the child's playroom, is not the absence of all order but rather 'the clash of uncoordinated orders' (Arnheim 1971:13). The analogy between the playful disorder of the child and that of sketching is interesting because it may evoke the "unprepared" field of drawing, as manifested in, for example, graffiti. But also how it may resonate with 'the child within each of us', a phrase coined by the 1948 artist Cobra group (quoted in Fineberg 1997:23). Thus, the notions of redundancy and entropy might be another small cognitive building block towards our understanding of the character of sketching.

Sketching as Language Understanding

Further to its etymology, the word sketch suggests a number of interpretations, extrapolations and analogies of both lower and higher levels of meaning, notably language. Although the notion of "visual language" has been criticised for being an 'absurd analogy', since the visual is not coterminous with the textual (Suchin 2000), it holds a prominent position in post-modern discourse, in interpreting images as texts. For example, it has been argued that the difference between "script" and "image" is that of recording medium, and that they both have a general linguistic quality of conveying a message (Barasch 1997:3). As an image conveying a message, the sketch may further become the subject of communication studies (see below).

As language, a distinction can be made between the act of sketching (verb), an activity in space and time, and the sketch (noun) as distribution of information in space. Other examples of such pair words are drawing, program, report, plan, and, of course, design. Moreover, they signify both process and product.

Moreover, language suggests communality, and sometimes designers are referred to as "a community" in which designers "speak, or share the same language". That is, designing is regarded as a "common language", as expressed in shared norms and conventions. For example, graphic designers share a common language in the form of a "common interface" of types, fonts and icons. Similarly, 'The graphical marks that architectural designers make are conventional and correspond to specific tasks that they engage in as they work' (Yi-Luen et al. 2000:491). Yet as argued by Chomsky, 'no notion of "common language" has been formulated in any useful or coherent way, nor do the prospects seem hopeful' (Chomsky 2000:31).

The notion of a common design language is controversial, yet lack of it may be observed from the multiplicity of design activities.

> 'It is very clear that the different practitioners in the art and design community have different languages to describe what they are doing … they express different linguistic constituencies' (Woodfield 2001:3).

Or, 'not only are designers likely to devise different solutions but they also perceive problems differently' (Lawson 1990:89). Such diversity, therefore, may question whether there is a distinct "design community". For instance, among architects, a traditionally well-defined professional group, opinions do differ about sketching. Thus Richard Horden holds that 'great architecture is the built sketch', whereas Hani Rashid is sceptical to 'the notion of the masterful sketch of the architect of a preliminary idea' (Raney 2001: 63-67).

However, design methodologists, in pursuing the notion of a unitary design process, claimed to have found similarities in design regardless of the domain: 'Activities as diverse as software design, architectural design, naming, and letter writing appear to have *much* in common' (Thomas and Carroll 1979:11). Or, 'My present belief, formed over the past six years, is that there exists a designerly way of thinking and communicating that is both different from scientific and scholarly ways of thinking' (Archer 1979:17).

Such discrepancies highlight what Cross calls the 'application gap' between design methodology and design practice (Cross 1984). Still, "common languages" may exist between experts, within specific research communities and within and between design teams in commercial practice. Kuhn, for example, suggests that professionals may be bound together in what he calls a 'disciplinary matrix' (Kuhn 1970). Similarly, Lawson, in emphasising how dependent designers can build on their collective experience, holds that 'a process of sharing ideas and value systems ... contributes to the formation of a team language' (Lawson 2001:143). The sharing of values was also evident in my introductory research when recruitment of designers was influenced by specific skills, including freehand drawing, that is, drawing was not just the ability to draw but also part of a set of design values (see Chapter *Introduction*). The notion of a common language may apply to design schools too. For instance, a study with architecture students showed 'that designers share and can understand one another's conventions in diagramming architectural concepts' (Yi-Luen et al. 2000:487).

Such conflicting views, however, suggest that there are several design communities, or sub-communities. Moreover, the many design communities might be described as "tribes" in which language is used in a tribal fashion accessible only to an insider group of practitioners and their supporters. This further suggest that there is not a "common sketch language" that is practised or shared by all designers, rather different approaches to "doing sketches", which is reflected in the "multiplicity of sketching", or *sketcherly ways of designing* (see Chapter *Methodology*).

Yet the notion of a common sketch language might be attractive as a unitary force in a digital design culture of networked environments. Therefore, researchers are trying to find new higher-order spatial concepts and signs with the goal of making interaction with software via sketches as natural as interacting with a person. More specifically, computers have been programmed to recognise sketches of architectural designers as a symbol language with the aim of selecting the most appropriate design tools. Results of such research suggest, for example, 'that a computer system could infer design intentions from the drawing symbols that designer use and provide designers with the "right tool at the right time"' (Yi-Luen et al. 2000:492). However, sketch recognition programs have been objected to, for instance, on grounds that standard symbol systems are 'inadequate to account for the richness and diversity of symbolic functioning in design domains' (Goel 1995:79).

The problem of describing sketching in computational terms is similar to that encountered in speech recognition, that is, meaning. Although speech is the most effective interface between humans, to get a machine to recognise speech through digitisation of sound it is not enough for the computer to recognise sound (strokes), it must also understand and interpret meaning, and put them into right context. (*The Economist Technology Quarterly.* December 8, 2001, pp. 14-16).

To recognise digital pen strokes (bitmap), however, the interpretative task may be even greater than that for speech because of significant amount of noise in the input, a result from the non-notational character of sketching, which need to be filtered. However, such filtering can be done digitally, for instance in the way a scanned sketch can be manipulated using painting packages. Yet it is the noise input that makes the sketch ambiguous, and ultimately what turns it into a mere doodle, in a similar way that fragmented notations of music ultimately turn cacophony. Interestingly, it was this characteristic of sounds that inspired the composer John Cage (1912-92) to use any means or material for musical composition, especially environmental noise.

It seems, therefore, that sketch recognition programs, although aiming at supporting designers in the conceptual phase, might "clean up" the sketch thereby risking to distort the sketch idea at the level of machine intervention (software control). However, sketch recognition programs reflect western mind of structural thinking, from Aristotle onwards, and the history of production, and whether expressed in the factory assembly line or computer code (Fry 1999). Still, it is this structured "scientific" way of thinking applied to the more fluid design process, and particularly in its early stages, that has produced an application gap between academic research and practice (Cross 2001).

Yet language carries powerful connotations. For example, James Joyce's Finnegans Wake, is about anybody, anywhere, anytime or, as Joyce puts it, about 'Every those personal place objects … where soevers' (in Tindall 1969:3). Applying literary analysis to the design field, it might be possible to see Joyce's "doublin existents" as a sketch metaphor that reflects Joyce's three minds. (1) Analogical, in making particulars general; (2) Verbal; in inventing a language that plays with many things at once; and (3) Shaping, in, as a Master Builder, building a second and solider tower of "Babble" from the debris of the first (Tindall 1969:6-8). In this sense, the notion of conceptual sketching may be seen as analogous to Joyce's modern Dubliners, something that might embody everywhere else all the time.

Thus inspired by literature, conceptual sketching could be regarded as a linguistic notion, a stretch of language, like a monologue (a personal narrative, as *sketching in first person*, or "I-sketch"), a dialogue (interpersonal communication, or "We-sketch"), or a descriptive discourse ("It-sketch"). As language, sketching might also be analysed in terms of styles and sequences of mark making and structure, a kind of natural drawing language perhaps worthy of a "grammar". Such visual grammars were developed in the 19th century, as exemplified by Owen Jones, the supervisor of the Great Exhibition (1851), who argued that basic forms in nature constituted universal styles of ornament (Jones 1910).

Barthes (1915-80), the literary theorist, in applying the science of signs (semiology) to art, argued that artistic creation cannot be reduced to a system. 'We have not been able to establish either painting's lexicon or its general grammar' (Barthes 1985:149). The idea that cultural expressions such as art and language are composed of signs, emerged from the "structural linguistics" of Saussure (1857-1913), who saw language as a closed system, as sets of binary structural elements, including Language and Speech. Language, according to Saussure, is the grammatical structure of verbal (spoken and written) communication, and is a social construct that can be studied objectively (in Schneider Adams 1996:134). In contrast, speech is individual and variable, but because children learn to talk before they learn grammar, speech is thought of as preceding language in the history of the individual, whereas, in cultural history, language precedes speech (ibid.). By analogy, sketching might be perceived as being closer to speech and therefore essentially part of personal development, whereas drawing, when based on rules and conventions, for instance technical drawing or CAD, would be closer to a grammatical structure.

However, if sketching is considered a form of graphic language, or a symbolic language of signs, in the tradition of Saussure, it may constitute a form of structuralism. As such, and to borrow Chomsky's notion of transformational grammar, conceptual sketching consists of 'surface structures', like the words and the sounds in a sentence, and 'deep structures', like those containing the meaning of the sentence (Chomsky 1957). The notion of surface structures may then be extended to include any conceptual tool, which suggests that ideation, as cognition, and therefore meaning, is about deep, rather than surface structure.

Moreover, as a language of signs, sketching may become part of the study of codes, composed of both signifying codes (systems of signs), and codes of behaviour (ethical and legal), that emphasises the social dimension of communication (Fiske 1990:69). Yet codes do not only convey meaning but also (a) depend on agreement amongst their users (shared culture); (b) perform identifiable social or communication function, and, (c) are transmittable (ibid.). In this sense, as codes of behaviour, sketching may depend on agreed conventions among designers in order to communicate their ideas to others, (a) and (b). Thus we may return to the question whether there is an identifiable, as opposed to an ideal design community (shared culture) who communicate through sketching (function), posing the rhetorical question: "How can you be a designer without a sketchbook?"

However, as a coded language, or symbol system that is transmittable (c), sketching would imply a structured activity in the more precise meaning of formal notation that would be found in technical drawing, analogue or digital. Formal notation also constitutes the foundation of computer language (programming). But whereas pictures, numbers and text are all formats that can be understood as notation, notation is an unambiguous representation that is absent from informal representations, such as sketches: 'A sketch with its dense field of overlapping, ambiguous executed marks is not a symbol scheme' (McCullough 1996:92, also Goodman 1976).

But although sketches as images, or surface structures, are easy to record digitally (scanning), manipulate (painting software packages) and transmit electronically (Inter- and intra-net) they are also very difficult for computers to interpret (deep structure):

> 'If we wish to understand notation as an unambiguous symbolic code, images are the least manageable format. Neither images nor their readings are based on distinct elements or syntactic conventions' (McCullough 1995:89).

That is, as argued by Barthes, the science of signs has not been able to make inroads into art thereby reinforcing 'the old humanist superstition that artistic creation cannot be reduced to a system' (Barthes 1985:149).

That sketching cannot be understood as a system also highlights the principle differences between algorithmic and heuristic computer programming. That is, an algorithm, as a complete set of operating steps, always leads to a precise objective, whereas the heuristic procedure will not lead to a predetermined goal but may, by trail and error, lead to progress in the general direction (Rose 1974: 39-41). This suggests that sketching is a heuristic activity, rather than algorithmic, which corresponds to computer drafting.

Sketching as Meta-language

'Concern yourself with things before they come into existence' (Tao Te-ching quote; 500 BC)

In a philosophical discourse, as an aspect of the phenomenology of perception, the meaning of the sketch would go beyond the picture plane. Sketching, then, might be expressed in a visual meta-language that would seek to identify sketching as an activity fundamental to design thinking and doing. Again, we would return to the question "how can you be a designer without a sketchbook?" Thus, as a regulating truth, sketching would express experimental thinking concerned with "what can be" rather than "what is". Such intuitive use of sketching may further suggest either 'the understanding of underlying meaning' through traditional sketching, or the focusing on 'truth as an act of disclosure' (Alvesson et al. 2000:52). Therefore, in a phenomenological perspective, sketching is not necessarily posited in conventional drawing systems but rather an intuitive and associative process suggesting multiple ways of generating and expressing ideas that further suggests a shift from surface to deeper structures. For example, psychological introspection, what in phenomenology has been described as 'the burdensome transcendence of freedom' (Pivcevic 1970:130).

The existential problem of freedom connected with possibility is an essential ontological characteristic according to Heidegger's concept of *Dasein* ('I myself'). That is, 'the essence' of *Dasein* ('its own possibility') cannot be determined by external observation but only by self-analysis (Pivcevic 1970:113). However, according to Heidegger, a general characteristic of *Dasein* is its *being-in-the-world*, a 'world' which is the field of Man's activity. This activity may be concerned with 'ourselves', 'other people', or with 'things' (Pivcevic 1970:116).

These are relationships that might correspond largely to what I call *I-sketch* ('I myself'), *We-sketch* ('other people'), and *It-sketch* ('things'). Sketching, then, and both as a means of self-expression and a means of communication, may take design into the realm of knowledge (deep structures), an extension of the temporal design space (space-time). This kind of knowledge can be experienced as intuition that 'implies a kind of inner "gazing", separate from the more formal and non-perceptual kind of knowledge' (Alvesson et.al. 2000:52). As an intuitive activity, then, conceptual sketching represents a form of intuitive knowledge that is achieved, 'not by laborious pondering, but rather at a stroke, whereby patterns in complex wholes are illuminated by a kind of mental flashlight, giving an immediate and complex overview' (Alvesson et al. 2000:52). But also, as inner gazing, intuition is based in self-image, rather than logic and formal structure. And as self-image (persona), this may help to explain why sketching may evoke strong opinions and feelings among designers and non-designer alike.

However, relating sketching to the concept of *Dasein* ('I myself'), and therefore the issue of freedom, might be overpowering. Kierkegaard, for example, who drew upon Hegel's *Phenomenology of Mind*, characterised anxiety as the 'dizziness of freedom' (in Gardiner 1988). However, designers, in problem-solving situations, may express moments of anxiety as "getting stuck" or "cut-and-run" ("premature decisions"), rather than "dizziness". Or, anxiety might constitute "designers' block", or constraints of the kind that may be self-imposed by designers (Lawson 1990). Moreover, anxiety might affect uses of conceptual tools because they provide physical and mental links between the known and the unknown, between the designer's ideas and final outcomes, between easy solutions and risk taking and experimentation.

Bridging the known and the unknown through imagination, and to use a metaphor, the sketch might be perceived through the looking glass as nonsense. That is, nonsense as opposed to science-sense, as mirrored in *Alice in Wonderland* where 'Carroll's uniqueness is to have allowed nothing to pass through sense, but to have played out everything in nonsense' (Deleuze 1998:22). Yet Lewis Carroll was also a mathematician, which may suggest that the difference between nonsense and science-sense, between imagination and reason might not be that apart.

However, to link everyday design sketching to Kierkegaards's notion of freedom as dizziness may seem an exaggeration because such affective language have induced later existential writings on this theme 'to inflate or over-dramatise the significance of large tracts of everyday thought and behaviour' (Pivcevic 1970:108). Instead the opposite, what has been called 'Folk-psychology', or common sense reasoning, might be a more apt way of describing how we understand mental states such as fears and desires in the realm of human behaviour (Haselager 1997). Yet common sense, although intuitively appealing when communicating every-day design, may not fully explore (method), describe (subject-matter) or explain (purpose) designing in all its aspects. This suggests, therefore, that a comprehensive view of designing may be enriched by a meta-language as expressed through philosophical discourse.

Sketching as Conceptual Understanding

The use of metaphor may help understand the notion of conceptual sketching. For instance, as visual thought, in bringing out, in giving birth to something that is not yet fully formed, sketching is like an embryo, genetically unique, or, an "imp", Old English for "young shoot". Such metaphors may project sketching as a forward movement pointing to possibilities, to what might be. A transitional space, in which ideas can take external shape and form. A creative space, in which the designer "sketch out" a concept that 'does not have necessary and sufficient conditions', nor 'clear-cut boundaries' (Johnson-Laird 1993:244-5).

Sketching, then, as cognition, or *thinking through sketching*, may occur in a dazzling variety of ways from, at one extreme, the free flow of ideas in daydreams, such as found in James Joyce's novel *Ulysses,* to the other extreme of mental arithmetic (Johnson-Laird 1993:217). Using Joyce's "stream of consciousness" as a metaphor, thinking may be represented along a continuum, from outside conscious awareness at one end to heightened alertness at the other. Or, from one extreme of the state of a daydream, in which there is no goal, to the other extreme of the state of deterministic thinking, which has a precise goal (Figure B:5). In trying to locate sketching along this continuum, it might be positioned as thinking that 'has a goal, but it is not carried out like a calculation' (Johnson-Laird 1993:218).

Daydreaming	*Thinking through sketching*	*Reasoning*
←	···	→
No goal	*No precise goal*	*Precise goal*

Fig. B:5 Thinking as continuum

According to Johnson-Laird mental processes with a precise goal are varieties of reasoning, whereas thoughts with no precise goal are varieties of creation (Johnson-Laird 1993:219).

> 'When you are trying to create a new idea – a work of art, a scientific hypothesis, or even something as prosaic as a new turn of phrase – there is a goal, but it is not precisely defined: there is not just one correct answer, and you do not follow a strict determined procedure. Different people tackle the same problem in different ways' (Johnson-Laird 1993:217).

However, such categorisations of thought, as Johnson-Laird points out, are merely convenient labels to reflect underlying distinctions, because it would be possible to do sketching in the midst of a calculation, or in the midst of a daydream. Yet, conceptual sketching may be represented as a thought model, a form of cogitation or type of mental process similar to that of Johnson-Laird's (ibid. 217-220). Therefore, in the flowchart below (Figure B:6) I have juxtaposed a simple diagram of thought for sketching to Johnson-Laird's thought model (left side in Figure B:6). Thus the Doodle represents a mental process that is similar to the Daydream, whereas CAD resembles Calculation, and the Sketch corresponds to Creation.

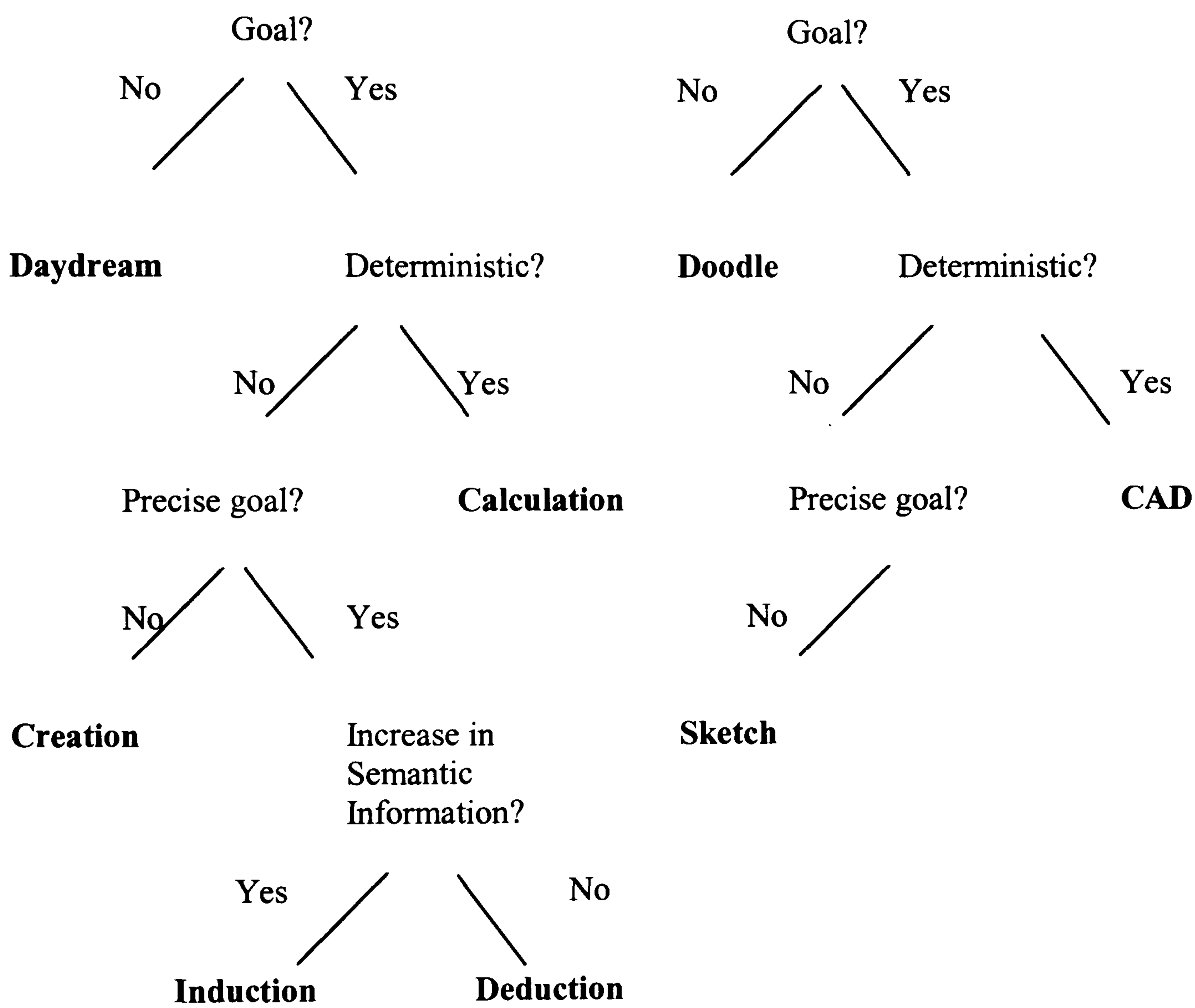


Fig. B:6 A Thought model for sketching (based on Johnson-Laird, 1993).

Conceptual sketching, then, as a non-deterministic form of thinking, seems closer to "the black box" design metaphor in which the most valuable part of the design process lies outside the designer's conscious control, in contrast to "designing out of a glass box" where the designer is

> 'a person who operates only on the information that is fed to him, and who follows through a planned sequence of analytical, synthetic and evaluative steps and cycles until he recognises the best of all possible solutions' (Jones 1970:50).

Moreover, in the glass box scenario, the designer attempts at externalising the design process, for the benefit of new system building, possible design automation, and inclusiveness of people (users) who are outside the designer's knowledge and experience (Jones 1970:45-46, 61). The glass box metaphor fits human thought as a kind of computer operating system. Yet, the human brain's monitoring of its internal activities, unlike the computer's internal workings, is limited.

> 'No amount of introspection can enable a person to discover just which set of neurons in which part of his or her head is executing some current thought-process' (Maddox 1998:306).

Moreover, it leaves out the fact that the human brain 'does more than monitor a person's sensory input' (ibid.). Therefore, in rejecting momentarily that we might make a computer that could really think, Dennet has entertained the idea that

> 'we might make a computer that expand *our* capacity in much the way microscopes, telescopes, microphones, and cameras expanded our sensory capacities' (Dennet 1986:299).

Yet again, design thinking is human thought rather than a computable activity and therefore it is said to be more rooted in past experience than in logical deduction. Or,

> 'much problem solving and decision making takes place through attempts to remember some previous experience that can serve as guide for the present' (Norman 2000:115).

Furthermore, as design problems require subjective interpretation, there are inexhaustible numbers of different solutions yet no optimal solutions (Lawson 1990). Designers, then, if they do not want to simply accept the parameters of the problem given, tend to opt for a 'solution focusing strategy' rather a 'problem focusing strategy' (Hanna and Barber 2001:260).

The solution focusing strategy highlights how memory relates to imagination and visualisation.

> 'Imagination visualisation is novel, as it involves the creation of previously unseen images', whereas 'memory visualisation is confined to previous experience and this constrains playful visual manipulation and reduces the generation of original images' (Dahl, Chattopadhyay and Gorn 2001:8).

This suggests that a novel, playful and original visualisation is a creation relying more on imagination than past experiences. Or, 'experience can be a great help, but it can also be a barrier to new developments' (Dorner 1999:408). Or, as argued by the architect Farshid

Moussavi, 'When you sketch you always rely on your visual memory, and only if you forget about those are you likely to surprise yourself' (Moussavi 2003:63).

Sketching as Visual Understanding

However, visualisation from memory confined to non-digital experience may suggest traditional, or analogue sketching modes, modes in which the word experience is read as 'that which is handed down, a deep and practised knowledge that emerges of time' [in German: *Erfahrung*] (Leslie 1999:115). In contrast, the digital medium may re-interpret the meaning of experience as 'the more likely modern form of experience, also translatable as adventure. It signals something discontinuous and fractured' [in German: *Erlebnis*] (ibid.). Therefore, digitisation, as a post-modern form of experience, may suggest that which is discontinuous and new, in contrast to that which is continuous and traditional (analogue)

Another way of looking at the difference between the notions of *Erfahrung,* that is, experience, and *Erlebnis,* that is, experience as comprehension, might be to situate *Erfahrung* in the sensory and *Erlebnis* in the cognitive domain. An example of comprehension might be the "Aha!" kind of insight. Although such experiences may be difficult to record, and impossible to predict, they might nevertheless be described as closer to a fractured rather than a continuous experience. In this sense, "Aha!" moments ("sparks", "flashes" etc.), as cognitive phenomena, reflect ideation as embedded in deep, rather than surface structures.

In the handing down of practised knowledge, such as in the observation of the evolution of forms or study of the structure of nature (*Erfahrung*), sketching may prove useful in understanding the objective world (*Erlebnis*). It may also suggest, at least for a more complex design task, improved visual understanding of how things are constructed or how they work. Moreover, it may increase understanding of conventions used in the design process, for example scale or perspective.

Moreover, sketching as cognitive experience, or "thinking through sketching", and to use the language of structuralism, might be likened to speech ("the signifier") and as such would be the expression of a mental concept ("the signified"). For Saussure 'speech and thought are simultaneous and indistinguishable', constituting "the sign" (Schneider-Adams 1996:207). Thus, in the "semiotics of design", to associate a sketch ("the signifier") with an object or an idea ("the signified"), sketching could be seen as a means of helping designers make sense of what they think, see and do. Sketching, then, as a cognitive tool, may sharpen perception (insight, awareness) in dealing with the inherent ambiguity of pictures and signs at the generative stage of the design process.

However, design as culturally based visual recognition of things and events is not necessarily factual because it may reflect how designers visualise things in their head before any marks are made on paper or on screen, expressed in words or material. For example, the architect Lloyd Wright argued that the idea is likely to sprint into life by way of concentrated thought: 'Conceive the building in the imagination, not on paper but in the mind, thoroughly before touching paper' (in Hoffmann 1978:15).

Yet, as part of the design process, ideas ultimately have to be manifested in some shape or form. The conceptual sketch, then, may be seen as an interactive space between brain and hand, a mediation space in which design ideas can be connected, critiqued and reflected on. Moreover, such interaction between mind, eye and hand, as in "thinking through sketching", might explain how designers look for sketching opportunities, or events in the conceptual phases of the design process. In this sense, sketching can be seen as a means of exteriorising visual and conceptual understanding of the design process. In other words, the function of the conceptual sketch is that of both tool and medium, to conceive and perceive.

Sketching as Constraint

Conceptual sketching in the sense of making "visible marks" on paper might suggest a kind of notation. Yet sketching has been firmly rejected as formal notation, a special case of symbol usage, like a musical score. Or, 'The sketch, unlike the score, is not in a language or notation at all, but in a system without either syntactic or semantic differentiation' (Goodman 1976:192). In contrast to the sketch, the familiar alphabetical, numerical, and binary notations do qualify as notational schemes because their characters (utterances or inscriptions) can be both freely exchanged for another and finitely articulated (Goodman 1976:127-173).

Therefore, the sketch, unlike a musical score or a binary computer programme, cannot be reduced to individual elements, like "notes" or "digits". This, in turn, reflects the "whole" character of sketching. However, the wholeness, or holistic notion of sketching does not signify the "final" picture, but something that is indivisible from the whole in a hermeneutic sense, something that has a dynamic relationship to the whole, that is the design process. This relationship further suggests that the sketch is not just a factual manifestation (outcome) but an operative fact (process) that is being passed on to the next phase of the design process as a means of further discoveries, revisions, decisions and judgements.

Moreover, the holistic view of sketching echoes the basic tenet of Gestalt theory in which the whole conditions the parts (Ellis 1938). Yet other Gestalt principles do not seem so relevant to sketching. For instance, the Gestalt concept of 'closure', a principle of 'good' (as clear, or as stable) organisation applied to the process of 'completing' an incomplete circle, and to the perceived 'completed' circle itself (Luchins 1959), does not seem to agree with the open and ambiguous character of sketching. For different purposes, however, the term closure may be applied to a final drawing, in the sense of a terminating phase of the pre-production design process.

The character of sketching highlights how, as part of designing, it is subject to external constraints, that is constraints imposed by the external environment, such as tools, client, user or regulator, or, by internal constraints, that is, constraints embedded in the individual designer. At first glance, there appears to be few constraints when sketching on paper because of its immediacy and economy of means. Yet freehand sketching might be hold back for reasons such as "I can't draw" (skill), "I won't draw" (attitude), or "I don't have to" (reward). However, when the designer falls back on "inner resources", sketching may be concerned with internal, rather than external constraints. 'One of the most important skills a designer must acquire is the ability critically to evaluate his own self-imposed constraints' (Lawson 1990:71). Or, 'When you create, the essential constraints are those that you provide yourself' (Johnson-Laird 1993: 268).

Therefore, and although sketching on screen or graphic tablet has its own particular constraints, the handling of the input device (mouse or stylus), or shaping and scaling on-screen may share some of the internal constraints of freehand sketching. For instance, using a painting software package, such as Painter™, for observational drawing or geometrical thought processes, suggests basic drawing skills: 'If you can't draw, Painter™ won't help you draw any better' (Cuir 2000:197, see also Chapter *Introduction: Vignette Ron Arad*).

Sketching as Drawing Skill

However, does conceptual sketching, as representation or visual mark making, call for formal drawing skills? This is controversial because drawing skills, as in draughtsmanship or illustration, do not equal designing. For example, a mediocre or poor design idea can be drawn beautifully. Therefore competence in drawing is not the same as satisfaction.

> 'Freehand drawing is ... not as essential to every kind of work as is usually thought – a designer can design well and not be able to draw in this way at all; conversely, a designer who draws marvellously well may be mistaking his vocation as an illustrator or painter' (Potter 1969:76).

Similarly, 'It is quite possible to be a good designer but a poor draughtsman' (Lawson 1990:179). Or, 'The inventive process does not require wider skills: not necessarily a larger vocabulary or unlimited graphic techniques' (Goldschmidt 2003:72). Or,

> 'Having an idea to communicate is, in the end, a more important sign of creativity than the mere ability to represent what already exists' (Buchanan 2004:36).

Arguably, then, an accomplished digital visualiser is not necessarily the same as a good designer. However, in contrast to Cuir (op. cit.), Harold Cohen, who has programmed a computer to simulate freehand drawing, has argued that computer-based art making processes are medium-less and therefore there are 'no skill-based disciplines to learn' (in Hamilton 2003:78).

Yet, the conventional view is that drawing is closely linked to creativity. 'In creative design, as in drawing, line is the artist's first ally' (Bevlin 1970:28), a view that recalls Klee's pedagogical notion of 'an active line on a walk' (Klee 1961). This approach then suggests a link between creating and learning (Johnson-Laird 1993:257). That is, learning in the sense what happens when, as a result of experience, 'you become able to do something you could not do before, or able to do it better', and whether through instruction, trial and error or imitation (Johnson-Laird 1993:129-130).

The interest in drawing as learning has resulted in researching the relationship between eye skill and drawing from life. For instance, Tchalenko poses the question which is the cause and which is the effect.

> 'If it is confirmed that subjects who draw regularly from life tend to have particular eye skill, then the investigation will be aimed at finding out whether such skills may be acquired through training and practice' (Tchalenko 2001:41).

Sketching, then, as loose drawing, might be learned through the practice of "doing sketching". Yet, ideation seems to have more to do with the expressive and communicative aspects of sketching than observational drawing (the co-ordination of eye-and- hand-movement, or perceptual-motor skills), and therefore sketching may be a creative activity 'for which learning cannot be guaranteed' (Johnson-Laird 1993:140). However, Taylor, in giving advice to students, suggests that the real issue is not whether drawing can be taught, but rather the way in which drawing skills are harnessed and used (Taylor 1990). Similarly, Goldschmidt sees fluency and command of orthogonal projections as two independent components of sketching skills for problem-solving and therefore argues that what matters for inventiveness is 'an ability to use the representational act [linguistic or graphic] to reason with on the fly' (Goldschmidt 2003:72). This, then, *on the fly*, suggests that sketching is an improvisatory, rather than technical skill.

But if sketching fails the "learning test", this might suggest that sketching is a poor means of conceptualisation in the sense that it has no skill or knowledge base like other professional activities:

> 'Expertise in the field of endeavour ... is directly tied to what a person has learned. For example, a painter or composer must know the paints, techniques, or instruments available' (Amabile, in Bernstein and Nash 1999:275).

Lawson has commented on the benefit of skills, 'we probably work best when we think least about technique' (Lawson 1990:7). Similarly, 'Creating without discipline of design skills is almost meaningless for the design profession' (Buchanan 2004:35). Yet, if sketching cannot be taught, it might vindicate that 'designers use weak, substandard, or defective symbol system', and therefore 'They should educate and train themselves to use more powerful notational systems' (Goel 1995:188). This may then be an argument for conception of creativity through CAD systems. However, Goel rejects the reductive logic of drawing systems, which essentially rearranges existing knowledge, rather than developing new knowledge through creative leaps.

> 'Non-notational symbol systems [such as sketches] are not weak, substandard, or defective in any sense. They are extremely powerful and productive, and much of their power comes from the very fact that they are non-disjoint, ambiguous, dense, replete, and so on' (Goel 1995:188).

But conceptual sketching, which goes back to the Beaux Arts tradition when sketch design was a means to develop 'rapid design ability' (Lawson 1990:2), is not the only means for design ideation.

> 'Without question, drawing is an important skill for designers. But it is not the only skill, and it is not the skill that best reveals whether a student will become a fine designer' (Buchanan 2004:36).

For instance, spoken and written words may at times suffice to describe and explain concepts: 'If an idea is unclear, explain it to somebody!' (Dorner 1999:409). But Dorner also suggests that to attempt to verbalise ideas prematurely might destroy the dynamics of thought, not least 'sudden insights' (Dorner 1999:411). Such insights sometimes take the form of visual analogy, which has been shown to enhance problem-solving skills in design (Casakin and Goldschmidt 1999). This suggests that imagination, rather than tool skills might be the first consideration for ideation. Or in the words of Johannes Itten of Bauhaus:

> 'Imagination and creative ability must first of all be liberated and strengthened. Once this has been achieved, technical and practical demands and finally commercial considerations may be introduced' (Itten 1963:8).

Yet, in a conceptually driven digital design culture, the role of technical skills seems ambiguous, as exemplified by Graham Hills' proposal for a flagship Master design course.

> 'There will be no sketching, making or toying with materials. This is a course of high intellectual content meant to go with talent and skills already there or being formed elsewhere' (Hill 1994:92).

This statement, then, reflects a new type of design curriculum ("Design studies") that presumes that students have either acquired drawing skills prior to post-graduate studies or would acquire such skills elsewhere, parallel to yet outside the MA study proper. Or, alternatively, drawing skills might not be that important.

Hills' view, however, reflects how, since the 1960s, tertiary design education has shifted from art-and-craft-based training in the Bauhaus tradition towards conceptualisation and critical discourse, in what Reyner Banham describes as 'the shift from design as a satellite of fine art to design as a social discourse' (in Whitely 1997:33). As a result, "verbalising ideas" has become as much part of post-modern design curricula as "making things". This development may favour the digital medium sometimes characterised by fragmentation and short attention spans. In this, the designer image, metaphorically speaking, may be that of, say, the butterfly (the Microsoft logo) rather than, say, the beaver, or the surfer (the Internet), rather than the deep-sea diver. Moreover, the virtual, mobile and non-territorial character of the digital medium may detach the designer physically from both studio space and artefact, in sharp contrast to the designer-maker still attached to the work bench with analogue (hands-on) tools and physical material. In this gap between theory and practice, between concept and artefact, contextual dwelling in cyberspace may dematerialise the analogue sketch.

Therefore, in a digital design culture, the notion of sketching becomes a virtual rather than material construct in which "thinking" rather than "making" is emphasised. Digital sketching, then, challenges the conventional view that the computer is a supplementary device ("just a tool") and 'that there is still something else that you are actually working on [such as hand drawing or physical model making]' (Coyne et al. 2002:284). Therefore, 'rather than the computer as a device for representing what is in the real world, it serves as reality' (ibid.).

Analogue and Digital Drawing

To differentiate between analogue and digital drawing reflects how drawing with pen and paper (analogue mode) is rooted in handicraft (the Renaissance drawing paradigm). In contrast, computer-aided drawing, CAD, (digital vector mode) is a scientific phenomenon that grew out of experiments in the 1960s with Sutherland's electronic sketchpad at MIT (first generation computer tools).

> 'The interaction the designer had with the finished art was organic in nature because of its directness and physical attributes. These were direct contact, mark making and physical manipulation. The post computer age was the gradual shift away from the organic towards the mathematical' (Cleveland 2004:152).

This shift was manifested in the second generation of computer tools, which developed two-dimensional representation of designs with the help of the graphical user interface, GUI, launched on Apple Macintosh computers in 1984. The third generation saw the development of Virtual Reality, VR, when computer tools for the first time did not simply translate the traditional manual drawing systems of the Renaissance drawing paradigm (Engeli 2001).

In terms of human-computer interface, HCI, distinctions can be made between analogue and digital modes of drawing because computer based sketching is relying on systems commands such as tool palettes and pull-down menus.

> 'Paper and pencil and computational systems currently require very different physical actions to create marks. Dragging and clicking a mouse has a very different "feel" to it than drawing on paper with a lead pencil' (Goel 1995:199).

The lack of tactile qualities and user-friendliness of current CAD tools was also said to be a main reason why conventional sketching methods were still largely preferred for creative design among designers at the turn of the new Millennium (Hanna and Barber 2001; Kuczogi 2002).

The preference for pen and paper was also found in an experiment where designers were allowed to choose between freehand and computer drawing tools (MacDraw drawing package): 'They invariable chose to use paper and pencils and did a lot of sketching' (Goel 1995:198). Because,

> 'In freehand sketching, when a new idea is generated, a number of variations of it quickly follow ... One actually gets the sense that the exploration and transformation of ideas is happening on paper in front of one's eyes as the subject moves from sketch to sketch. Indeed, designers have very strong intuition to this effect' (Goel 1995:200).

Moreover,

> 'When a new idea is generated in MacDraw, its external representation (in MacDraw) seems to fixate and stifle further exploration. Most subsequent effort after the initial generation is devoted to either detailing and refining the same idea, or generating the next idea. One gets the feeling that all the work is being done internally with a different type of symbol systems and recorded after the fact, presumably because the external symbol system can not support such operations' (Goel 1995:200).

However, the designers, in the same experiment, asked for the computational drawing systems during the latter stages of their freehand sessions (Goel 1995:201). Therefore, freehand sketching might be described as vacillating in an "analogue flux" until defined by vectors, when it becomes "digitally fixed".

Goel's findings suggest that the apparent inability of CAD to capture vagueness would favour freehand sketching when expressing a tentative solution in response to a problem posed, to an invented problem, or in giving birth to an idea out of nowhere, now here, *hic et nunc* ("the serendipitous sketch"). However, serendipity suggests a design environment that goes beyond drawing tools, analogue or digital, because the thrust of ideas can be expressed in a variety of forms, such as gesturing, verbalisation (spoken and written words), or sketch modelling in direct interaction with material, say clay. For instance, 'gesturing (bold hand movement)' has been found important for effective design (Coyne et al. 2002:265). Similarly, using common sketch modelling material such as cardboard or styrene as the chosen conceptual medium can convey an idea for, say, a product or building, substituting or complementing 2D sketching, and whether its "anatomical" or "aesthetic" quality of form (Ashford 1969). Moreover, such physical 3D sketch models can be laser-scanned for further design development in Virtual Reality Modelling Language, VRML, as exemplified by Gehry's design for the Guggenheim Bilbao museum (Bruggen 1998).

But although sketching on paper with pencils, markers and similar implements may provide the freedom to draw rough design ideas quickly ("raw sketches"), and moving radically between them, it can be hard to modify and interact with sketches as the design task evolves into greater complexity. This is because sketches on paper can get cluttered and be difficult to search, organise, store and reuse ("management of hard-copy sketching"). The freehand sketch can also be a slow or inadequate means when repetition, or complexity, is a common feature in the design task. In contrast, the digital medium, unlike the conventional sketchbook, provides much more scope for editing, storing, duplicating, modifying and searching sketches.

Digital Sketch Tools

The limitations of conventional sketching in terms of management (organisation, storage, search, and transferability), have encouraged the development of digital sketching tools that have not only appropriated the language of traditional pen and paper but also claim to be as easy to use (Landay and Myers 1995). For example, digital notepads and Tablet PCs that use pen-based interface, rather than keyboard or mouse, allow designers to sketch directly on the computer screen. Moreover, design research has suggested that digital sketch tools can offer advantages over the conventional sketchbook because of non-destructiveness of files (electronic history mechanism), portability (small size relative to file storage capacity), unified media (more types of media applications, including 3-D mock-ups), and transferability to other media (Hoeben 2000). This further suggests the potential of the digital hyper-sketch as a design narrative in a multimedia format easily reproduced, altered and filed.

Such functional advantages may also apply to digital pens when used for input directly on paper, rather than on touch screens. For example, one type of digital pen, launched in 2003 (Logitech™), combines the workings of an ordinary ballpoint pen with that of a scanner when used on digitised paper (Anoto™). The digital pen, which has a built-in sensor and processor, captures on the basis of microscopic dots printed on special paper natural handwriting in ink, such as text, tables and drawings, which can then be downloaded as computer readable files to a PC, or transmitted by a mobile phone. A similar digital pen system (IBM™) has no need for special paper but uses infra-red technology to transmit movements from the pen to its accompanying converter, which in turn process the information into vectors or text.

However, the digital, or wireless pen, and although it emulates analogue drawing in that it draws on digitised paper the same way it draws on regular paper, is a ball pen, not a pencil, crayon or charcoal. Therefore, this type of digital pen, when launched, was primarily aimed at teachers, lawyers and others who take a lot of hand written notes that need to be transferred to a PC, rather than designers (the first version was only supported on the PC platform, not Mac). However, the seduction of technology in the digital capture of handwriting (Image Character Recognition, ICR) has been criticised because in the future the pen might become an unnatural way to create text because children would use computers before they try handwriting. But also, developers of digital pens may misunderstand why people use pen and paper in the first place (Reports in *The Economist Technology Quarterly* December 8, 2001 pp.34-35). Yet, digital pens are in their infancy and continue to develop. The Disney studio, for instance, has developed an input device that allows artist designers to sketch with their preferred tools onto whatever kind of paper that simultaneously input the sketch into the computer (Norman 2002, in *Appendix A*).

CAD as Conceptual Tool

If CAD systems (vector) signify precision and certainty, then freehand sketching signifies approximation and ambiguity, and these might be defining differences between analogue and digital tools.

> 'The real virtues of digital instruments are those of notational systems: definiteness and repeatability of readings'. - 'Where the task is gauging or measuring, the analogue instrument is likely to play its chief role in the exploratory stages, before units of measurement have been fixed; then a suitable designed digital instrument takes over' (Goodman 1976:161-162).

Or,

> 'problems requiring great accuracy, data processing, compilation of mathematical tables or solutions of sets of equation, must be tackled by a digital machine' (Rose 1974:33).

These differences suggest that freehand sketching is an explorative instrument for a task that has not been fixed. It is in this sense that sketching can be described as "deferred" drawing (in Schneider Adams 1996:162). Therefore, the sketch, as a dynamic sign in a state of flux, in order to overcome its incompleteness, would need to be defined ("firmed up") through detailed drawings or models, which can either be produced by hand or digitally (CAD/RP). Until then, the sketch would reside in a state of *fluxus,* both in its materiality and meaning.
Also, when viewed as a technical instrument, the CAD interface presupposes specialised knowledge of drawing packages (technical expertise) that is not only more complicated than paper and pencil but also needs frequent up-dating. Moreover, it has been said that computer tools can be over-specified and that their lack of ease might lead to loss of spontaneity for ideation purposes. Therefore designers may have to abandon computerised tools until much later in the design process or forced to change design techniques in a way that is not conductive

to early creative design (Landay and Myers 1995). However, such views have been challenged for being conventional in a digital design culture because 'Computing in design discloses new work patterns and practices ... and a certain kind of experimentation' (Coyne et al. 2002:271).

A Conceptual Tool Matrix

Different analogue and digital working practices have been plotted in the matrix below as an illustration to where sketching might be situated in the design process (Figure B:7). Thus the freehand sketch is positioned in the art/craft quadrant whereas the 3-D sketch model (modelled by hand) is placed in the design/craft quadrant. Similarly, graphics (by hand or by computer-aided graphics, CAG,) is found in the art/technology quadrant, whereas technical drawing or rapid prototyping, RP (drafted by hand or by means of computer-aided design CAD/RP) is situated in the design/technology quadrant. Noticeable is that graphics, technical drawing and modelling can be executed either by hand, that is, informal or formal (rule bound), or through coded (formal) sequences (vectors) in CAG, CAD or RP. In contrast, the pen and paper sketch is represented informally ("sketches as informal drawings"), although it can be scanned and manipulated as a bit map graphics file. The matrix illustrates, for instance, how a designer might move clockwise through the matrix, from the freehand sketch to modelling, via graphics and technical drawing, or across, from freehand to CAD, from informal to formal drawing.

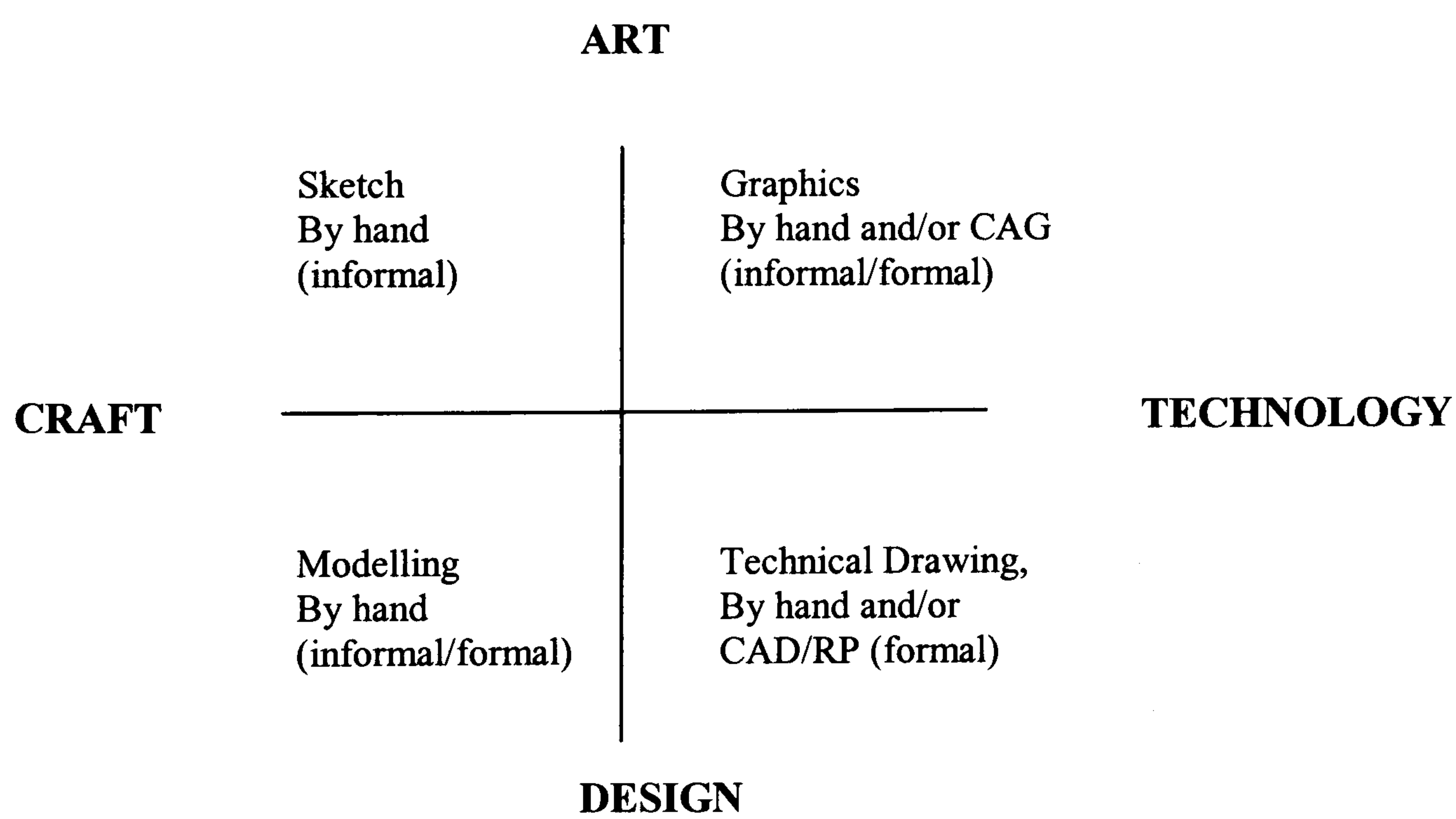


Fig. B:7. A Conceptual Tool Matrix

Although the matrix is for convenience only the labelling may suggest underlying distinctions. For example, analogue, or freehand sketching may correspond to the class of design called creative design, signified by new design solutions, whereas CAD/RP systems may be favoured tools for routine design development (Schmitt and Chen 1991). Thus, for innovative design, sketching may move (develop) from freehand to CAG mode and then to CAD. For example, a freehand sketch can be scanned into the computer as an underlay for further two-dimensional manipulation (CAG) or used as a creative guide for a three-dimensional virtual model (CAD). Such analogue/digital relationships, although here theoretically simplified, illustrate, for instance, how pen and paper is used for the exploratory stages of designing, before units of measurement have been fixed; then CAD takes over (Goodman 1976). Similarly, when using a digital tablet taking the ideas from CAG to CAD/RP (see Chapter *Introduction: Vignette*).

Pixelsketch vs. Vectorsketh

Although CAD systems are recognised as a formidable tool for modelling, representation, simulation and evaluation purposes (Mooy and Valkhoff 2001), CAD has also been regarded as restricting ideation and therefore not suitable for the early phases of designing (Verstijnen et al. 1998). Arguably, however, it is the precise, technical aspect of CAD, and its interface, rather than the computer medium itself that might impede ideation. This would also apply to analogue tools because it has been argued that the setting up of measured perspective using T square and set square can limit the free flow of thought (Lawson 1990:172).

This suggests there is an important difference between CAD as a technical drawing tool and a visual, creative medium, because the computer can be seen as a kind of computerised knowledge base for "knowledge acquisition" that can function as an extension of the designer's creative ability (Berger 1980). As such CAD can build on traditional visualisation technique in the ideation phase, for instance, montage, tracing or collage-making, and therefore reveal something new. In fact, drawing on screen and tracing on tracing paper show that "background lighting" can play a part in both digital and analogue drawing techniques. But also, in challenging the conventional view of CAD as a *supplementary* rather than an *essential* design device, it is held that computer can introduce new practices and promote different ways of working towards experimentation and discovery (Coyne et al. 2002:271; see also Chapter *Findings Y2 Students and Practitioners*). Arguably, then, to regard CAD as "just another tool" is a limited reading of the full potential of *computer-aided ideation*, CAI.

Yet the debate about the role of CAD in the early stages of designing is also influenced by the two major kinds of computer graphics display systems, that is, *raster* and *vector* graphics. Raster displays, also known as bit-map displays, are the most common displays on Personal

Computers, PCs. Thus graphics produced by painting software packages, such as Adobe Photoshop™, are saved as a bit map (pixel-based programs), whereas drawing packages, such as Adobe Illustrator™ or AutoCAD™, are stored as vector graphics, or object graphics. That is, vectors are a group of mathematically defined (vectorised) objects, which are created as collections of lines, rather than as patterns of individual dots or pixels.

Thus 2D drawing packages demand precise numbers (x; y; co-ordinates) to produce drawings.

> 'On the surface of it CAD looks very much like a super electronic pencil – a kind of graphical word-processor with all sorts of ways of producing lines on paper very quickly. But below the surface something much more significant and very different from making lines on paper is taking place. The computer program supporting the graphical effects is doing very precise calculations and storing the location of each point and the parameters of each line to a degree of precision only possible with a computer' (Jones 1992:14).

Moreover, bitmap images are resolution dependent, that is, lines tend to get "jagged" when scaled up, whereas object oriented drawing systems are resolution independent, that is, the drawn images can be enlarged without losing any quality, for instance, lines and curves will still print smoothly and crisply. As a result, in terms of resolution, or fidelity, sketching done on a graphics or PC tablet (painting package), or a scanned freehand sketch may look similar on screen. The bit map effect might be the reason why there were practitioners who did not differentiate between sketching done on paper and on graphics tablet, although by emphasising what is *in the sketch,* or surface structure, what is *outside the sketch*, or deep structure might be overlooked (see Chapter *Introduction*). However, the difference between bitmap and vector modes might suggest two different classes of sketches: *pixelsketch* and *vectorsketch.*

The mathematical precision of computer-aided design systems compared with the ambiguity of sketching has been a fundamental criticism of CAD as a means for conceptualisation (Lawson and Loke 1997; Bilda and Demirikan 2003). Similarly, and to borrow from Saussure's dichotomy Language-Speech, the need for precision of CAD is closer to the structure of "grammar", in contrast to the imprecision of sketching, as in "free speech" (Schneider Adams 1996:134). Or, rhetorically, in situating design in a social, political and semiotic context, conceptual sketching inhabits the realm of free "speech" of the individual, rather than superimposed "grammar" of the collective (machine code). In so doing, 'the computer also invokes a language of control and manipulation' (Coyne et al. 2002:272).

Another alleged drawback with CAD is its display systems that may prevent the designer from seeing the whole working area, and therefore, in comparison with drawing sheets, make it difficult to locate and focus on-screen (Meniru et.al. 2003). Therefore, the limited viewing space make large-scale reorganisation and structuring more difficult to achieve, compared with designing on paper that can be spread, say, on the desk, wall, or floor. However, this limited view space does not apply only to CAD but to all screen-based design.

Yet, despite the limitations set by the notational workings of CAD, Goodman, although rejecting CAD as a sketching tool, has suggested that 'a notation may be devised in order to transcend the limitations of time and the individual' (Goodman 1976:121). Therefore researchers have been investigating computer-supported sketching including virtual reality, shape grammar systems, and pattern recognition models (Landay and Mayers 1995; McFadzean 1999). For instance, sketch recognition programmes have been developed with the aim of creating a computer-based sketching system that feels as natural as sketching on paper. Such programmes, which include behaviour models to resolve ambiguities inherent in the conceptual sketch, and when built into CAD systems, are thought to improve interpretation and enhanced editing of sketches in the conceptualisation phase (Alvarado and Davis 2001). Still, CAD drawing packages that incorporate some form of sketching routines have remained, at the beginning of the 21st century, fairly basic and at an underdeveloped level (Hanna and Barber 2001:260). Also, the technical fact remains that whereas CAD drawing packages (vectors) are true notations, sketches are not.

> 'The significant distinction between the digital or notational and the non-notational, including the analogue, turns not upon some loose notion of analogy or resemblance but upon the grounded technical requirements for a notational language' (Goodman 1976:171).

Therefore, there are considerable difficulties in designing sketching software because in the absence of notational certainty ambiguity must be inferred. Moreover, usability tests of CAD for sketching have concluded that currently available interfaces do not to support the informality of sketching (Plimmer and Apperley 2002). Therefore the label vectorsketch seems inappropriate.

However, to say that CAD is not a *sketching tool* is different from saying that CAD is not a *conceptual tool* because with the help of a drawing package, such as Illustrator™, 3DStudioMax™ or AutoCAD™, the designer can generate and develop 2D ideation images or virtual 3D idea objects. Therefore, as a digital medium, CAD can stimulate, inspire and provoke thoughts at the early stages of designing and therefore expand ideation opportunities (Gibson 2000).

Therefore, it seems important to make the distinction between painting (pixel) and drawing (vector) packages because digital sketching suggests a painting package (bit map) rather than a drawing package (vector). In this technical sense, painting packages may be regarded as a digital tool that has a *generative* impact on ideation, whereas drawing packages have a *definitive* impact. This suggests that tension, or confusion, might be avoided if CAD is seen foremost as a conceptual tool that 'discloses an orientation towards *experimentation* and *discovery* (Coyne et al. 2002:271), rather than a digital sketching tool that tries to emulate or improve on freehand sketching. Because, in broadening the conception of sketching, *or sketcherly ways of designing*, what matters is that tools are used creatively (deep structure). This suggests that the impact of digital technology on conceptualisation is a matter of creativity, rather than technology.

Sketching as Multiple Intelligences

The conceptual sketch may reflect the intellectual aspect of sketching. However, it has been argued that the traditional notion of intelligence is too narrow (Gardner 1983). By analogy, then, Gardner's eight multiple intelligences might expand the conception of sketching, or:

- Linguistic intelligence, or "Word smart" – sketching as visual language.
- Logical-mathematical intelligence, or "Number/reasoning smart" – CAD
- Spatial Intelligence, or "Picture smart" – sketching in 3-D
- Bodily-Kinesthetic intelligence, or "Body smart" – sketching as gesture
- Musical intelligence, or "Music smart" – sketching as improvisation
- Interpersonal intelligence, or "People smart" – sketching as communication
- Intrapersonal intelligence, or "Self smart" – sketching as self-expression
- Naturalist intelligence, or "Nature smart" – sketching as observation

Another possible comparison is how conceptual sketching might fit theories of organisational strategy, often used in business studies. For instance, one such theory, with the aim of achieving transformational change and value creation for industry, was developed by analysing patterns in the contributions of design. As a result four generic design strategies emerged (Keeley 1994: 99):

- Improve concept: seeks a ten-fold improvement over the status quo.

- Extend concept: transforms an existing strategy in a surprising way.
- Integrate concept: combines many current capabilities systematically.
- Invent concept: creates something wholly new and valued by end users.

Therefore, the four key words, viz. *improve, extend, integrate* and *invent* may be used not only to formulate strategies for change (design management), but also to emphasise the creative role of sketching for formulating and expressing such changes.

Sketching as Communication

'Confusion would be avoided ... if draughtsmanship were always studied in the general context of communication practice' (Potter 1969:76)

In early communication studies, the transmission of information was described at three levels each raising specific problems (A, B and C). A. As technical problems, how accurately can the symbols of communication be transmitted? B. As semantic problems, how precisely do the transmitted symbols convey the desired meaning? C. As effectiveness problems, how effectively does the received meaning affect conduit in the desired way (Shannon and Weaver 1949).

Although this description has been criticised for being an outdated mechanistic base for communication studies (Fiske 1990), it might be useful to see how sketching may relate to the three levels, particularly in the digital age when collaborative design takes place globally around the clock, or diachronic design (24/7). At *level A,* then, sketching may be viewed as a symbolic form of message separated from inter-related design processes. This suggest that the digital sketch format, where the measure of information is in binary digit form, may have a higher degree of transmitted accuracy (electronic file management) than the analogue sketch. At *level B,* the semantic, or interpretative level (meaning) of the sketch may be altered by the means of transmission, that is the lack of immediacy or tactile qualities of the original sketch may impact the understanding, perception or "feeling" of the sketch message.

At *level C,* the smoothness of the digital sketch (screen or printout) may be perceived as more "final", and therefore appear less "ambiguous" carrying more "authority" than the analogue sketch. This may speed up the decision-making process (efficacy). Yet, there may be a risk with the "finished look" of the digital sketch in that it might foreclose "unfinished" ideas embedded in the sketch to the detriment of further exploration of ideas and therefore potentially innovation. That is, whereas the immediacy of the analogue sketch suggests openness, or deferred judgement, the digital sketch may suggest closure and therefore prompt early decision-making. Paradoxically, then, it seems that whereas the digital sketch can be communicated through an easily accessible "open" medium, say email attachment (level A), in terms of meaning, the "sketch message" may appear "closed " (levels B and C).

Conceptual sketching, however, does more than convey information (outcome). It is a means for generating ideas (process). In this, conceptualisation seeks to create meaning out of what can be perceived as wicked problems (Rowe 1987:41). Yet, in the context of communication theory, the idea sketch might be seen as a structured yet relational model, a kind of map, or sign system that indicate relationships between elements.

> 'These models do not assume a series of steps or stages through which a message passes, rather they concentrate on analysing a structured set of relationships which enable a message to signify something. In other words, they concentrate on what it is that makes marks on paper or sound in the air into a message' (Fiske 1990:39).

As a structured model, then, the sketch might be analysed according to its individual inter-related components, or building blocks. However, the sketch as a structured or fragmented model may have specific, rather than general application, for instance a typographic layout or an architectural plan. Yet, sketching can be a high-level abstraction and as such might be seen as an experiential form of structured creativity, perhaps similar to serialism in music, which is characterised by the blurring of traditional musical form and sound effects, or the blending of languages in rap. This also highlights the potential of *computer-aided ideation, CAI.*

The notion of redundancy, that is, what is predictable or conventional in a message (= high predictability) and entropy (= low predictability) in communication theory might also be illuminating. For example, it is held that a degree of redundancy is essential to practical communication. Thus the English language is said to be about forty per cent redundant, that is, we can delete almost half of the words and still be capable of transmitting understandable messages. Therefore, in applying the notion of redundancy to the conceptual sketch, it might be described as a drawing of low redundancy, a kind of drawing that is not predictable. In this sense, a detailed drawing would be the opposite, very predictable and of high redundancy. Or, to use the notion of entropy, the sketch could be seen as an entropic drawing, that is, of low redundancy and therefore low predictability (Fiske 1990:10).
However, the concept of entropy also signifies a quantitative element of disorder in a system (Arnheim 1971:8). As the conceptual sketch carries the idea of ambiguity or uncertainty, or a

measure of disorder, the sketch might be described as a kind of disorderly drawing. However, and accepting that the sketch is not a notational system, it cannot be a quantitative measure of the degree of disorder in a system (Goodman 1976).

Yet disorder, as can be observed in the child's playroom, is not the absence of all order but rather 'the clash of uncoordinated orders' (Arnheim 1971:13). The analogy between the playful disorder of the child and the loose quality of sketch may evoke 'the child within each of us' (Fineberg 1997:23). That is, the child who is 'necessarily buried by the conventions of adult socialisation ... who nonetheless exercises potent influences on the entire range of adult behaviour' (ibid.).

In another example of applying the notion of redundancy to drawing, Arnheim observed a child's drawing of a skyscraper building. The drawing showed how the child had begun to put in the rows of windows but lost patience after a while and instead of adding more windows added the letters "etc" to the last window sketched. What the child had effectively done was to recognise the redundancy of the window pattern and 'practised economy by a shortcut in communication' (Arnheim 1971:17).

However, this example reflects redundancy as a quantitative measurement representing what is superfluous in the message. That is, the row of windows is a convention and convention is a major source of redundancy, and of easy decoding (Fiske 1990:11). This suggests that sketching within a set of visual and verbal conventions, say, in the form of annotated sketches by a close-knit group of designers, would be easier to read, or decode, and therefore would be more effective as a means of communication.

> 'Broadly we may say that encoders, whether artists, preachers or politicians, who build redundancy into their messages are audience centred. They care about communicating. Those who do not are more concerned about subject matter, or (if they are artists) form. So redundancy is concerned primarily with the efficiency of communication and the overcoming of communication problems' (Fiske 1990:13).

This may have some important implications for sketching, both theoretically and practically.

Firstly, that the sketch with a low degree of redundancy is more likely to cause communication problems with an audience of non-designers, say, clients or other users of design outside a well-defined design community, rather than with a group of specialist designers, who depend on sharing common knowledge. That is, common knowledge that assumes that the specialists speak "the same language", that is, they share jargon, rules, conventions, perhaps even similar experiences. Or put differently, they are *cognoscenti*, or members of tribal design communities (see also Chapter *Introduction*).

Secondly, with the increase in three-dimensional solid-based design processes (the virtual building model), two-dimensional techniques, such as sketching, might be seen as outdated form of communication resulting in problems of misinterpretation. That is, computer models can be superior both in formulating and communicating design concepts because of their capacity of better visualisation and faster analysis, and thus accelerating manufacturing times. (Smith 1999).

Thirdly, when a designer is engaged in "artistic creativity", or "innovative" design, rather than communicating "routine" design, say, modification of existing designs, or aspects of materials and construction, sketching may be very entropic, or low in predictability, and therefore would lie outside communication studies proper. This would be particularly the case in the personal creative or contemplative sketching mode, or I-sketch, whereas the We-sketch would represent a more collaborative or participatory sketching mode. These differences may also help explain why information theory, as the opposite of entropy in communication theory, has been largely unsuccessfully applied to the arts because of difficulties in reducing aesthetic form to quantitative measurement (Arnheim 1971).

This may lead on to the basic concept of *phatic communication*, i.e. maintaining and strengthening an existing relationship, which can only exist through constant communication (Fiske 1990:14). For sketching, then, to have a phatic function, it would need to be in a form that reaffirms the audience as belonging to a particular group or sub-group of designers. That is, a phatic sketch would be a sketch used as a means of communication between a tightly knit group of designers, for example, in a studio-based team situation. The phatic sketch, as a means of collaboration or communication *intra-pares*, would also correspond to what I call We-sketch. Noticeable, though, is that the phatic function implies that all team members do sketching, that is, they have the knowledge, experience and skills to ideate through sketching. That is, they can effectively communicate through sketching and therefore they identify themselves through sketching. However, this is not always the case in everyday practice in digital design environments (see Chapter *Introduction*).

Sketching as Time

Time would normally be inherent in conceptual sketching, in the interaction of mind-eye-hand when generating and externalising ideas, in the forward and backward movements of eye and hand when expressing what might be (possibilities). In this, sketching, and whether in analogue or digital mode, may reflect a state of *alertness*, but also *restlessness* out of which creativity may be born. This also highlights the speed aspect of sketching, where sketching may be seen as a *rapid response tool.* Furthermore, the temporal aspect of sketching may be seen as a mapping exercise of cognition and behaviour, a quick response to a given challenge of an inspirational nature ("Aha!"), or driven by commercial necessity set out in a brief. However, sketching as cognition, or thinking through sketching (deep structure) may suggest that the sketch can be *out of sync* with a streamlined CAD process, again underlines the dilemma with describing CAD as a sketching, rather than a conceptual tool. Moreover, and emphasising sketching as deep structure, in a deconstructivist reading, the unconscious, which spans past, present, and future, could potentially be received from the "sketch-as-text", and therefore the sketch would not necessarily be time-based (Schneider Adams 1996:162 ff.).

In a commercial context, practitioners often work against time to meet tight deadlines. For instance, 'new models are already into their design process before the old ones have even been released to customers' (Norman 2000:143). "Designing against the clock", then, may put pressure on designers to design for novelty's sake, but also cut out user experience feedback (ibid.). Moreover, the time pressure in commercial, digital design environments might in turn put pressure on drawing as a reflective practice, as suggested by Schon (1983).

Reflective practice, however, does not imply mind-tool interaction measured in minutes or hours because design also reflects how designers "think on their feet". Yet speed, in the sense of being able to move rapidly through complex ideas in the creative stages of the design process, is 'probably one of the attributes of successful design teams' (Lawson 2001:144). However, the ability to move quickly through complex ideas suggests not only speed but also tool skills and correction facility, that is, relationships between different levels of speed and fidelity of the intended design.

The matrix below illuminates how the speed factor may relate to fidelity of the technique used when sketching, and either in analogue or digital modes (Figure B:8). In this way, pencil and paper (analogue) can be seen as *low-fidelity*, whereas on-screen sketching (digital) *high-fidelity*. Such a distinction suggests how the applied visualisation techniques may be described according to the level of precision (detailing) or specialised knowledge needed, and to the level of correction and revision needed (Zeleznik et al. 1996). If there is no need for precision and specialised tool knowledge and the level of correction and revision is low, as in sketching or scribbling over with pencil and paper, the technique could be described as *low-fidelity* sketching (Hi-speed/Low-fidelity quadrant). Conversely, need for precision and specialised tool knowledge and advanced editing and revision support would suggest *high-fidelity* digital modes, as in computer-aided graphics, CAG (Hi-speed/Hi-fidelity quadrant). Similarly, the matrix could be applied to interactive (digital) and static (analogue) whiteboards respectively.

Hi-speed

	Hi-fi	Low-fi
Hi-speed	Computer-aided-graphics (CAG) (High-level precision, high correction and revision)	Freehand sketch (Low-level precision, low correction and revision)
Low-speed	Interactive Whiteboard (High-level precision, high correction and revision)	Whiteboard/OHP (Low-level precision, low correction and revision)

Low-speed

Fig. B:8 Speed/Fidelity Tool Matrix

C: METHODOLOGY

Design as research

Design has been described as a 'hybrid activity' (Jones 1970:10), a description that reflects the multitude of references given to the word design, from engineering to functional aesthetics, from urban planning to philosophical discourse. Thus, as a verb, the word design signifies activity and process, as a noun, an outcome and artefact, and as an adjective, such as graphic, industrial or interior, a skilled activity in a specific design domain. Moreover, design has become an attributive noun, as in "designer label", reflecting the culture of consumerism and the power of branding. As a result, as society is becoming more design intensive and new artefacts are being created to satisfy our desires as much as our needs, the word design suggests everyday connotations of life styles and fashion, rather than, say, a preliminary sketch for a building or a machine (Crozier 1994:1-2). Thus design, like art, may be viewed as an evolutionary adaptation, or one of its by-products, for instance, 'the ability to design artefacts to achieve desired ends' (Pinker 2002:405). But more than this, in response to Simon's large-scale definition that designing is a human activity of devising plans for change (Simon 1984), it is being held that designing is an activity undertaken in most professions, and across 'products', 'services', and 'systems' (Love 2000). This suggests that 'designerly ways of knowing' is no longer essentially the knowledge that 'resides in objects' or resting on 'the manipulation of non-verbal codes in the material culture' (Cross 1982:225).

For research, education and practice the large-scale definition of design suggests inclusive processes that allow broad considerations, from form and function to communication and business, in which process and outcome are integrated wholes articulated in collaboration across design domains supported by specialists, from technologists to marketeers. With reference to both formal and heuristic concerns, the concept of design, then, serves a range of purposes, from idea generation to logic of discovery, from system building to pedagogy. But also, in common with the concept of art, design is a 'normative force; not just an instrument for exhibiting personal taste from case to case' (Aldrich 1963:98). Moreover, as a normative force, design research can aim at improving design processes (Kroes 2002:287).

Yet the continuing convergence of design, in which traditional design domains and field boundaries disappear or become blurred, in what has been called 'the digital melting pot of professions' (Thompson 2002:41), exerts pressure on design research, education and practice, both methodologically, pedagogically and vocationally. This development suggests implied rather than proven knowledge for which arguments tend to be inductive rather than deductive, using metaphors, analogies and rhetorical inventions in explaining complex concepts. Or,

> 'Design discourse seems to trade in various oppositions, such as design as an abstract reasoning or thinking process opposed to design as an embodied activity dependent on tools and media, variously manifested as ideal opposed to pragmatic, or abstract opposed to situated' (Coyne et al. 2002:269).

The blurring of boundaries between previously distinct design activities and the pervasive interaction with technology has not settled the somewhat uneasy relationship between design and science following the attempts by the design methods movement of the 1960s to "scientise" design. Although much research aims at successfully integrating art, design and science, continuing attempts to systematise the design process through computational technologies have been largely ignored or rejected by design practitioners. For example, practising architects have argued that this linear model of the design process 'flew in the face of all shared experience' (Fawcett 2003:2).

However, this 'application gap' (Cross 1984) between academia and professional practice has been observed elsewhere, for example, in the legal process, where psychological research on the complexity of eyewitness testimony and its reliability has had little impact on the admissibility of evidence in court. 'It has been represented to us that a gap exists between academic research ... and the practical requirements of courts of law' (the 1976 Devlin Report on Evidence of Identification in Criminal Cases, in Eysenck 1995:243).

It has been argued, therefore, that for design methodology to influence design practice and education the *situational* aspect of design has to be addressed (Dorst and Dijkhuis 1995). Therefore, much more knowledge about designing "in the real world" is needed before design researchers can advise on 'how designing work is done' (Dorner 1999:413). Thus the need to observe and document what really goes on in design schools and practice has provoked a shift among researchers from seeing design as a rational problem solving process to design as a reflective practice, that is, product-focused activity, or 'reflection-in-action'; or process-focused activity, or 'reflection-on-action' (Schon 1983). Or, a shift towards design research based on intuitive and cognitive processes rather than technical rationality (Cross 2001 [b]).

Still, the influence of the design methods movement in describing design as a rational problem solving process is present in design terminology, for instance, when design research is being described as 'a systematic inquiry that creates knowledge on various aspects of design and the design process' (Hanna and Barber 2001:259). Similarly, "mind mapping", a note-taking technique developed in cognitive-behavioural theory, is being used to describe design processes: 'They [maps] have proved invaluable in provoking a continued study of the design process' (Lawson 1990:28).

But although "the design process" may be a convenient label, or reference for describing a generic, or ideal design process, simplified and abstracted, it may not necessarily reflect the "real" design situation outside a few well-defined fields, such as engineering or software design. For instance, the notion of a generic design process may overlook differences between design that addresses simple product modifications, and design that deals with new products and innovations. Similarly, it may fail to capture differences between finding solutions through rational analysis, creative leap and pure chance. Also, it may suggest prescriptive ways of doing and learning design that are too formulaic or mechanistic and therefore leave out personality, cultural and social context, including beliefs, intentions, and values.

> 'Design is not just a process, it is an affective process. The designer must make his materials disclose themselves, but he must also disclose himself through the design' (Louridas 1999:534).

Moreover, the notion that every designer follows a valid design process has been criticised for being a misconception similar to the idea that design is one 'thing' or, 'the unitary notion of design' (Lloyd et al. 1996:461). However, in a socio-political context, the "unitary concept" of design and technology has been proposed for compulsory education in England (Davies 2002).

Therefore, a scheduled design process, as implied in the term "the design process" might be misleading. 'It suggests that one stage necessarily follows from another; but in the instant of designing the two [analysing and synthesising] are inextricably linked' (Broadbent 1973:325). Yet, the term has been commonly used both in academia and professional practice since the early days of the design methods movement. For example, among product designers, designing has been expressed as a process going through three phases: 'conceptual, layout, and detail' (Cross 1989) or, 'concept generation, design development, and specification' (Pipes 1991). In film making, the process, or "scene setting", has been described as the translation of the initial vision into freehand concepts, then turned into working drawings and scale models to be finally built by set finishers, sculptors and engineers (Sibley 2002). In the automotive industry the design process has conventionally been structured to 'emphasise the demarcation between styling and engineering' (Tovey and Owen 2000:570). Or, in the context of architectural problem solving, the design process has been divided into four phases, viz. 'Problem structuring, Preliminary design, Design refinement, and Detailing' (Goel 1995).

Although the term "the design process" reflects the efforts made by design methodologists towards specific design methods, the large, inclusive notion of design with its link to the liberal arts has prevailed. This may be one of the reasons why design research has not established its own distinctive methodology, unlike other relatively new academic disciplines, such as communication or business studies. Therefore, and although a methodological foundation for design education was established by *Bauhaus* in the 1920s (Bayazit 2004), 'design research is an immature field by comparison with many more traditional forms of research' (Lawson 2002:109). As a result design researchers have become reliant on a humanistic methodology in general, and social science oriented methods in particular.

From a post-modern historical and socio-political contextual perspective, design has been described as 'the sociology of art in which artists and designers are cultural producers' (Wolff 1981:143). Thus, as cultural work, design, like art, has blurred previous distinctions between high and popular culture and emerged as a heterogeneous discipline that, alongside the classical tradition of the liberal arts, considers the economic and social context of design under influence, among others, from Marxism, post-modernism, and feminism. From the position of the post-modern as 'a cultural form as well as an era of history' (Vidich and Lyman 1994:42), design has become part of critical studies of cultural phenomena, of interpretative and critical research that also suggest qualitative rather than quantitative research methods.

Without typical criteria in design research, researchers have come to question routine methodologies. For instance, it has been argued that concepts and standard procedures from other disciplines might distort the research or hold back inventing esoteric or idiosyncratic research tools (Gray et.al.1993). Or, that the 'primary consideration [in a PhD in art or design] must be intuitive, supported by reason but not outlawed by it' (Jones 1998:6). Or, the risk of adopting the social science route and its heavy reliance on text: 'Sometimes, writing is even seen as the core of social sciences' (Flick 1998:241). Moreover, text-centred approaches to design can bring the problem of describing non-verbal behaviour of designers through linguistic conventions (Davies 1995).

However, there is a risk also with the large notion of design in that the broad cultural study approach might flatten research questions and therefore weaken contribution to the building of a "rigorous" theoretical base for design. Arguably, then, the ultimate concession to "everything is design" might result in design research that is void and without discrimination, that is, it would destroy the discipline itself. Yet, the loose and diverse post-modern notion of design may suggest a *generative*, rather than *reactive* design attitude that lends itself to new meanings of cultural production, and therefore to a wider range of research approaches. This broadens the concept of design that supports the view that designing is about communicating and sharing creative experiences, and whether as engineers or composers (Simon 1984).

Positively, then, design, as balancing practice and research, innovation and tradition, reflects the way we see and depict the world around us that depends not only on techniques and technologies, but also on our varied experience, practice, interests, and attitudes (Gombrich 1960). In this broad sense of design as part of a contemporary visual and material culture, it can be neither distinctly analogue or digital but involves the coexistence of several kinds of images and ways of seeing (Lister et.al. 2003). Moreover, design, as human creation, embodies the evolution of visual language, from pictograms to ideograms and non-alphabetic scripts, from pre-historic cave paintings to Egyptian hieroglyphics and Chinese writing. And leading ultimately to the alphabetic code, the source of western inventiveness and, most recently, digital media. It is, then, in this world of design layered between natural language - "In the beginning was the word"- and iconography, of "writing image"– "a picture says more than a thousand words" - that the stage is being set for this thesis.

Post-modern design

Design ideation may be described as how designers generate and develop intuitive or rational responses to design tasks and then explain and communicate emerging ideas as concepts and data through a variety of means, such as words, sketches or diagrams. But also how the designer may have an idea, or mental image, and then tries to find an existing object to fit it, in what might be described as "putting ideas on top of objects". The sequential action of "object + idea", rather than "idea + object" may challenge assumptions about "the design process", for instance, that design is being initiated or driven by freehand drawing. In this, designers may act as "informal" designers similar to that of modern artists who, as argued by the critic Jean Paulhan, no longer make art (pictures) out of ideas, but 'the other way round' (in Klein 1979:185).

The view of designing as "object + idea", echoes Duchamp's Ready-mades, that is, objects taken from the man-made environment and transformed into "art". For example, his first Ready-Made, was a shovel, which he bought in a hardware store and gave the title 'In Advance of a Broken Arm' (1915). In Duchamp's shovel, there is 'an implied narrative, a sequence of events that takes into account the passage of time', in contrast to the visual metaphor of Picasso's 'Bull's Head' of 1943 made out of the seat and handlebars of a bicycle (Schneider Adams 1996:12). But although both used manufactured objects, Duchamp created a visual metaphor through choosing a new title to the object ("punning"), whereas Picasso created a visual metaphor through an assemblage of everyday objects to evoke the natural image of the head of a bull (ibid.). Arguably, then, Duchamp, may be described as a sceptical analyst, a conceptual innovator, or, in his creation of art through labelling, a 'rhetorician' (Sylvester 1996:226), whereas Picasso appears more of a creative synthesiser, closer to the "designer-maker". Yet both Duchamp and Picasso, in their respective renaming and rearranging of the "found object", may be seen as precursors to post-modernism in which creativity is given new meanings that 'turns attention to the margins and reverses the usual adherence to dominant cultural values' (Manning and Cullum-Swan 1994:468).

This suggests a notion of post-modern design that is being influenced not only by contemporary conceptual art that emerged in the 1960s, but also by avant-garde art and its critique of the early 20th century, therefore making the functionalists' separation of art and design untenable. The post-modern also suggests theory and non-object based design in which the object is no longer the end point for design. Arguably, then, post-modern design is driven primarily by concepts and cultural events, rather than mass-production processes, cutting loose from the architectural model of the Russian Constructivists, de Stijl, the Bauhaus, and conventions of functional design ("functionalism"). This further suggests that design, like post-modern art, may have no model at all.

Arguably, then, post-modern design may give relative value to any innovation or discovery that favours the personal and eclectic over the impersonal and functional, in which design is tribal, rather than communal, and where common ground is embedded in initiation and jargon rather than formal language. More specifically, in this designer landscape of hunters and gatherers, sketching is a nomadic, rather than a settled activity. But also how post-modern design then becomes self-referential, in which word-based autobiographical imagery may result in design being read and interpreted as "text". Or, how a design object may exist only to illustrate the text. Therefore, driven by theoretical input and digital media events, post-modern conceptual design routes reflect how design has acquired its own intellectual culture.

Furthermore, the approach of "object + idea", rather than "idea + object" may question core traditional competencies resulting in different attitudes to skill-based design, including freehand drawing, to the extent that post-modern theory, in a digital design culture, may upstage the material medium of design. Post-modern design approaches, therefore, may suggest a shift from "design practice" towards "design studies", from "making" to "thinking" design, in which the "arts and crafts" and "functional" elements of designing become subsumed under design as a "stylistic" or "cognitive" process. Positively, this suggests a broadening of the concept of the discipline that not only adapts and reacts to contexts but also creates and generates contexts (Jonas 1997), or, negatively, a further drift of post-modernism that widens the gap between theory and practice.

The implied narrative in Duchamp's shovel suggests how narrative is more than 'the report of a single discrete event' and therefore 'concerned with process' (Lodge 1986:142). As a series of events, then, a narrative 'cannot be reduced to a proposition', but also 'it need not follow [a chronological] sequence' (ibid.). Moreover, narrative, as a descriptive process, raises questions like 'and then?' or 'why?' (ibid.). Such a sequence of questions, therefore, may help create, generate, and disclose new contexts for design that would suggest an emergent concept of the design process that has more affinity with narrative based communication ("telling and showing"), rather than propositional knowledge of a scientific kind. This further suggest that the notion of a *design narrative*, rather than *design process* might better capture verbal and non-verbal attempts at communicating ideas and concepts and therefore meanings in post-modern design discourse (see Chapter *Findings Y2 and Practitioners*).

Design paradigms

The post-modern widening (positively), or drift (negatively) of the concept of design becomes topical in what might be perceived as a paradigmatic shift from analogue to digital ways of "seeing" and "doing" or, the rhetorical "digital revolution". Rhetorical because "revolution" suggests a disruptive rather than an evolutionary change. But if revolutionary, how to find "common ground" between analogue and digital phenomena when, as argued by Kuhn (1922-96), in paradigmatic shifts there are no shared sets of criteria? (Kuhn 1970 b). That is, analogue and digital phenomena, or paradigms, might be polarised beyond rigorous comparison - they become 'incommensurable' (ibid.). If so, interpretation of analogue versus digital design might be limited to concerns of either aesthetics ("art studies") or commercial effectiveness ("business studies") that would result in yet more of what has been described as 'superficial and fashion-oriented aesthetic definitions' and 'bland, market-led "safe" solutions' (Walker 2002:3).

A different view of paradigmatic shifts as revolutionary forces is argued in post-modern discourse. For example, Feyerabend's (1924-94) contention that "anything goes" (in Lazar 1998:14) or, Scheurich's rhetorical call for 'loud clamor of a polyphonic, open, tumultuous, subversive conversation on validity as the wild, uncontrollable play of difference' (Scheurich 1997:90). From this perspective, naturalism and humanism is said to be reconciled, which suggests effectively a rapprochement between analogue and digital phenomena, through the relativist position that 'there are only truths and no universal truth, versions of reality, but no one reality' (Lazar 1998:20). Arguably, then, such views may promote post-modernism as a popular, relativist activity that applied to design suggests non-traditional ways of designing using techniques and materials without preconceived ideas of what "design" is or ought to be.

Another paradigmatic approach might be to consider digitisation as unfolding technology, an evolutionary rather than revolutionary force that not only tries to emulate analogue modes but also seeks to transform design into more ambitious ways of thinking and doing. Also, from an evolutionary standpoint, digitisation may support subtle forms of changes within as well as between paradigms. For instance, in terms of values and beliefs, digitisation may emphasise design as socially driven, or, say, related to ecological studies or philosophy. Design, then, may be seen as a transformational paradigmatic structure in which paradigms are not only described as examples or patterns but also as world views or belief systems that guide researchers (Guba and Lincoln 1994). Moreover, such systems are not 'monolithic cultural dinosaurs but are multifarious constructs' (Dripps 1997:27). Arguably, then, what might interconnect the analogue and digital worlds are not so much paradigms of a technological nature but rather of values and beliefs.

From an evolutionary perspective, Broadbent, in extrapolating exponentially from past generations of design methodology, that is, Craft, Design-by-drawing, Hard systems, and Soft systems, has suggested that the next generation of design methodology, the 'fifth-order design', is likely to be an evolutionary systems thinking supported extensively by electronic technology (Broadbent 2003). This further suggests an emergent design methodology evolving around complex and multifaceted paradigms, rather than the two major competing paradigms for describing design activity, that is, either as a rational problem solving process, or a process of 'reflection-in-action' (Dorst et al. 1995). Or, 'There have never been so many paradigms, strategies of inquiry, or methods of analysis, to draw upon and utilise' (Denzin and Lincoln 1994:11).

Philosophy of design

Multifarious paradigms as ways of describing, relating and interpreting design also suggest multiple and complex references of the sensuous, intellectual and emotional that are implicit in design thinking. Such thinking, then, may be seen as a kind of logic of 'multiplicities', or 'manifolds, a pragmatic matter that shows the complications in our thinking' (Deleuze 1994; Rajchman 2000). More specifically to sketching, in the Renaissance tradition of "designing through drawing" (from Italian *disegno*; from Latin *signum*, a mark), it has been said that sketching confirms the exploratory, opportunistic and reflective nature of design thinking (Cross 1999). This suggests that design thinking may prompt *critical reflection* on what designing entails ("how?" or "why?"). In this, design research may be joining other disciplines such as psychology and modern linguistics that have been asking, rather than answering important questions (Maddox 1998:278).

The asking of questions suggests how design research may look to philosophy in search for knowledge or, more specifically, how, 'drawing explores ways of being-in-the-world' (Penone in Zegher 2004:101). A philosophical enquiry might also emphasise the subject-matter of designing pointing to the limitations of an analogue versus digital discourse for addressing design in a digital culture, thereby refuting the binary opposite of the terms subjective and objective (Morgan 2001). Or, how 'Design has been posited as neither lodged in the natural nor the artificial, but as that which has made these binary oppositions untenable' (Fry 1999:289).

Moreover, from a philosophical perspective of reality and man's place in it, designing may be seen as an aspect of phenomenology, described as 'the study of experiences with a view to bringing out their "essences", their underlying "reason"' (Pivcevic 1970:11). Pivcevic holds that the main advantage of a phenomenological analysis is that it does not make any presuppositions that themselves need explaining, and therefore it is wholly based on what is self-validating and evident (Pivcevic 1970:13). For Deleuze (1925-95), in his critique of western metaphysics, the lack of presuppositions refers back to sensible, concrete empiricism (Deleuze 1994). In taking an empirical stance, Deleuze can also be seen to address the critics of the phenomenological or, "humanistic" approach to personality as 'naïve, romantic, and unrealistic' (Bernstein and Nash 1999:426).

The lack of presuppositions seems attractive in that it reflects how design is part of human experiences. As such, presuppositionless philosophising may enable design research to get started without hypothesising, that is, without speculating about existing relationships, because 'beginning means eliminating all presuppositions' (Deleuze1994:129). However, Deleuze admits that to avoid all presuppositions is a delicate problem because in philosophy there are two kinds of presuppositions: the objective, which through 'axiomatic rigour' can be eliminated, as in science, and the subjective (or implicit), which is 'contained in opinions rather than concepts' (Deleuze 1994:129). However, as the large notion of design reflects opinions, rather than axiomatic rigour, subjective or implicit presuppositions cannot be avoided. Moreover, to try to eliminate presuppositions is complicated by how prior knowledge and experience play a large role in designing. However, Deleuze suggests a way out of the dilemma by referring to the subjective or implicit presuppositions as 'Everybody knows, in a pre-philosophical and pre-conceptual manner ... everybody knows what it means to think and to be' (Deleuze 1994:129).

But although common sense, as in "everybody knows", has its appeal from an everyday design perspective, in a post-modern, academic context, it might suggest research at a pragmatic, rather than a conceptual level. That is, an approach that might portrait design as a skill-based "process of making", rather than a knowledge-based "process of abstraction". Or, design as "folk theory", rather than "academic enquiry". Yet, and reflecting the diversity and complexity of contemporary design practice, there exists, in parallel to relativist and conceptually driven post-modern design, a "common-sense" approach to design that is rooted in the designer-maker tradition of functional aesthetics ("form and function"). Or, 'Each of the earlier historical moments is still operating in the present, either as a legacy or a set of practices that researchers still follow or argue against' (Denzin and Lincoln 1994:11; cf. practice-based PhD research).

Design as a craft-to-technology continuum can be represented by, for example, the furniture designer Jasper Morrison: 'Design is above all a practical pursuit' (Morrison 1990:20). However, this does not necessarily set practice against theory. 'An understanding of the nature of the design process requires insight into the nature of the product designed, and vice versa' (Kroes 2002:290). Still, in "post-capitalist societies", in which there is a shift to 'the production and distribution of knowledge and information rather than the production and distribution of objects' (Drucker 1993:166), it has been argued that design thinking can be applied to almost any human activity (Love 2000).

However, when design is undergoing rapid technological change, the role of common sense might be understated, rather than overstated, even overlooked. Scientific methodologists, for example, argue that by using a wide range of common sense knowledge some of the problems inherent in ruled-based systems may be overcome thus enabling Artificial Intelligence, AI, to cope with 'unexpected' real world situations (Lenat et al. 1996). Similarly, in discussing criteria-based models that support the designer of computer systems for creative tasks, it has been argued that such systems 'must enable the user to adopt a holistic perspective on the task or problem under consideration' (Candy and Edmonds 1997:192). This then suggests that pragmatism and philosophy are not necessarily opposites because together they may better respond to specific needs in digital design situations.

Digital design

In the context of everyday designing, in transforming ideas into materiality or translating them into systems, is the "digital revolution" going to change fundamentally how designers think and work, and therefore do research? Or more specifically, does it suggest that digital drawing systems ultimately may replace freehand sketching in the design studio or, that rapid prototyping with digital three-dimensional printers ("digital-mock-ups") may take over sketch modelling? For example, how architects are using computers to simulate building processes, and, ultimately, might be building without working drawings by manufacturing directly from CAD files (Keller 2002). Or, 'you don't actually need to build the building. You can do it on the computer, the impetus for "virtual architecture"' (Coyne et al. 2002:284).

In my preliminary research (see Chapter *Introduction*) I noted a change in studio-based drawing practice. That is, of the three main types of freehand drawing in design, that is, conceptual (preliminary) drawing, presentation drawing, and colour renderings, digital advancement has made manual presentation drawings and renderings almost redundant in industry. The question, then, is whether a full "conversion" or "uptake rate" of designers "going digital" would apply to conceptualisation, or the early stages of a design project. That is, if designers have to translate design ideas into the digital dimension at some stage in the design process, why wait till a later stage? Or, in terms of design communication in digital environments: 'Text and drawings don't exist until they are in a computer' (Coyne et al. 2002:284). Therefore,

> 'Providing computational representation for the early stages of design suggests how [knowledge-based tools] might be employed sooner rather than later' (Gross 1996:54).

In this way, computer-aided design becomes part of managing the digital workflow as digital input (text and images) from start to finish, as is largely the case, say, in the graphic industry.

However, the argument for using computer-aided design in the early phases of design goes back to the main reason for introducing CAD in the first place, that is, 'to raise productivity, to increase efficiency and to improve operation' (Lansdown 1987:80). Moreover, there is the linked argument of cost. For instance, 'it is widely agreed that the first 5 per cent of the design process commits 80 per cent of the overall costs to market the product' (Sharpe 1995:472). Or, how 'the conceptual design stage can take 10-30 per cent of industrial designers' total design time' (van Dijk 1995:63).

However, digitisation of the conceptual stages of design also depends on the nature and complexity of the design task (low-tech/high-tech). For example, computer-aided design, CAD, is used in the early phases of design when the design task involves 'incremental modification of existing, tried and true concepts rather than entirely new approaches' (Lansdown 1987:76). For innovative designs, however, CAD may overlook the inherent uncertainty in the creative design process (Lawson and Loke 1997). Yet, computer-aided design is also enabling designers to create forms that were previously considered too complicated or inaccurate if created by hand, and therefore impossible or too costly to build. For instance, the Guggenheim Bilbao museum could not have been designed and built without the use of advanced CAD software developed for the aviation industry (Bruggen 1998).

However, not only advances in digital technology but human-computer interface, HCI, and individual designers' values and preferences may influence the actual use of CAD in the early stage of designing. Furthermore, the application rate of new design technology may vary between design domains and cultures. For example, architecture, graphics and product design have traditionally been at the forefront of computer-aided design while other design domains have been trailing behind. However, collaboration across domains together with Web-based design networks have narrowed the digital application gap allowing for asynchronous 24-hour design practice, in which designers have 'access to all data from all phases of the process at any time from anywhere' (Schmitt 2001:38).

Current design practices in industry suggest that drawing in the later, "downstream" stages of the design process is characterised by sequential moves and operations, rather than non-linear, as in the conceptual, "upstream" phases (see Chapter *Introduction*). Arguably, then, computing is more suited for downstream activities and therefore conceptualisation, as an upstream activity, may continue to be shaped and influenced by non-sequential practices, such as freehand sketching and modelling because of their advantages for ideation. For example, for product design, Dorner suggests that sketches and models fulfil three functions: 1. They clarify the characteristics of the machine. 2. They serve the purpose of forming a logbook for the whole design process. 3. They provide a good basis to reveal the mechanics of one's own thinking. (Dorner 1999:408-409).

Yet to set traditional practices against digital technology may be a false dichotomy between the analogue and digital mediums because digital work and traditional craft may not be that apart. For example, it is argued that working digitally, despite the lack of physical medium, can be characterised as craft (McCullough 1998). This is because a pen, for instance, and whether used for digital input on screen or on paper, can be seen as essentially an enabling tool for a particular design task that helps the designer to express intent, and irrespective of medium. This suggests that digitisation may take the conception of craft to a higher level of abstraction.

This in turn may evoke the answer given to the question "Why do we use tools?", which is that 'tools don't so much make jobs easier as make jobs possible' (Fisher 2002:48). In this sense, software tools may give further manipulative advantage extending the designer's realm of possibilities, as, again, exemplified by the Guggenheim Bilbao museum where Gehry and his architectural team relied on computer modelling for design development, detailing and component manufacturing although proceeded by a physical freehand model (Bruggen 1998). However, history shows that building complexity is not a modern phenomenon, as witnessed by Brunelleschi's dome of the cathedral of Santa Maria del Fiore in Florence (1436). Or, for a more recent example, Gaudi's unfinished *Segrada Familia* cathedral in Barcelona, which is being completed with a combination of craft and CAD/CAM tools. Or, in McCullough's dictum: 'The possibility of craft lies not so much in the technology as in the outlook you bring to it' (McCullough 1998:272).

Technology-induced changes in working practices, however, recall previous paradigm shifts, for example, when industrial mass production largely replaced craftsmanship. Then, as now, the argument was over the hand versus the machine, and whether the machine age posed a threat, or opened up new opportunities. The opposition to machine-made objects in the 19th century, however, appears iconoclastic by today's standards, because evolution tells us that throughout history the best technical and mechanical devices of the day have been sought after, to the extent that technology has fundamentally shaped western civilisation. The failure of the arts and crafts movement to see the possibilities offered by new techniques was not lost on the modern movement. For instance, Paul Klee (1879-1940), who taught design at Bauhaus:

> 'We do not wish to destroy these techniques [of industry] which possess almost unlimited possibilities: we want to develop them into more suitable and penetrating techniques harnessing both action and knowledge, manual and mental activity' (Klee 1961:15).

Bauhaus, then, in an electromechanical era, accepted new technology to the extent that the school has inspired the manifesto for *the Digital Bauhaus* arguing for the analysis of 'the false dichotomies of computing' and a vigorous discussion of the 'meeting of technology and values' (Ehn 1998). This suggests that Klee's "unlimited possibilities" *post-Bauhaus* exist in digital technology influencing not only *what* is being designed but also *how* it is being designed creating a new time/space relationship, or new structures of decentralised interaction between human and machine, or human-computer-interaction, HCI. However, digital media are not unique in revealing new ways of seeing. For example, similar disclosures of new worlds took place with the introduction of microscopic photography. Here, too, the Bauhaus school of thought was quick to point this out.

> 'They reveal [microphotography], in this age of haste and superficiality [*sic* 1930s], the marvel of the smallest unit of construction, our substitute for the longer period of time that primitive man could devote to observation' (Moholy-Nagy 1947:25).

In short, technology, as an evolutionary force, has long been an integral part of design thinking and making.

Empiricism and theory

The multifaceted nature of design, operating both in real and virtual worlds, resulting in both material and non-tangible outcomes, suggests that design research can be approached either empirically and theoretically, or combined, what is called "grounded theory". Grounded theory has been described as 'a general methodology for developing theory that is grounded in data systematically gathered and analysed' (Strauss and Corbin 1994:273). But it has also been argued that one advantage of grounded theory is 'that sources of data traditionally rejected or having bias (anecdotes, opinions, subjective judgements etc.) can be legitimately used to enrich theory' (Bessant and McMahon 1979:21). However, in post-modern discourse, theoretical approaches lean towards relativism and as a result 'Interpretative theories, as opposed to grounded theories, are now more common' (Denzin and Lincoln 1994:10). Yet interpretative accounts have been criticised in that they 'lack any critical interest or the ability to critique the very accounts they produce' (Schwandt 1994:130). Meeting this objection, however, Schwandt suggests a possible resolution in that 'Interpretative accounts (efforts to make clear what seems to be confused, unclear), are to be judged on the pragmatic grounds of whether they are useful, fitting, generative of further inquiry, and so forth' (ibid.). A pragmatic test, then, may be meaningful and useful to scholars and practitioners alike in that it might help to bridge the application gap between theory and practice, between the academic and the commercial worlds.

A flexible and pragmatic approach

The multiplicity of design suggests an approach to design research that is both flexible and pragmatic. An approach that does not favour theory over practice, collegiate knowledge over business, rather it suggests methodological strategies that are flexible enough to be applied to design activities in both design schools and industry, and whether of a material or non-tangible nature. A strategy that would 'reject dichotomous thinking on pragmatic grounds' (Schwandt 1994:131), or 'consider the research question to be more important than either the method they use or the worldview that is supposed to underline the method' (Tashakkori and Teddlie 1998: 21).

A flexible methodological approach in the gathering of data, or "research materials", would situate ideation in the everydayness of working practice in which the designer experiences the task at hand from the wide perspective of sensation, perception and conception. This would be an approach in which designers employ a range of means for generating, developing and communicating ideas, and whether in design schools or in industry, an activity in which, say, the sketchbook may constitute a "book of revelation" (see Chapter *Introduction*). However, such revelations also *disclose* something about the personality of the designer, revelations that, in applying the theory of interpretation, may draw attention to 'the situated nature of all judgements' (Coyne 1997:141). Yet the personal aspect of designing signifies that ideas, as expressed, for instance, in the conceptual sketch, cannot be judged objectively in the sense that designers are rarely dispassionate or detached about their work (Lawson 1990). Therefore too much emphasis on the persona might pose problems with data gathering in that it may hold back designers' willingness to share evidence of their conceptual activities with the researcher. This may be the case not only when the researcher is in a temporary relationship with research subjects, for instance, during an ad hoc interview, or a visit to a design studio, but also in a capacity of participant observer.

Although the digital design culture tends to favour "slick", computer-generated images, rather than "rough sketches", the designer's relationship to imagery as part of the need for self-expression seems to remain important irrespective of medium. This is probably one of the reasons why freehand sketching can touch a nerve among designers, as noted in the early phase of the investigation (see Chapter *Introduction*). Yet, in a period of rapid technological change, to pigeon-hole designers as either for or against sketching, as either "Geeks" or "Luddites", seems not only an oversimplification of design practice but also a risky value-judgement that might contaminate if not obstruct data collection. This suggests an approach to research that is not only flexible and pragmatic but also ethical, that is, explicit about designer values and attitudes in trying to identify strengths (S) and weaknesses (W) as well as the opportunities (O) and threats (T) posed by digital technology ("SWOT" analysis).

Priorities and research questions

The manifolds of design, both practically and theoretically, refutes 'the unitary notion of design' (Lloyd et al. 1996:461), a position that translates design research into an interdisciplinary activity engaged in many sub-fields of research. This suggests a choice of research procedures and data gathering methods specific to the chosen subject or line of enquiry. Yet "unitary" design arguments can be appealing as unitary suggests "common ground" between designers across disciplines that make up "the design community". For example, it has been suggested that design without drawing is inconceivable (Tversky 1999), or that drawing is an essential activity that cuts across all design domains: 'Most creative fields share a tradition of sketching as an essential part of the design process' (Plimmer and Apperley 2002:9).

However, the view of sketching as a generic activity may be a paradigmatic assumption ("the Renaissance drawing paradigm"), as in, "how can you be a designer without a sketchbook?" That is, an assumption based on tradition and conventions, rather than the reality of current design practices in design schools and industry. Therefore, sketching as common ground for designers may project an ideal that does not necessarily reflect the actual role of sketching in a digital design culture, which suggests a possible gap between *ethos* and *techne*, between the character of sketching and its application (see Chapter *Introduction*). This points to the question,

> 'whether some types of sketching and drawing are more potent in terms of their design implications both at different stages within the design process and between different design disciplines' (Purcell and Gero 1998:398).

Yet the design literature, since the early 1980s, has commented on sketching as an essential activity for generating ideas in the early (conceptual) stages of the design process (Schon 1983; Suwa et.al. 1997; Cross 1999; Tversky 1999; Plimmer and Apperley 2002; Bilda and Demirkan 2003). The research, however, has focused mainly on freehand sketching as visual and spatial reasoning in architecture and engineering-based design, particularly industrial and product design. Furthermore, a great deal of the discussion has been confined to 'asserting the importance of sketching and leaving many interesting and important questions unanswered' (Purcell 1998:385). For example, Lawson and Loke have argued that 'there is a general lack of understanding about the act of drawing and the nature of drawings made by designers when they design' (Lawson and Loke 1997:183). This suggests that the "importance" of sketching has not been sufficiently examined or challenged, and particularly so in a digital design culture.

The interest in trying to understand the nature of drawing has broadened the research field to include the cognitive aspects of sketching. For instance, Goldschmidt has argued that sketching 'reflects visual thinking' (Goldschmidt 1994:162), and Fish has claimed that 'sketches are representations of "visual thought" that help facilitate perception and translation of ideas' (Fish, in Yi-Luen et al. 2000:484). Similarly, Cross has suggested that 'the thinking processes of the designer seem to hinge around the relationship between internal mental processes and their external expression and representation in sketches' (Cross 1999:29). But also, the link between images and language: 'In terms of visual thinking there is no break between the arts and the sciences; nor is there a break between the uses of pictures and the uses of words' (Arnheim 1986:147). Or, that 'drawing and talking are parallel ways of designing' (Schon 1983:80).

Moreover, Hewitt holds that an idea sketch may be 'personal and intuitive, or it may be based on clearly defined methodologies or programs of instruction' (in Yi-Luen et al. 2000:485). The conceptual sketch, then, may express both rational and intuitive elements, from rational problem solving to hunches that may be appearing "out of the blue" or, "happen all at once" ("Aha!"). Therefore, in embodying both rational and intuitive approaches to design conceptual sketching can express relationships both of tree-and root-like phenomena, what might be called *dendronic* and *rhizomatic* sketching respectively.

When designers conceptualise they do so in a variety of modes to develop an awareness of both the inner and outer design environments (Davies and Talbot 1987). Such ideation modes include free association and analogy, the challenge of conventional ideas ("why?"), or the combination of elements into new ideas. For example, conceptualisation may take the form of brainstorming between two designers, what might be called *Idealogue*. But also, in terms of means, methods and techniques for externalising ideas, "for getting the ideas out", everyday design practice tells us that conceptualisation does not only involve freehand sketching but a range of verbal and non-verbal means of expression, including words, modelling and computing. But although Archer promoted modelling as cognitive as well as practical capabilities (Archer 1979), it would be unrealistic to expect one single tool to sufficiently support every design process (Mooy and Chen 1991). But whatever the conceptual means are, I refer to these as *Conceptual,* or *Ideation tools*, or tools for generating, representing or communicating ideas.

The use of the word tool, therefore, is not restricted to physical tools that may reflect a mechanical, rather than a digital age. Rather tools are being read as a shorthand or placeholder for a range of both physical and cognitive activities that go beyond mechanical functions and processes, as expressed in, for instance, "thinking tools". In this sense, reading can be an ideation tool, which implies *critical thinking*, but also the social aspect of designing, similar to how 'tools are intrinsic to social relationship' (Illich 1973:21).

Conceptual tools, then, allow designers to extend or amplify their ideation processes, which suggests that conceptual tools stand for both thinking and action or rather, *ideation-in-action*. In this, conceptual tools are not identical, rather they represent peculiar possibilities, limitations and expressions although they may reinforce or substitute each other. Furthermore, the expressive mode of a conceptual tool may be a vehicle for metaphor. For instance, a "conversation of ideas", can be expressed either verbally (written or spoken words), or through sketching ("conversation sketch"), or both, because conversation 'is sometimes a slow, thoughtful process, sometimes one in which the ideas, like pencil lines on paper, come quick, thick and fast' (Sibley 2002:48).

Moreover, uses of conceptual tools suggest 'divergent thinking' described by psychologists as 'the ability to think along many paths to generate multiple solutions to a problem' (in Bernstein and Nash 1999:275), although, for the purpose of creativity, divergent thinking would need to be balanced with convergent thinking (Lawson 1990). Conceptual tools, then, are used for generating new ideas with the intention of identifying, developing and communicating a solution to a design problem, what I refer to as *Design ideation* (ideation = idea generation). In this, conceptual tools help designers add value to their ideas. Therefore, ideation can be seen as a generative, "added-value" process of divergent/convergent thinking, where ideas become contingent on conceptual tools, hence the focus on *tools* in the investigation.

This description of ideation, however, does not necessarily make a distinction between "idea" and "concept", although "idea" might be subsumed under "concept", a basic element of thought that can be either visual, concrete or abstract (Bernstein and Nash 1999:224). Furthermore, design ideation may be perceived as a pluralistic, post modern concept of radical and critical thought. Or, ideation may be likened to a kind of multi-lingualism, in which no one conceptual tool would be the sole language, although it may be a dominant one. In this sense, design ideation embraces art because 'all artistic structure is essentially "polyphonic"' (Ehrenzweig 1993:xii).

Against this background, the investigation is primarily looking for uses of conceptual tools in "creative design" that deals with "innovations", rather than "routine" design although new design concepts are not necessarily exclusive to innovations as they can be applied when changes or improvements are being made to existing designs. But while ideas are drivers in most designs, ideas *per se* may not be that important. That is, "thinking ideas" is not enough because, in way of analogy with branding, and how a fashion label has to be on the outside rather than on the inside, designers also need to externalise their ideas and make them known to others. Or put differently, nothing happens until designers put their ideas "on the outside", or "brand" their ideas. This illustrates how design ideation is an *externalised* thought process.

Moreover, conceptual tool usage in a digital culture suggests ideation within the large notion of designing, which is not tied to the single notion of design as primarily a rational problem solving activity, or necessarily involving an object or artefact. That is, designing is viewed as a process that seeks to discover or create new connections, in the Deleuzean sense of creative thinking that is nomadic and unfixed (Rajchman 2000). But to find out about "real" uses of conceptual tools, the enquiry would have to be situated, or contextualised as close to conceptual activities as practically possible. That is, in the everydayness of design practice of students and professional practitioners alike, in- and outside the design studio, wherever traces of ideas are left by designers, or *situated design research* (cf. Situated Learning; Lave and Wenger 1990).

Yet there are risks with situating research, as knowledge acquisition, in the realm of ideas because 'the idea seems to come out of the blue and the designer cannot always trace the steps which led to it' (Davies and Talbot 1987:21). Therefore, it may be difficult to describe, explain and generalise from uses of conceptual tools. Such potential perplexity highlights concerns for reliability of methods and validity of conclusions as well as a sound contextual framework. Therefore, particular attention would have to be paid to the designing of reliable research instruments that enable the gathering of meaningful research material.

In short, conceptual tools can be thought of as means that enable designers to generate and develop ideas. However, although sketching with pencil and paper has traditionally been seen as the prime conceptual tool, the digital design culture has introduced new practices, including CAD, which suggest a broadening and semantically upgrading of the notion of sketching, what I will call *sketcherly ways of designing*. This term emerged from the introductory interviews and the literature review where I found that sketching could not be predictive, or narrowly defined (see Chapter *Introduction* and Chapter *Literature Review*).

The study, therefore, is concerned with how designers go about capturing, articulating and recording their ideas, and more precisely, how they *externalise* their ideas in a digital design culture across a range of design disciplines. In so doing, and from a hands-on, rather than a cognitive science perspective, what conceptual tools do they use, and why? Therefore, the focus is on the impact of digital technology on uses of conceptual tools, not on the impact on ideas. In this, moreover, the study may help designers better understand their "ideation processes", both on a personal and collaborative level.

What are data?

Before developing a strategy for data gathering, it would make sense to know what kind of data, or research material, may be embedded in conceptual activities. However, and although freehand sketching is only one of many conceptual tools, I will start by looking at how conceptual sketching with pen and paper, or the traditional sketch, might be classified as data that can be recorded for research purposes. From there, it might then be easier to see what might constitute data in the larger context of conceptual activities. The search, however, will be from a post-modern perspective in which the enquiry will not assume a scientific approach of objective measurement, rather a subjectively constructed reality.

First, then, the conceptual sketch, as outcome, is a creative artefact, and, by analogy, art historians have long interpreted the underlying structure of works of art seeking rules of geometric composition proportion, including the golden mean (Baker 1993:54). Therefore the conceptual sketch might be classified as a form of artwork for which rules, typologies, precedents or aesthetic value judgements could be made.

> 'There is no good reason to suspect that the general principles of classification do not apply to aesthetic objects as they apply to metals, butterflies, economic systems, or mental diseases, though the difficulties of applying those principles may be unusually great in the arts' (Beardsley 1981: 174).

However, contextual and semiotic approaches, rather than aesthetic value judgements (formalism and style), are said to be the central issue of contemporary art history (Schneider Adams 1996), which suggests that meaning, rather than aesthetics would be central to sketching too. However, this is not to dismiss the notion of the "beautiful sketch", rather to consider other methods of artistic analysis that have developed since the 19th century that might help design research. But although methodologies of art history and artistic analysis may be adapted and applied to the design field, they tend to reflect different ways of interpreting art as *outcome* rather than *process*. In contrast, my concern is not so much about interpreting existing sketches as gathering evidence that might reveal ideation processes. That is, I am interested in data of a *dynamic*, rather than *static* complexity that may illuminate different uses of conceptual tools.

However, certain aspects of conceptual sketching might be open to pictorial analysis. For instance, it might be possible, at least in theory, to analyse digital sketches to find out whether their underlying digital structures (bitmap or vector) could reveal perhaps hitherto unrecognised values or patterns that might play a role in an attempt to classify sketches. That is, viewing digital sketches as a specific medium might produce sketch patterns strong enough to merit a category, or categories of digital sketches. However, to fit into a general taxonomy of sketches, computer generated sketches would have to be not only aesthetically but also technically comparable with analogue and mixed media sketches. In this compositional or structural sense, the bitmap, or scanned sketch, might be compared with a freehand but not a vector-generated sketch because vector suggests a mathematically defined drawing. That is, the notion of a *vector sketch* would be a taxonomic and generative misnomer (see Chapter *Literature Review*).

But any general taxonomy of conceptual sketches, analogue and digital, would need to be "coded and categorised" or "documented and edited" to use terms from the social sciences, in order to classify them in a rigorous way to critical standards while maintaining interpretative freedom. Then, as a "class of things", in the sense that conceptual sketches could be sorted as objects, labelled or defined, the sketch would have a number of attributes, such as "visionary" or "referential", that would have to be described both in analogue and digital terms. Such a low-level coding scheme was, for instance, developed for the classification of architectural drawings according to projection types, viewing angles, medium used, and intention (Yi-Luen et al. 2000:497). In graphics, 25 different types of drawing were identified and 23 corresponding drawing abilities (Schenk 1989). Similarly, in identifying drawing types, a non-sequential analysis of relationships between an architect's drawings was undertaken as a way of understanding a design process (Neiman 1999).

Data gathering techniques may be borrowed from ethnography where visual data are collected through linking observation and interviewing ('openness to observer's subjectivity'), participation in the life world which is observed ('openness to the process'), and plurality of the applied methods ('structuring'), to be selected against the material obtained (Flick 1998:163). Another methodological approach is one in which chronology, context, comparison, anomalies are possible signposts (Silverman 2000:84-85).

Further taxonomical studies might describe conceptual sketches as design information, that is, as systematically or randomly acquired visual data or phenomena. Thus, as research categories conceptual sketches might fit the definition of taxonomy as 'a means of classifying objects or phenomena in such a way that useful relationships among them are established' (Miller 1967).

In this way, informed judgements might be made about conceptual sketching through the build-up of an identifiable and validated collection of conceptual sketches in design (recognition, identification and location). Initially, this might be done through thematic clusters of conceptual sketch images sampled in the research process. As for numbers of categories, Miller has suggested that classification becomes cumbersome when over fifteen to twenty sub-categories are needed (Miller 1967).

Any classification of conceptual sketches, however, suggests that the sample sketches are sufficiently representative in both content and context to be classified as such. Therefore, in trying to locate sketches, communities of designers would also have to be looked at. Such communities might be found in design schools or industry, and be based on design discipline or subject area.

A start, then, could be the creation of some major headings of sketches according to design domains, for example, fashion, architecture, graphics, product and so on. Other categories may be linked to industry or education standards, based on norms and conventions, functions and aesthetics, past and present (the history aspect). Or according to scale, medium and stages of "rawness", or intent, self-expression or means of communication. Or referring to classification methods in design methodology, for example, the routine, innovative and creative classes of design (Schmitt and Chen 1991).

In this the researcher would not only act as a critical observer but also seek collaboration with practitioners in industry for the gathering of "specimen sketches" which would guide further work. This in turn would involve extensive image reproduction, with ensuing copyright issues, as well as field notes in the form of writing, for example, 'contact summary sheets' or extended memos after each observation (Silverman 2000:142). Apart from the complex logistics of such data gathering, classification of the individual character of conceptual sketches according to "type", "mode" or "style" would also have to address the fact that the design community at large is hardly a homogenous group that speaks a "common language" (see Chapter *Literature review*). True, a classification of the purely pictorial, or "archival" interests is possible, as can be appreciated in the Victoria & Albert drawing collection. Significantly, however, the V&A collection is short on conceptual sketches because such sketches tend to be discarded in everyday designing (Lambert 1983), which reflects the ephemeral character of ideation sketches.

In classifying design information, however, Jones suggests that it is pointless trying to establish mutually exclusive categories at the early stage of the research, and, moreover, the inventing of a classification is a personal task (Jones 1970). This, therefore, suggests a flexible approach as new factors emerging during the research may change the size or the focus of the sample (Silverman 2000:108). But also, there may be a risk of taxonomy taking on a life on its own without necessarily contribute significantly to new knowledge about conceptual sketching.

Research strategies

Although a flexible approach to design research has an intuitive appeal, flexibility alone does not constitute a research strategy. Therefore there are many methods to consider and draw inspiration from, and both from the natural sciences, the arts and humanities. For architecture, Lawson has suggested a few basics research approaches, viz. experiments, interviews with designers, observation of what designers do, and theorising (Lawson 1990). Cross, in addressing both architecture and product design, has added protocol studies and simulation trials (Cross 1999). More specifically, methods used in studying the role of drawing in design include 'analysis of think-aloud protocols, retrospective analysis of design behaviour, introspection and even analysis of design products and speculation about the processes that may have led to them' (Yi-Luen et al. 2000:485). I will briefly describe some of these methods and reflect on how they may help in formulating my research strategy.

Case study

A case study, which can be either single or multiple, is an empirical inquiry that can be used as a means of identifying key issues (Bell 1999), or 'to explore possible causes, factors, processes, experiences, etc., contributing to the outcome' (Robson 1993:147). The method is particularly useful when 'the boundaries between [contemporary] phenomenon and [real-life] context are not clearly evident' (Yin 2003:13). It is a research strategy that has been applied to design, for instance, in 'improving understanding of the psychology of creative behaviour' and 'identifying features of successful design performance' (Cross 2001 [a] :48). Although the two main sources of evidence for case studies are 'direct observation of the events being studied and interviews of the persons involved in the events' (Yin 2003:7-8), evidence may also come from 'documents, archival records, participant-observation, and physical artefacts' (Yin 2003:83). Thus a case study is 'a heterogeneous activity covering a range of research methods and techniques' (Hartley 1994:226) that does not exclude any method for collecting data (Bell 1999). For example, a radical analytical model from social science proposes that it is possible to generalise from the existence of any case: 'tap into whomsoever, wheresoever and we get much the same things' (Sacks, 1984:22 quoted in Silverman 2000:108-109). However, the apparent flexibility of case study is tempered by how 'the data collection process for case studies is more complex than the processes used in other research strategies' (Yin 2003:106).

A case study shares with experiment the focusing on "contemporary events" and the research questions "how?" and "why?" but differs from experiment in that the experiment takes place in an environment that is largely controlled by the researcher (Yin 2003). The lack of experimental controls in case study means that there is no guarantee that results are replicable or that they can be universally generalised. For example, it seems unlikely, when comparing individual designers, that two designers given the same problem task would approach it in the same way, or even that the participant would repeat the same process in a different project (reliability). This is considered a major weakness of case study, particularly by researchers working within the rational problem solving paradigm where the design problem is well defined: 'case studies are definitely seen as irrelevant, because they do not lead directly to generalizable knowledge of the design process' (Dorst and Dijkhuis 1995:266).

Experiments

The experimental method has developed from the natural sciences, making it possible to verify hypothesis within stated confidence levels through statistical tests. However, an experiment depends on a reductionist (scientific) approach that may limit the scope of the experiment. That is, an experiment 'deliberately divorces a phenomenon from its context, so that attention can be focused on only a few variables [typically, the context is "controlled" by the laboratory environment]' (Yin 2003:13). Against the experimental method, Gruber has argued that research in creativity cannot be based on a ten-minute pen and paper test. 'Creative works are constructed over long periods ... the laboratory simply cannot measure them'. Thus Gruber escapes from the laboratory of N = 30, N = 60, into the case study, where N = 1, because the individual is worth knowing (in Lavery 1993).

Experiments in the context of ideation were carried out by Goel in which the subjects were divided into two groups both using in turn freehand sketching and computer drawing systems (MacDraw) to test the hypothesis why sketching should be correlated to the conceptual phase of design problem- solving (Goel 1995). Although Goel confirmed his hypothesis that replacing freehand sketching with a drafting-type computer system (CAD) hampered idea generation, the experiments also showed how difficult it was to instruct the subjects to use the computer drafting system during the conceptual design phase when they would normally sketch freehand (ibid.).

Biographical method

Designing, linked to creativity and innovation, is often seen as an individual pursuit despite the fact that design is essentially a team-based or collaborative activity in industry. The individual worth knowing, then, may favour a biographical approach that relates to the life and personality of the designer. For example, a case study of a successful product designer revealed not only personality characteristics but also how 'intense work is needed to develop, evaluate and refine the solution details' (Cross 2001:57). Although this method may illuminate how successful, innovative designers work, and 'extraordinary individuals certainly make life more interesting' (Gardner 1998:140), Cross also identifies weaknesses with this approach, notably the accuracy and relevance of the analyses (Cross ibid.). That is, the study of expert designers may highlight strong individual traits that might not apply to designers more generally because he or she may be an "atypical" professional even within his or her field. There is also the risk of the expert being portrayed in a reverent manner that may result in the biographical method contributing to the notion of design as "elitist" or, the successful designer as a "genius".

Furthermore, in focusing on single authorship, the method might overlook important social, economic and environmental factors in designing, including teamwork and the impact of technology. For example, the impact of digital technology might be understated or poorly understood because when the work is seen as determined primarily by the designer (author) the computer might take on a secondary, rather indeterminate role as a designer tool. Yet the individual's role in conceptualisation would make it difficult to disregard personality characteristics. For example, Gardner, in examining the achievements of extraordinary creators such as Mozart and Gandhi, suggests that to achieve extraordinariness depends on regular, introspective activities ('reflection'), building on identified personal strengths ('leverages'), and on habitual, positive interpretations of daily life ('framing') (Gardner 1998).

Descriptive and Comparative study

A descriptive design study has been defined as 'an investigation of the way in which a design process actually occurs' (Dwarakanath and Blessing 1996:93). The methods used are observation, interviews and questionnaires (retrospective), and a combination of these and/or other techniques (ibid.). In comparative design studies the researcher divides the cases beforehand into two or more groups, which can be based on, for example, the designers' experience, or tools used (ibid. p. 95). The drawback with comparative studies is that it can be difficult to generalise the results yet they can be important for revealing the context in which new tools for designers can be developed (ibid.).

Research Participants

Finding designers to volunteer for research can be difficult. Their time is valuable, and they may be reluctant to submit themselves to what can be seen as personal enquiry where they become the subject of the researcher's "probing" of their creative activity. Probing creativity might be a particular problem with the method of direct observation (see below), as research has revealed that being watched, and whether by 'someone peering over the shoulder', or by video cameras, is not conducive to good work (Stanton 2001). To minimise the intrusive element in personal enquiry, in applying rigorous ethical research standards, it has been suggested that observations would have to be arranged and conducted freely and openly, on a careful case-by-case basis (Gardner 1998).

Also, when choosing participants, attention would have to be made to the variations in the background and ability of designers, and to different design cultures and traditions. In the context of design drawing, for example, in Italy and Spain, 'Concept sketches serve only to convince the designer himself and his assistants within the studio that a design proposal is possible' (Pipes 1990:38). In contrast, in the UK sketching is a working practice not exclusively within the immediate studio environment but may involve clients or contractors, both as an explorative and presentation tool (see Chapter *Introduction*).

Interviews

The interview is a widely used research technique for data collection not least because its adaptability in giving the interviewee the opportunity to reveal, say, the reasoning behind his or her actions (Seale 1998). Thus the researcher can monitor what is being said, ask for clarifications and intervene gently in a non-directed manner (Flick 1998).

Interviews can be *open-ended*, that is, no pre-specified set or order of questions; *focused*, that is, guided by specifying key topics but without a fixed order of questions; or *structured*, that is, following a standardised set of questions (Robson 1993:159). Interview data can be either of a quantitative or qualitative nature, or both. According to Seale (1998), the classical, quantitative survey tradition of treating the interview as resource, that is as 'real facts', has been criticised for applying standardised meaning in the form of, for example, fixed choice attitudinal questions (or questionnaires). In contrast, qualitative interviews offer greater flexibility through freedom from the need to construct a data matrix. Therefore case study interviews tend to be focused or open-ended in which the researcher 'can ask key respondents about the facts of a matter as well as their opinions about events' (Yin 2003:90).

However, "missing data" can be a problem with interviewing, that is, the participants may have faulty memories, post-rationalise on their studio activities, and find it difficult to describe non-verbal design processes in words (Darke 1979). For example, in a comparative study of changes in working practice over time, recollection may be particularly important as tools or techniques can be made fast redundant in a design culture driven by digital technology. Moreover,

> 'We are conscious only of the end states, not of the means for getting there. As a result, in this view of the mind, our explanations of our own behaviour are always suspect, for they amount to stories made up after the fact to explain the thoughts that we already have' (Norman 2000:117).

Questionnaires

Used as an alternative, or compliment to interviewing, the questionnaire can be an effective method to reach a large number of people. Yet, as a retrospective method, the drawbacks with questionnaires include 'the time-lapse between the event taking place and being reported' resulting in 'fewer details of the observed process compared to real-time, introspective techniques, and possible bias of date' (Dwarakanath and Blessing 1996:94). Questionnaires may also result in incomplete answers and a poor response rate. For example, when a team of researchers involved with developing a computer-aided conceptual design system emailed 60 practising designers a list of questions based on conceptual design methods, they received only five replies. From the low response rate the researchers concluded that their questionnaire was too theoretical. That is, the questions were of a hypothetical nature and not sufficiently specific to a real design situation. In other words, the research methodology reflected the application gap between academia and professional practice. Consequently, the researchers changed direction and set up a protocol study involving five designers who were being observed under controlled conditions. This approach, however, limited the scope of the study (Mooy and Valkhoff 2001).

Protocol analysis

Protocol study that uses audio- and/or video-recordings of an individual subject, "concurrent verbalisation" or "thinking aloud", is often relied on to study problem-solving activities (Ericsson and Simon 1984). Such concurrent verbal accounts, also known as "think-aloud protocols", try to capture "What were you thinking when you were doing that", and are being used to analyse design activity, particularly in architectural and industrial design, and software design (Cross et al. 1996). Design researchers have studied design drawing based on analysis of design protocols 'that specifically seek to examine the early stages of the design process and the role of sketching' (Purcell 1998:385). For example, in analysing how a practising architect cognitively interacted with his own sketches, it was concluded: 'Most importantly, sketches serve as a physical setting in which functional thoughts are constructed on the fly in a situated way' (Suwa et al. 1998:483).

Protocol analysis emerged from psychological theory of information processing (Eckersley 1988). However, in an effort to find a rigorous form for empirical research protocol analysis was adopted by design methodologists as a research technique situated between experiments of the natural sciences and observational methods of the social sciences (Cross et al. 1996). Yet in viewing design reasoning as information processing there are disadvantages with protocol analysis. For example, it has been argued that the method may rely too heavily on verbalisation of the design process and therefore be weak at capturing non-verbal thought processes (Cross et al. 1996). Moreover, and although concurrent verbalisation (think-aloud protocols) is a well used technique for analysing design activities, it can interfere with designing itself (Davies 1995), and therefore 'may result in inaccurate accounts of the design process' (Yi-Luen et al.

2000:486). Therefore 'missing data' must be carefully interpolated in the protocol analysis (Akin 1979:193). Generally speaking, protocol analysis has been found to have 'severe limitations in capturing the non-verbal thought processes going on in design work', and to emphasise too much 'safe' research techniques, at the expense of 'relevance' for design practice and education (Cross et al. 1996:13-14).

Observation

Observation is a qualitative research method often used in professional practice, notably in education (Barnes 1992). But unlike observation in compulsory education, where the researcher can work close to laboratory conditions ("captive audience"), observation in a self-directed studio environment is different. Here the researcher would have little or no control of what is going on given the open-ended character of designing, notably during conceptualisation. Moreover, observation might intrude on participants' working practice and thus influence the research outcome. This is because psychological research has shown that 'being watched increases our sense of being evaluated, producing apprehension that in turn increases emotional arousal (Penner and Craiger, in Bernstein and Nash 1999:515). However, direct observation may be less formal, for instance during a field visit, 'including those occasions during which other evidence, such as from interviews, is being collected' (Yin 2003:92).

Participant observation can be appropriate when the researcher and the participant collaborate on the same project although there is a risk that the researcher may become too involved influencing the outcome and losing perspective of the aim and purpose of the research thereby also producing potential biases (Yin 2003:94). Another disadvantage is that 'data can never be gathered in the same way twice' (Barnes 1992:114). Moreover, unlike protocol study (concurrent verbalisation), which is best suited for relatively short observation times, typically a few hours, participant observation can take place over lengthy periods although, generally speaking, the longer the observation the more difficult to record details.

Focus on case study

From the above I concluded that methodology is not a "ready-made", and that the method of case study is advantageous because of 'the opportunity to use many different sources of evidence' (Yin 2003:92). The use of many sources also suggests flexibility. Or, 'Case study is not a methodological choice, but a choice of object to be studied' (Stake 1994:236). However, flexibility is not the same as "anything goes" because 'the needed flexibility should not lessen the rigour with which the case study procedures are followed' (Yin 2003:55). Therefore, as case study relies essentially on direct observation and/or interviews as sources of evidence (Yin 2003), awareness of *context* is crucial. This in turn suggest that attention would have to be paid to the selection of cases as well as data gathering techniques, particularly as situated design ideation would be difficult to investigate under controlled conditions. In this, protocol study *within* case study might offer subtle yet rich insights into how individual designers use conceptual tools for generating and communicating ideas. In short, the case study can be seen as an attractive "placeholder" for a research strategy that draws inspiration from a variety of methods. 'A case study approach is not a method as such but rather a research strategy' (Hartley 1994:225).

Reliability, validity and generalisability

Ultimately, however, any chosen research strategy raises the important issues of reliability, validity and generalisability of the research. Because without these tests, it is commonly said, poor quality, untrustworthy, or illegitimate work might be paraded as "truth". Yet reliability, which refers to consistency of methods, and validity, which concerns accuracy of representations ("truth"), are both difficult and controversial (Silverman 2001). For instance, 'good reliability does not ensure good validity' (Maxwell 1970:39). Therefore, post-modern conceptual claims for authorship have rejected the traditional, positivist criteria of reliability, validity and generalisability either outright, by stating that there can be no criteria for judging the products of qualitative research or, by replacing them with the criteria of dependability, credibility, and transferability (Denzin and Lincoln 1994). Moreover, from an epistemological perspective there are alternative forms of validity: For example,

> 'Rhizomatic validity represents attempts to present non-linear texts with multiple centre where multiple voices speak and articulate their definitions of the situation' (Lather, in Denzin and Lincoln 1994:585).

For the reliability test, Yin makes the analogy with accounting in which the auditor carries out a reliability check. 'A good guideline for doing case studies is therefore to conduct the research so that an auditor could repeat the procedures and arrive at the same result' (Yin 2003:39). But Yin also suggests that not all of the testing occur at the formal stage of research design, that is, some of the testing would take place, for instance, during data gathering (ibid.). In other words, a flexible and pragmatic approach to case study quality control seems advisable.

However, the post-modern criteria of dependability, credibility, and transferability, rather than of reliability, validity and generalisability might be preferable (Guba and Lincoln 1989). This is because post-modern quality control of research design can hardly be objective in the positivist tradition. Or, 'as conditions change ... this affect the validity of theories, that is, their relation to contemporary reality' (Strauss and Corbin 1994:278). Therefore, in a digital design culture, data collection methods might be better described as dependable, rather than reliable, or that the case study findings are transferable to other settings, rather than generalisable.

Yet in seeking to establish trustworthiness from a practical and pragmatic perspective, too much attention might be given to the semantics of assessment criteria, which, finally, all aim at convincing the audience that the researcher used reliable methods and drew valid conclusions (Silverman 2001). Therefore, it has been suggested that the key issues are internal validity (credibility), 'to ensure that the subject of the enquiry was accurately identified and described' (Robson 1993:403), and external validity (transferability), 'to the extent to which the findings of the enquiry are more generally applicable' (Robson 1993:66). But also, 'whether the findings are really about what they appear to be about' (ibid.).

The problem of generalisability is reflected in the differences between survey methods and case study selection procedures in that 'generalisability is a standard aim in *quantitative* research and is normally achieved by statistical sampling procedures' - 'such sampling procedures are, however, unavailable in *qualitative* research' (Silverman 2001:248; my italics). This is so because case study is not survey research and therefore does not rely on samples (statistical generalisation) but on some broader theory (analytical generalisation) (Yin 2003:37). That is, in qualitative research cases are not randomly selected but very often chosen because they allow access (Silverman 2001). Or,

> 'Many qualitative researchers employ ... purposive, and not random, sampling methods. They seek out groups, settings and individuals ... where the processes being studied are most likely to occur' (Denzin and Lincoln 1994:202).

Of the key issues regarding the quality of the research design in case studies, perhaps the most controversial is whether 'a study's finding is generalisable beyond the immediate case study' (Yin 2003:37). The most simple answer has been offered by Stake who argues that case study has intrinsic value and therefore the question of generalisabilty need not arise: 'this case is of interest ... in all its particularity and ordinariness' (Stake 1994:23). Robson, in contrast, points out a number of threats to generalisability, including 'selection', that is, findings being specific to the group studied, and 'setting', that is, findings being specific to, or dependent on, the particular context in which the study took place (Robson 1993:73).

In the context of design ideation, quality assessment may also raise the issue of the validity of ideas, or rather, the relationship between individual ideas and those concepts that can be verified against reality. In this relationship ideas might be likened to interpretations in that both try to give meaning to creative work. But ideas, like interpretations, are temporally limited. Or, 'All interpretations ... are always provisional ... and limited in time' (Strauss and Corbin 1994:278). Therefore, in their temporary, or "suspended" cognitive state, design ideas are incomplete in design terms until their meanings have been established by external means such as sketching and modelling.

For example, the conceptual sketch (or conceptual model) is an external manifestation of an idea yet to be fully realised (artefact, built environment or system). Therefore, on the journey from idea to outcome conceptual sketching would be followed by sketch development, detailing and so on, until the idea has been turned into, say a final drawing, a coded (computer) description, or a prototype, and with or without verbal support. Only then, it seems, would there be sufficient evidence to attempt judging the quality of the original concept. Frustrating as this may be, it highlights the dilemma of design ideation, which cannot capture reality, only an approximation of it, hence the development of computer driven simulations and, one might add, the importance of imagination. Moreover, ideas on their own may not be that important because without tested against reality ideas cannot be truly assessed for quality.

Analysis of qualitative data

The fact that case studies generate a large amount of qualitative data also suggests that case study analysis can be started while the enquiry is still in progress, yet 'there is no clear and accepted set of convention for analysis corresponding to those observed with quantitative data' (Robson 1993:370). A multi-method approach is therefore often recommended, for instance content analysis, or issues analysis, where 'the issues can be used as a means of organising and selecting material' (Robson 1993:378).

Huberman and Miles, in exploring strategies for cross-case analysis, point out the tension of reconciling the particular and the universal, and the danger 'that multiple cases will be analysed at high levels of inference ... ending with a smooth set of generalisations that may not apply to any single case' (Huberman and Miles 1994:431). With this risk in mind, Noblit and Hare have made a case for preserving uniqueness while making comparisons, but also 'cautioned against aggregating or averaging results across cases, in order to avoid misinterpretation and superficiality' (in Huberman and Miles 1994:435). Huberman and Miles then go on to exemplify the many ways to proceed with multiple-case data (A-C).

A. Case-oriented strategy: 1. Replication strategy: 'A conceptual framework oversees the first case study, then successive cases are examined to see whether new pattern matches the one found earlier'. 2. Multiple exemplars: 'Particular phenomena are collected and inspected for essential elements or components'. 3. Types or Families: 'Cases in a set are inspected to see if they fall into clusters that share certain patterns or configuration'.

B. Variable-oriented strategies: 'Finding themes that cut across cases'.

C. Pattern classification: 'Where a key variable comes clear only during cross-site analysis'. (Huberman and Miles 1994:436).

Formulating a research strategy

The purpose of the methodology chapter was to seek and formulate a research strategy for exploring, identifying, recording, and analysing uses of conceptual tools in a digital design culture. The outcome has been divided into four phases, **I, II, III and IV**.

Phase one [I] is an introduction to the field of study across a broad spectrum of design activities, from textile to aero-engineering. The aim of this phase was to explore the research area and identify issues ("problem feeling") that, together with the *Literature review*, would help formulate the research questions. The approach was loosely structured to allow for both informal and formal conversations with educators, students and design practitioners (see Chapter *Introduction*). Informally, conversations took place in a variety of venues, from conferences to design studios, from trade fairs to gallery exhibitions, where I noted down casual remarks, observations and thoughts. At a formal level, interviews were arranged with practitioners using a range of techniques, from taking notes over the telephone to audio-recorded studio visits, from postal letters to email messages. The interview questions were focused yet open-ended that allowed for a dialogue between the interviewer and interviewee (see Appendix A). Leads for interviews came from a variety of sources, from trade magazines to institutions such as the Royal College of Art (RCA) and the Royal Society of Arts (RSA).

Phase two [II] contains a single case pilot study with the aim of exploring, identifying, documenting and evaluating issues relating to conceptual activities (see Chapter *Pilot*). Moreover, the purpose of the pilot was to serve as *a test and launch pad for the multiple case study* [IV]. Data were collected from a second year, Y2, design student, who volunteered to take part whilst engaged in an assignment as part of the BA Design programme at Goldsmiths College, using two protocols; the Self-analysis protocol, and the Interview protocol. The Self-analysis protocol was designed as a self-report, a kind of diary, in which the participant was asked to keep track of uses of conceptual tools during the assignment. The Interview-protocol was a placeholder for the audio-recorded interview that followed at the end of the assignment.

Phase three [III] is a single case study composed of a number of ideation workshops within the Year-One (Y1) Design programme at Goldsmiths College, University of London (see Chapter *Finding Y1 Students*). The workshops, which emerged from the pilot and previous drawing workshops with the Y1 students, had *three aims*: First, to encourage the students to generate and develop ideas through the exploration of conceptual tools (*learning objective*). Second, to test how effective was the workshop format for ideation activities (*teaching objective*). Third, to illuminate the research question on the impact of digital technology on uses of conceptual tools (*research objective*).

Similar to the pilot, therefore, the study employed two research instruments: A Self-report and a Questionnaire. The Self-report was used by the participant students to trace and record individual uses of conceptual tools while engaged in four separate workshops in the domains of fashion (FA), architecture (AR), graphics (GR) and product (PR) design respectively. The chosen domains corresponded largely to the multiple case study [see IV], and informed the ideation tasks set for the workshops, which were thought to be inspirational for Y1 students on a general, rather than specialist BA design programme. The ways the students approached the design tasks conceptually were then thought to illuminate uses of conceptual tools. The workshops focused on process, rather than design outcomes in order to encourage the full flow of ideas using a variety of tools and media, both analogue and digital.

The Questionnaire, contained in the Self-report, consisted of structured yet open-ended questions. It was filled in and returned immediately after each assignment, together with any evidence of idea generation, such as conceptual sketches, rough 3-D models, and computer printouts. Each workshop was allocated three hours, of which two-hours and fifteen minutes were set aside for the actual ideation task and the remaining 45 minutes split between the introduction of the design brief and protocol (15 minutes), and presentations and group discussions at the end of the workshop (30 minutes). The presentations were not assessed but aimed at developing students' communication skills. Then, any judgement during the presentation would be by peer, rather than by tutor (peer-group learning).

Phase four [**IV**] builds on the findings of the pilot study [II]. The investigation took the form of *a descriptive, comparative multiple case study* in which empirical data were gathered from five second–year design students (academic year 2002/03), and five design practitioners (graduates in 2001 or 2002) in Fashion, Architecture, Graphics, Product and General design. That is, two participants from each design discipline (see Chapter *Y2 Students and Practitioners*). The number of cases was judged sufficient for obtaining research material within a methodological framework that was manageable. This reflected how 'the state of the art in descriptive design research is based on rather small samples (2 to 16 subjects)', and how 'the results derived from such small samples play a significant role in propelling forward the state of the art in this area' (Akin 1997:325).

The cases were divided beforehand into two groups, viz. Y2 students, and Practitioners, which reflected the discipline of the participants as well as their different levels of knowledge and experience. The reason for seeking recent design graduates was that they, as junior designers, were seen as less "settled" in their ways of designing, a judgement based on my findings during the preliminary interviews in industry (see Chapter *Introduction*). In addition, junior, rather than senior designers were more willing to participate in the study, that is, "access" influenced the choice of participants. The selected domains were thought to illuminate the core of the art and design spectrum as found in leading London-based design schools and professional practices. As a result, disciplines at the far ends of the design spectrum, for example, craft and engineering based design such as ceramics and aerospace design, were left out of the study. In this, the selection corresponded largely to the sub-fields of design as represented by the membership of the *Chartered Society of Designers,* CSD, that is, fashion and textile, exhibition, graphic, interior, and product design. Moreover, the choice of participants represented purposive sampling, that is, sampling that 'allows us to choose a case because it illustrates some features or process in which we are interested' (Silverman 2001:250). Or, how the cases were 'chosen because it is believed that understanding them will lead to better understanding ... about a still larger collection of cases' (Stake 1994:237).

The creative nature of ideation suggested a focus on process rather than outcome, that is, the generation, exploration and recording of ideas, rather than final outcomes. However, it has been argued that to consider the quality of outcomes may be a core issue in the expert and novice drawing research (Purcell and Gero 1998). But to evaluate ideas against outcomes would have been difficult because there can be a considerable time-lag between conceptualisation and realisation in industry. 'In some cases, final judgements about the quality of a design may have to wait until the product is actually used' (Akin 1997:326). In design schools, ideas rarely reach beyond the prototype stage. Moreover, 'we tend to assess the creativity of an idea in terms of our personal reactions to the idea itself' (Lawson 1990:108). Therefore, as an aspect of assessment practice, to evaluate participant students' ideas might have a negative effect on motivation and behaviour (Gipps 1994). Furthermore, differences in skills and experiences would make it inappropriate to compare work of students with work of practitioners, particularly as individual projects would invariably differ from each other. Therefore, the focus is on uses of conceptual tools, not the evaluation of ideas, or possible links between specific tools and specific ideas.

Participants for both groups were accessed through contacts with course leaders at three London design schools (Goldsmiths, Central Saint Martins and The Bartlett), and London based design firms. The London location meant that all research sites were within easy reach for research purposes. The schools were approached and chosen for their knowledge-based design programmes characterised by high conceptual teaching and learning content, which, according to Oxman, is rare among design schools (Oxman 2004), but which I considered particularly relevant for the context of the research questions, and notably *to contribute to original research.* That is, for the research to be understood as 'original investigation in order to gain knowledge and understanding' (Higher Education Funding Council, HEFC, definition for the purpose of the Research Assessment Exercise, RAE) suggested *situated research close to future-oriented design education.* Similar consideration applied when accessing participants from industry.

All participants were volunteers with the only requirement that the research task had to be carried out in the participant's everyday study or working environment ("situated research"). Apart from supplying leads for potential participants, there were no further undertakings from the design schools or industry in order for the case study to be independent and confidential. That is, the participants were to represent themselves as individual designers, not their institution or company, although this did not exclude the collaborative aspects of designing. For example, if the project involved teamwork that would then feed into the case study as any other data. Moreover, no payments or any other inducements were being offered to participants emphasising the voluntary nature of the research task, although a quality sketchbook was offered to each participant at the end of the project, as a small token of appreciation.

The case study built on the Pilot experience. First, each participant was asked to keep a record (Self-analysis protocol, as in the Pilot) of uses of conceptual tools while engaged in an individual project in education or industry ('reflection-in-action'; Schon 1983). Second, each participant was interviewed (Interview protocol, as in the Pilot), at the end of the project ('reflection-on-action'; ibid.). The interviews were audio-recorded and lasted about 30-45 minutes.

I introduced the protocol study in person to each participant prior to the start of the individual design project. This was to make sure that the research task was fully understood as well as establishing trust between researcher and participant. Although I estimated a rough time-span for each case in order to plan and manage the overall research schedule, each design project was independent and explicitly open-ended. Consequently, I had no influence or control over individual design processes, neither timing, nor outcomes.

Overview of strategy

Research strategy: The aim of the research strategy was:

I to get a feeling for and overall sense of the current situation of uses of conceptual tools in design schools and industry;

II to determine the feasibility of the research strategy;

III to illuminate differences in uses of conceptual tools among Y1 students when performing different ideation tasks.

IV (a) to illuminate differences in uses of conceptual tools between Y2 design students and design practitioners;

IV (b) to illuminate differences in uses of conceptual tools between different design domains;

Findings of I, II, III, and IV would then lead to discussion on possible implications for methodology, theory, teaching and learning, and practice, a discussion in which the researcher provides material for 'discovery learning' (Stake 1994:240).

Field procedures: To gather research material from participants in design schools and industry through self-reporting, and interviews/questionnaires, where the participants effectively would become co-researchers.

Analysis: By using multiple methods and obtaining information from several informants the analysis would amount to *triangulation of research events* or, 'locating similar data by several routes' (Bessant 1979:21), which 'is an indispensable tool in the real world enquiry' (Robson 1993:383).

Research questions: The research questions emerged from the context and the conceptual framework developed in the *Introduction* and the *Literature review*: What is the impact of digital technology on design ideation, particularly on uses of freehand sketching in the conceptual phases of designing? Does the impact differ between design domains, and between design students and practitioners in industry, particularly between Y2 students and junior designers? What are then the implications for design education and practice, both on a personal and a collaborative level?

The research strategy could be summed up thus:

I **Introduction** (Conversations with educators and practitioners in the field)

II **Pilot study** (Protocol analysis + interview)

III **Single case study** (Protocol analyses + questionnaires)

Fashion

Architecture

Graphics

Product

IV **Multiple case study** (Protocol analyses + interviews)

Architecture *Product* *Graphics* *Fashion* *General*

D: PILOT STUDY

Planning

In preparation for the multiple case study, a single case pilot study (hereafter referred to as "Pilot") was planned in the summer of 2002 and carried out in the following autumn term. The aim of the Pilot was to test the feasibility of the research strategy, notably the relevance of the research questions and data collection techniques. In this sense, the Pilot was not a 'dress rehearsal' (Yin 2003), but rather a developmental tool for the research design. For this purpose, a second-year student volunteered to take part during a five-week design assignment on the BA Design programme at Goldsmiths College, University of London.

Having chosen case study as research strategy (see Chapter *Methodology*), two main sources of evidence presented themselves (Yin 2003): *observation* of the events, that is, uses of conceptual tools, and *interview* with the person involved in the events, the "conceptualiser", or "ideator". The reason for considering two sources of evidence was that observation alone might interfere with conceptualisation, whereas interviewing on its own might rely too much on verbalisation of the ideation process *post hoc*. That is, interviewing carries the risk of "inaccurate " or "missing data" as a result of the participant's "faulty memory" or overly favourable response. Also,, and particular in the context of creativity and design, 'free imaginative thought can readily be subjected to rational evaluation later' (Lawson 1990:118). Moreover, such after-thoughts, post-justifications, or retrospective analysis may not necessarily be intellectually driven but reflect how designers also act from feelings, instincts and impulses, acts which can be difficult both to observe and describe, which emphasise the need for more than one source.

The key factor in the research design task, then, was to find a means of capturing uses of conceptual tools as they actually happened during a project in a design environment with which the participant was familiar (*situated qualitative research*). The familiarity with the environment was considered important because, and unlike research under laboratory conditions, the participant would need to be surrounded by his own 'tools' (Dwarakanath and Blessing 1996). Moreover, in terms of resources and tools, the design environment, as a mediated learning environment, may be seen as a form of a *distributed learning space* (Marchionini 1999) in which designers would need to be able to navigate freely with unrestricted access to information. Therefore, it would be for designers, as learners, 'to decide for themselves the type of information they prefer to access and the order in which they process different types or modes of information' (Plass et al. 1998:25). This would make sense because idea generation, as a non-linear creative process, occurs in any order consisting of overlapping, rather than discrete, sequential stages (Davies and Talbot 1987).

The observation of events would focus on uses of conceptual tools, rather than the volume, variety or originality of ideas. This would include the commonly recognised "Aha!" or "Eureka" moment, when a sudden mental insight arrives (Akin and Akin 1996), also described as creative 'sparks' (Kimbell 2002), or 'mental flash light' (Alvesson et al. 2000:52). Moreover, such illuminations, described by Wallas as 'appearance of a tentative solution in a moment of insight often accompanied by a sense of exhilaration' (in Davies and Talbot 1987:24), may crucially influence the ideation process. Yet it has also been argued that 'design concepts do not appear, in their totality, all at once' (Goldschmidt 1994:164). This suggests that observation would not focus on explicitly discrete tool events, for which experiments might be more appropriate, but on uses of ideation tools in a comprehensive design brief. That is, and unlike the laboratory surrounding, which restricts the number of influences on the design process (Dwarakanath and Blessing 1996), the Pilot would have to recognise the many influences on design ideation, including external and internal constraints in the design environment (see Chapter *Literature review*).

To observe, or rather capture uses of conceptual tools, there were two major data collection techniques to consider: Participant observation; and direct observation (see Chapter *Methodology*). However, participant observation, in which 'the researcher participates in the events being studied' (Robson 1993:159) would be too time-consuming and cumbersome during an open-ended assignment lasting weeks rather than days. Also, the participant may be working at home or in "other places" where ideas arise because ideation is not necessarily situated in the studio environment. When working in college there would also be the issue of privacy because participant observation might be too intrusive, particularly in an open-plan studio environment. Moreover, envisioning how the Pilot would be largely replicable for the multiple case study, participant observation would be an impractical method for gaining access to practitioners in industry, in which case the researcher would have to become a "team member". However, these concerns also raised the issue of reliability of the case study, or consistency of methods, which suggested how the criteria of trustworthiness and authenticity would be more appropriate "tests" than the traditional criteria of reliability, validity and generalisability (Guba and Lincoln 1989, see also Chapter *Methodology*).

The second data collection technique to consider was direct observation, particularly in the form where researchers use audio- and videotape for recording design activities, which has been used to study and analyse processes going on in design work, including drawing activities (Cross et al 1996). This approach, the so-called think-aloud method, involves 'the recording of problem-solvers' concurrent verbalisation under controlled conditions' ... 'and subsequent analysis' (Lansdown 1988:87). For instance, 'we videotaped the designers at work, and asked them to explain what they were doing as they worked. Then we transcribed and analysed the videotapes' (Yi-Luen et al. 2000:487).

The think-aloud method, however, can have an impact on performance similar to that of other people's presence (Aiello and Kolb, in Bernstein and Nash 1999:515). Therefore using think-aloud protocols in ideation situations may not only be intrusive but might also impair the "free flow" of ideas, and 'affect, possibly in unpredictable ways, the design process itself' (Davies 1995:103). Moreover, the results of thinking aloud may depend not only on the type of design activity being examined but also on the ability and training of the subject to perform in this extrovert manner. For instance, compare the painter who is able and willing to think-aloud about his or her work-in-progress whilst painting with artists who would not feel comfortable to talk about their work but retrospectively. Moreover, in my experience as studio tutor, students can be reluctant to reveal "design thinking" while being observed, from fear of criticism, negative stress, or lack of confidence.

Another objection to think-aloud protocols is that although they are 'a potentially effective method for the controlled observation and experimental analysis of design problem-solving behaviour' (Lansdown 1988:87), they are not suitable for open-ended observations over long periods, particularly when the participant would not be permanently working in one fixed location. Also, the analysis and interpretation of the many hours of videotape would have to be taken into account because the video analysis method can be very time consuming (Mooy and Valkhoff 2001). Furthermore, it has been found that with the time limit and restrictive settings of video taping 'the ability to mull over ideas or engage in opportunistic solutions [were] restricted or removed from context' (Brereton 1996:321). That is, think-aloud protocols tend to become non-context dependent 'capturing a few aspects of design activity in great detail' (Cross et al. 1996:13), or the very opposite of the free-flowing nature of ideation.

Although having found against the think-aloud method for data gathering, and against interviewing as the sole source for case study evidence, I was still attracted to the notion of protocol methods because they might give a clue to how I might gain insights into uses of conceptual tools. Or, 'a verbal protocol is a self-report of behaviour, which usually includes the individual's reasoning about the behaviour.' (Johnson and Briggs 1994:61).

The term "self-report" was of particular interest here because it suggested how situated, authentic feedback might be received from participants if they themselves were to track, identify and record their conceptual activities as they went along, rather than being observed and recorded by the researcher. True, only the outcome would tell because, as noted by Oppenheim, participants' interest in filling in the protocol, or similar information gathering techniques, such as diaries, could cause them to modify their behaviour (Oppenheim 1966:215). For instance, participants might use a greater range of conceptual tools to create a more favourable impression of the way they went about ideation. However, it is also fair to say that any openly declared measuring method is likely to influence the subject's thinking and behaviour to some degree. Therefore, there is no truly "objective" qualitative measuring method of recording verbal or non-verbal thought processes in design activities, and also considering research ethics.

Moreover, the kind of protocol, or self-report, I was looking for would be a situational, hands-on instrument to be used by the participant while engaged in generating ideas over a lengthy period, that is, self-reporting that excluded direct or participant observation. Also, the research instrument had to be capable of capturing uses of conceptual tools in a consistent and non-obtrusive manner, that is, it had to be reliable (trustworthy). Put differently, I was looking for how data could be recorded conscientiously *by* the participant, not *after* the conceptual events, but *during* the events in a way that did not interfere with the design activity. Moreover, as conceptual activities might be expressed in a variety of mediums, the recording instrument had to be capable of capturing both verbal and non-verbal data. How could this be done?

The creative nature of ideation suggested focusing on process rather than final outcome because creativity does not always take the form of a finished product but also new and innovative ways to approach a project or problem. Therefore, the focus would be on uses of conceptual tools for the generation, exploration and recording of ideas, rather than finished artefacts. However, it has been argued that considering the quality of outcomes may be a core issue in drawing research when comparing novice designers with experts (Purcell and Gero 1998). It might therefore be of interest to look at the quality of the ideas presented and link them to the conceptual tools used, or to look for, say, any relationship between tool usage and the number of ideas produced by a particular tool. Yet, in design schools, ideas rarely reach beyond the prototype stage and therefore it would be difficult to judge or evaluate the outcome of ideas as such. Moreover, assessment of ideas evokes personal reactions to the idea itself (Lawson 1990), and therefore assessment might have a negative effect on motivation and behaviour (Gipps 1994). But, and in anticipating that the Pilot protocol would be applied to the multiple case study, also in industry it might be difficult to evaluate the quality of ideas because there can be a considerable gap between conceptualisation and final realisation of ideas. For example, the vignette of the product designer reflected a two-year gap between ideation and final production (see Chapter *Introduction*). Furthermore, differences in skills and experiences would make it inappropriate to compare final work of students with that of practitioners, particularly as individual projects would invariably differ from each other.

Designing the research instrument

The first thoughts about designing the protocol were born out of my personal experience of how designers use note- and sketchbooks, creative journals, diaries and similar devices for exploring, articulating and keeping track of ideas. Thus from the start I was looking for how designers leave "conceptual traces", the making and leaving of tracks such as sketches, which, as suggested by Gruber, is part and parcel of the process itself, a kind of activity characteristic of people doing creative work (in Lavery 1993). In other words, uses of conceptual tools would leave traces of ideas, which the protocol had to be able to capture

Furthermore, the research literature provided ideas how this might be done. For example, Dorner has suggested that the sequence of sketches and models 'serve the purpose of forming a logbook for the whole design process' and 'provide a good basis to reveal the mechanics of one's own thinking' (Dorner 1999:408-409). Such thinking, then, resembled Schon's reflective practice theory in which the designer is having a conversation with the drawing (Schon 1983). Or, Yin's case study techniques and the notion of the 'data protocol' ... 'a kind of researcher's checklist ... recommended for increased reliability' (Yin 2003:68ff.), suggested an approach that might be relevant for self-reporting. Or, observational methods that included coding sequences of behaviour (Robson 1993). Or, from "Phenomenonography", a method that includes self-reporting for better understanding of learning in higher education from the student's perspective (Marton et al.1984).

Therefore, the major concern for the design of the self-report was how to capture uses of conceptual tools. For this, I would need a coding scheme and an obvious solution would be to use one "off the shelf" because there are already in existence a multiplicity of such schemes (Robson 1993). However, they tend to be applied to structured observation commonly used in field experiments where the researcher, rather than subject, does the observing. But in my case, the self-report would have to be designed to suit primarily the participant, rather than the researcher. Therefore, a tailor-made coding scheme seemed the best solution, for which Robson provided a few suggestions (Robson 1993:212). Thus a coding scheme should be:

- Focused, that is, of what use would the data be. This requirement would be related to the research questions on conceptual tools.
- Objective, that is, requiring little inference from the observer. This meant that the research instrument would have to be non-intrusive to the participant's conceptual activities
- Explicitly defined, that is, each coding category needed to be exemplified. Therefore the meaning of each conceptual tool would have to be made explicit
- Exhaustive, that is, the scheme needed to cover all possibilities. Or, how many conceptual tools would the participant possibly use.
- Mutually exclusive, that is, a single category for each thing. Therefore, the tools would have to be coded separately.
- Easy to record, that is, the protocol coding must be user-friendly and familiar to the observer. This underlined the need for clarity of the protocol design and guidelines for its use because 'Instructions need to be explicit' (Bell 1999:148).

Moreover, the problem of knowing for certain whether the undertaken protocol task was being recorded conscientiously would emphasise the need to make sure that participants knew *what* to do, and *why*. Therefore the participant would have to be truly motivated and 'fully in sympathy with the task' in order to complete it thoroughly (Bell 1999:147).

From these considerations emerged the need for two, rather than one protocol to capture uses of conceptual tools. That is, (1) a protocol for recording "data" during the project and (2) a protocol for recording "data" at the end of the project.

The Self-analysis protocol

The protocol, which is referred to in the thesis as either the Self-analysis protocol or Self-report, would have to be designed as a hands-on instrument, to be used by the participant for tracking and recording conceptual activities during the design assignment, what might be called an *ideation tracker*. In this, the Self-analysis protocol could be likened to a kind of diary, a means of gathering information how individuals record or log work patterns and professional activities (Bell 1999). Moreover, the tracing of conceptual tools might be seen as 'reflection-in-action' (Schon 1983), an activity that 'works particularly well in the conceptual stage of the design process, where the designer has no standard strategies to follow and is proposing and trying out problem-solution structures' (Dorst and Dijkhuis 1995:274).

Furthermore, in designing the Self-report I was prompted by the conceptual framework developed in the literature review, for instance how different analogue and digital working practices might be plotted in a matrix in the attempt to locate sketching in the design process (see Chapter *Literature Review*). Or, inspired by graphic designers such as Tufte (1997), who has emphasised that both rigour and imagination can be applied effectively to visual displays. Therefore, the *interactive* aspects of the Self-report became paramount because the task was to elicit and make explicit uses of conceptual tools.

As a result a number of layouts were sketched out, discussed and reflected on, in what effectively became *an interactive design process* in which the coexistence of verbal and visual data was important. That is, the Self-report would reflect a complimentary verbal-conceptual and visual-graphic relationship. Such relationships have been explored in various activity modes, for example, the Activity Based Model where data are sorted into categories using a set of criteria such as drawing, writing, and talking (Akin and Lin 1996:38). Or, the Repertory Grid Technique used by research psychologists, market researchers and in architectural and environmental design, in which the grid formalises the process under investigation (Fransella et al. 2003).

A grid-like layout seemed particularly appropriate because the grid has a long history of serving the structuring of information and therefore would serve as a placeholder for recording conceptual activities. However, the need for a user-friendly Self-report interface also suggested a layout that was simple, rather than elaborate, like the minimalist layout of crosswords, or the blocks of dates in a calendar. As a result of these considerations, the final Pilot protocol was laid out as a grid of numbered squares in which each square represented a time- and event- based coding unit (Figure D:1).

Each numbered square (1-36) represents one half-Day session worked.

S W M C 1	S W M C 2	S W M C 3	S W M C 4	S W M C 5	S W M C 6
S W M C 7	S W M C 8	S W M C 9	S W M C 10	S W M C 11	S W M C 12
S W M C 13	S W M C 14	S W M C 15	S W M C 16	S W M C 17	S W M C 18
S W M C 19	S W M C 20	S W M C 21	S W M C 22	S W M C 23	S W M C 24
S W M C 25	S W M C 26	S W M C 27	S W M C 28	S W M C 29	S W M C 30
S W M C 31	S W M C 32	S W M C 33	S W M C 34	S W M C 35	S W M C 36

Footnotes: Using the square numbers as reference (1-36), add other tools, special circumstances or "landmark events" ("Aha!") you experienced during the sessions worked.

Fig. D:1 Self-report

Thus each numbered square was a *time-based* unit representing roughly one half-day working session, which was thought a manageable interval for recording conceptual events over a longer period. This meant that the protocol was laid out in two grids totalling 72 squares (2 X 36) spread over two A4 sheets (Figure D:1 shows one A4 sheet) so it could accommodate roughly the five-week period set aside for the Pilot assignment. However, within the allocated time, it was at the discretion of the participant to decide when to start and finish recording uses of conceptual tools. This was to enable the capturing of *authentic* conceptual events as they unfolded along the time-line.

Therefore, each numbered square was also an *event-based* unit in which four different modes of designers' conceptual activities were represented by symbols for conceptual tools, that is, S = Sketching; W = Words (spoken and written); M = sketch modelling; C = Computing. The participant's task was then to record the type of conceptual tool used in each session by circling, with pen or pencil, the relevant tool symbol. If more than one single tool was being used in any one session, then all the tools used would be circled in the relevant square. Equally, if no conceptual tool(s) were used, the square would be left blank. Therefore, the Self-report was *action-based* where the recording was intended to capture uses of ideation tools.

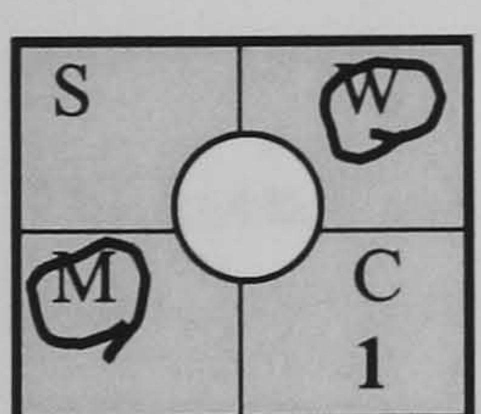
The four categories of tools, [S], [W], [M], and [C], were not exclusive for capturing uses of conceptual tools. However, they were based on my background knowledge of studio design, as well as the literature review, and reflected the most commonly used conceptual tools in design across domains. Also, having four categories were convenient both in numbers and as labels for making the protocol user-friendly and manageable in the hands of the participant and the researcher alike. In addition to the four tool categories, an empty circle was inserted in the middle of each numbered square. This provided space for the participant to record the reasons for using the conceptual tool(s) that had been encircled in the square. Thus up to four reasons could be given and consequently marked in the circle, that is, a = because I could not do without it; b = because I liked it (personal preference); c = because of tutor/peer/client influence; and d = because of assessment criteria (see below *Protocol Guidelines*).

However, there was a risk with only four tool categories in that the coding units might be perceived as "ticking-boxes" for conceptual activities that prompted or prescribed certain tools. For this reason, at the interactive design stage, a footnote apparatus was embedded just below the grid in the protocol to cover for any other conceptual means that the participant might use, other than [S], [W], [M] and [C]. Moreover, the footnote apparatus served as a placeholder for any comments about conceptual activity or event experienced during the sessions, including "Aha!" moments (Figure D:1).

The participant was then asked to use the protocol to keep track of uses of conceptual tools as explained to him in person and set out in the Guidelines printed on the back of the four-page protocol (Figure D:2). The term "conceptual tool" was used to underline how conceptualisation is not just "having ideas in one's head", because already common sense tells us that if ideas are not externalised, nobody else would know about them (see Chapter *Methodology*). Therefore, just "thinking", or say daydreaming, was not considered a "tool option", although as a cognitive activity it might be added as a footnote in the protocol. However, daydreaming, if externalised as say, doodling, would be recorded as sketching. The self-reporting, by means of the protocol, in conjunction with the interview that followed at the end of the project, would then constitute primary data, which then might yield an "ideation profile" of the participant's uses of conceptual tools.

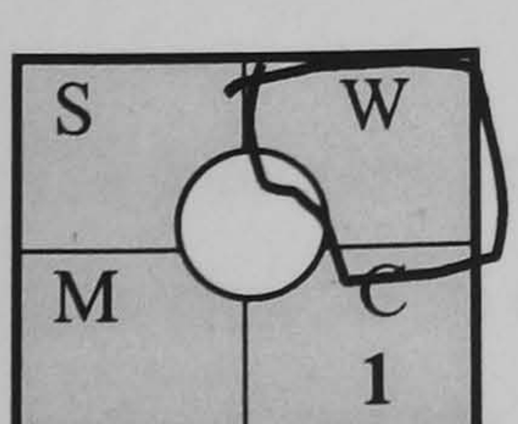
Guidelines:

I. For each session worked, circle the
tool(s) (S,W,M,C) you used
in that session. If other than S,W.M,C,
describe in numbered footnote (1-72).

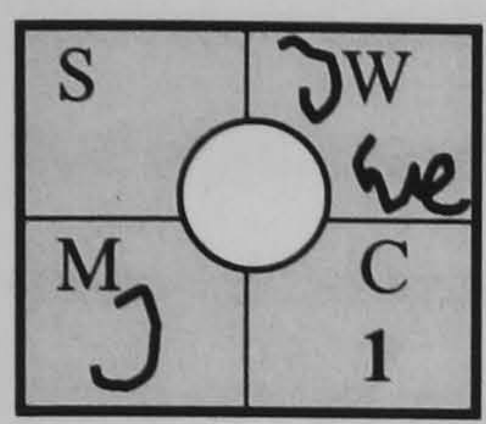


S = Freehand SKETCH
W = Spoken & Written WORDS
M = Sketch MODELLING
C = COMPUTING (CAG/CAD/Multimedia)
1 (1-72) = Other tools in numbered footnote.

II. Draw a frame around the tool
you considered the most important in each
session worked.

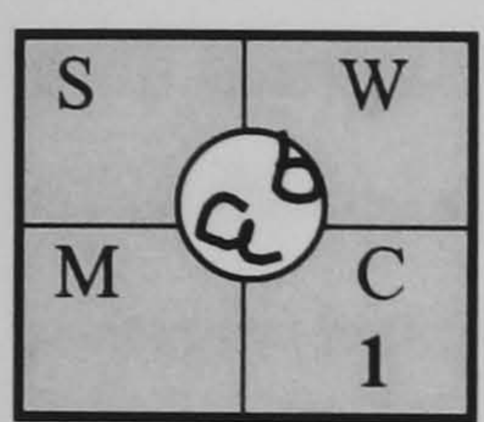


III. Add "I" and/or "We" next to the tool you used to indicate mode of communication.



"I" = Inner-personal communication
"We" = Inter-personal communication

IV. In the circle, indicate the reason(s) (a,b,c,d) why you chose the tool(s) you did.



a = Because I could not do without it
b = Because I liked it (personal preference)
c = Because of tutor/peer/client influence
d = Because of assessment criteria

Fig. D:2 Self-report guidelines

The Interview protocol

The Interview protocol was designed to compliment the Self-analysis protocol. The format was an eight-page A4 spread that contained a mix of structured yet open-ended questions, with the intention of capturing (reflection-on-action) during the interview. That is, in the interview the participant would reflect on what had occurred during the assignment, as recorded in the Self-analysis protocol (reflection-in-action). The interview questions had progressively emerged during the literature review and in conversations with designers in industry prior to the set-up of the Pilot, and were finalised in a tripartite meeting with the participant and my supervisor.

The Interview protocol was initially thought of as an aid-memoir for the conduct of the interview, to be audio-recorded and transcribed. However, as I was thinking about ways of representing the emerging data from the Self-analysis protocol, I decided to provide space for empty charts in the Interview protocol into which the self-recorded data could be transferred.

The idea with the data transfer into charts was that it would make it easier to "read" and therefore interpret the "raw" data recorded in the Self-report (see *Protocol Findings* below).

The interview took place immediately at the end of the five-week studio assignment to assure that recollections of events were as fresh as possible. However, the participant turned up for the interview without the Self-analysis protocol so the interview was carried out and taped without the protocol. However, this meant that the interview had to rely solely on the participant's recollection of events, that is, without any data backup or cross-referencing to the Self-analysis protocol. This was unsatisfactory because verbalisation from memory of what had actually happened during the assignment might weaken the quality of the data (post-rationalisation). In other words, verbalisation alone 'may not accurately reflect what happens at the behavioural level' (Davies 1995:103). Therefore, a second interview was arranged for the following day in which the recorded data from the Self-analysis protocol were transferred to the charts in the Interview protocol. The second meeting lasted about an hour of which half was taken up by the taped interview.

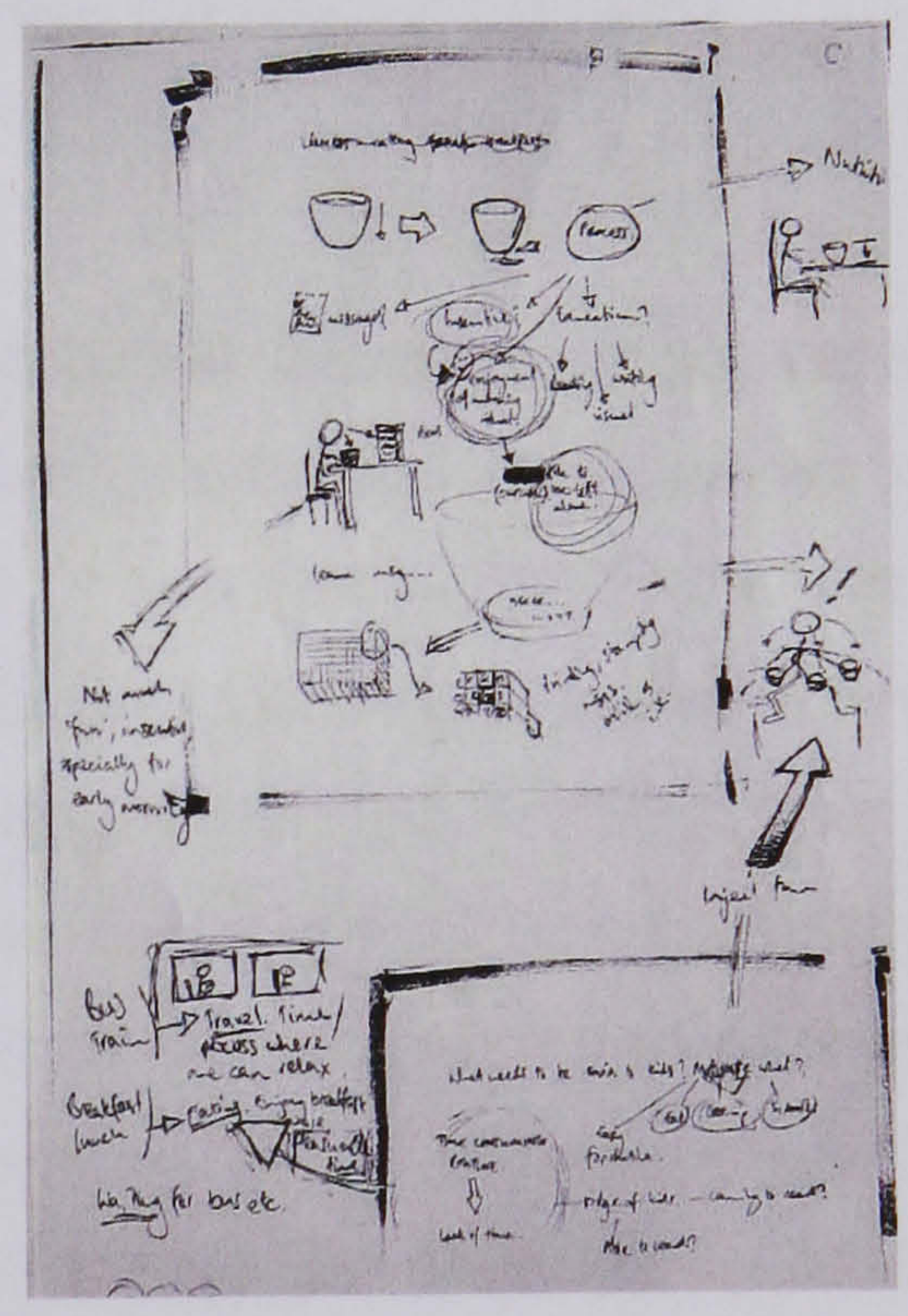
The transferring of the "raw" data from the Self-analysis protocol to the Interview protocol took place at the very start of the interview session and was a collaborative activity. That is, as the participant read out the data, for instance, the number of sessions in which a certain conceptual tool had been used, I transformed the data into matrices, bar and pie charts. During the recorded interview that followed, the data thus turned into charts acted as reference for both the interviewee and the interviewer. The benefit of this arrangement was that the protocol data were laid out in front of us in a visual format that was easy to read "at-a-glance". In this way, the protocol, as a kind of visual diary, became a preliminary to interviewing (Burgess 1981).

In addition to the Self-report and Interview protocol an informal checklist was kept during the Pilot to monitor progress. The checklist, unlike the protocol and the interview, was not a document but consisted of once-weekly, informal meetings with the participant during the assignment. The meetings were brief (about 10-15 minutes) but provided useful feedback, both as to the form and content of the protocol and any problem that might arise from it. 'Within the process of a single work's coming into being we can often observe a fairly surveyable approach to the solution of a given problem' (Arnheim 1986:273). Moreover, the Pilot feedback would be considered for designing the next step of my research, that is, the multiple case study (for the final version of the Interview protocol, see *Appendix F:2*)..

The Pilot project brief

The participant student's assignment was a Royal Society of Arts' open competition brief on the subject of re-innovation calling for ideas to identify and solve a problem with an existing product or service. The brief did not prescribe any conceptual tools as such but the entry requirement included a statement (words), sketches, and 2-D models or 3-D mock-ups. In the participant's words, it was 'an ambiguous brief that was looked at in a number of different ways, in all sort of different directions'. The participant's idea was for a child's breakfast bowl designed so the child could leave an imprinted message "thanks mum" on the table after the meal was finished. The design ideas were externalised in sketches, both analogue and digital (Illustrations D:1 and D:2), and in a video clip (not included).

Ill. D:1 Digital sketch



Ill. D:2 Analogue sketch

Protocol findings

The fact that Self-recording can be inaccurate also affects data analysis and interpretation and therefore, like any kind of diary exercise, raises inevitably the problem with representativeness (Bell 1999:148). For instance, did the participant represent a typical Y2 student in skills and experience? Or, was there an explicit or implicit bias in the brief or in the design environment towards the use of any particular conceptual tool? For instance, bias in interview studies may stem from 'the interactive nature of the interview situation and the researcher's subsequent attempts to impose coherence' (Davies and Talbot 1987). Such concerns were relevant because if the data were not representative then the usability and reliability of the Pilot might be put in question, and therefore its use for the multiple case study. However, case study is not sampling from which statistical generalisations can be made (Yin 2003). Instead, the purposive sampling method employed in the Pilot was to raise 'awareness of context' (Silverman 2001:252), through seeking out 'groups, settings and individuals ... where the processes being studied are most likely to occur' (Denzin and Lincoln 1994:202).

Therefore, the question was not so much whether the student in the pilot was "typical" but rather that his experience was likely to illuminate uses of conceptual tools in a meaningful way. However, representations of ideation can never be flawless in the way a discrete, sequential "material" work process might be recorded accurately step-by-step, This approach, therefore, implies a personal interpretation, of making sense that does not rule out alternative interpretations.

However, counting the number of conceptual tools (distribution, frequency and sequence, see below) might suggest a quantitative approach, and 'counting and statistical analysis are viewed as anathema by many advocates of qualitative research' (Robson 1993:400). That is, 'the researcher develops a coding scheme that categorises the design activity by topic and then spends the bulk of the research effort coding, quantifying and analysing the data looking for interesting patterns in graphs or informative statistics' (Brereton 1996:320). Yet, the case study method does not exclude a mix of quantitative and qualitative data, rather it may suggest how a quantitative element is introduced into a qualitative procedure. Or, 'A surprising amount of counting goes on when judgements based on qualitative data are concerned' (ibid.). Also, quantitative elements reflect how 'terms like many, frequently, common, rare, indicate organisation and counting although not precisely defined' (Robson 1993:401).

Furthermore, the Self-analysis protocol (reflection-in-action) was explicitly used together with the Interview protocol (reflection-on-action). This enabled cross-checking of data but also illuminated how conceptual activity, as a creative pursuit, was a discontinuous (non-linear) rather than continuous (linear) process towards completeness (Lansdown 1987; Goel 1995). In other words, design ideation is not a well-defined activity along the time-line. Thus, the participant pointed out in the plotted graph in front of him how ideas had come together 'significantly' first in Week 4 of the five-week long project, and expressed in freehand sketching [S] and computing [C]. This suggests that conceptualisation, and in contrast to commonly held views, does not necessarily occur primarily in the early stages but throughout the design process (see Chapter *Literature Review*).

In transferring Self-protocol analysis data (Figure D:3) into charts it became easier to interpret the uses of conceptual tools according to their distribution, frequency and sequence in the design process. This was first done freehand at the time of the interview, as shown below (a dedicated software program was used in the multiple case study – see Chapter *Findings Y2 and Practitioners*).

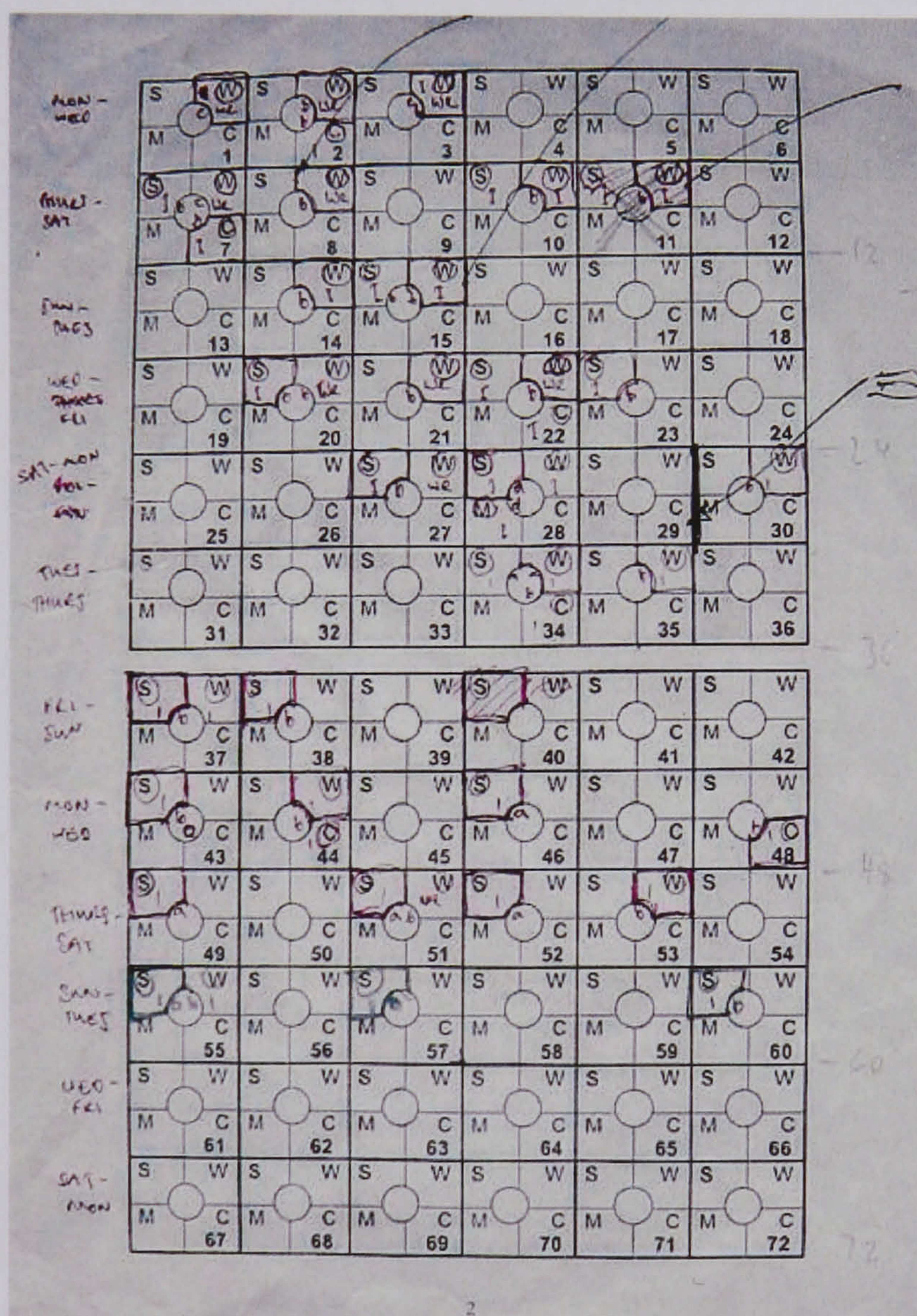


Fig. D:3 Raw data in the Self-report

Distribution and frequency of tools

Therefore, the first transfer of data into charts was the recording of the most important tools ("essential tools"). This showed the sequential distribution of the conceptual tools as used in each work session throughout the project (Figure D:4). The selection of "essential tools", rather than "all tools", was done because the plotting of all tools, which was first tried, produced a chart that was too dense for an at-a-glance overview of the tools used. Thus from plotting uses of essential tools the chart revealed how the participant started the assignment (Square One) in the verbal mode, or spoken and written words [W]. This mode continued for three sessions followed by a session of Internet search, which was recorded as computing [C]. Ideation then continued in the verbal mode before moving into a single sketching session [S]. Thereafter it went through a series of backwards and forwards moves expressed in words [W] and sketching [S]. Towards the end of the assignment, ideation occurred in the sketching mode [S] but for a single computing [C] and a single word [W] session. Presented graphically, the distribution of tools used during the assignment clearly shows the iterative nature of conceptualising.

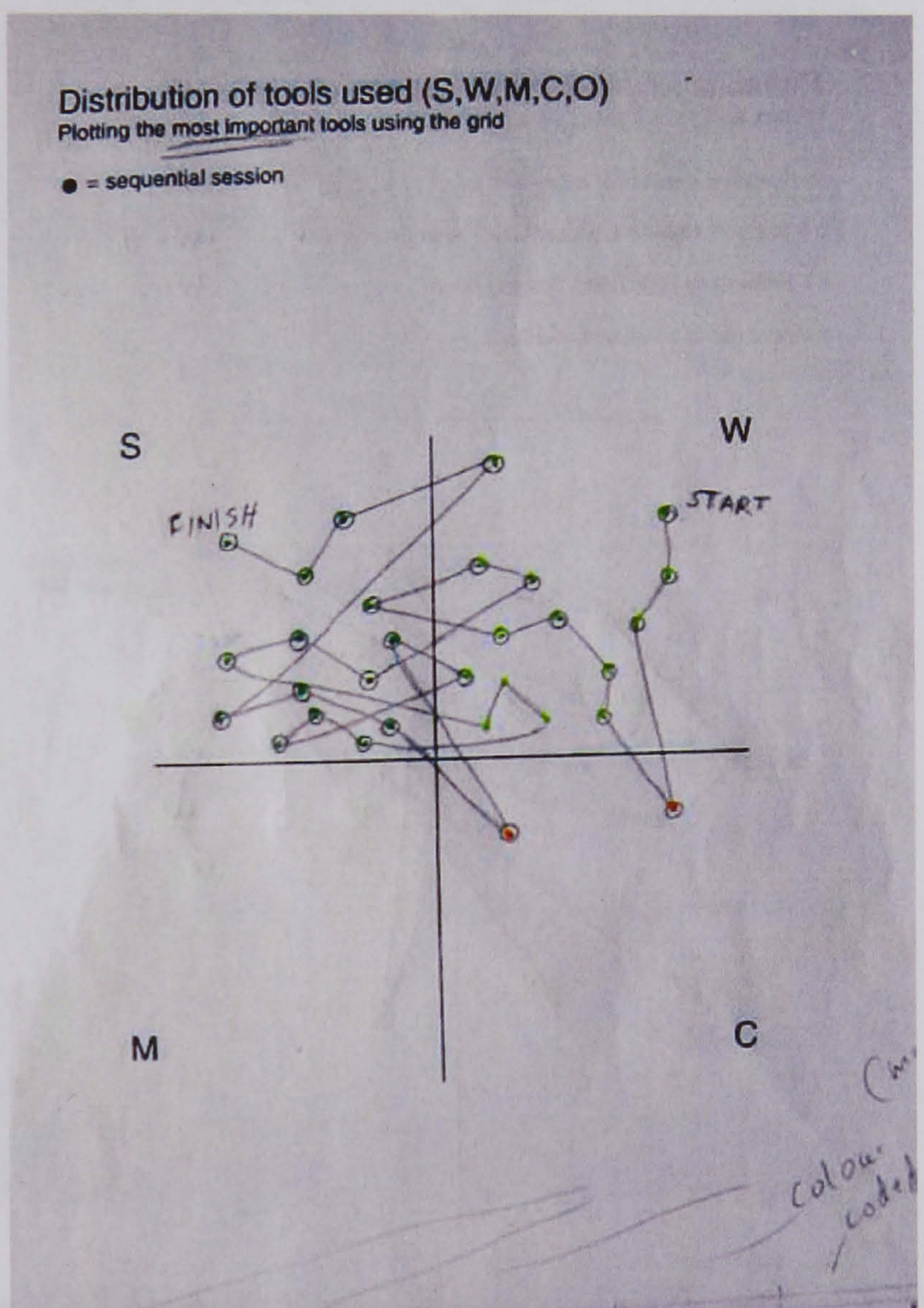


Fig. D:4 Distribution of tools used
Plotting the most important tools in the grid

In contrast to the distribution chart, uses of all conceptual tools, and not just essential tools, were plotted according to frequency and sequence (Figure D:5). Thus the bar charts below show how sketching [S] and words [W] were used in 19 working sessions each. Computing [C] was used in five sessions and sketch-modelling [M] in only one session. One library search event was recorded as other tools [O].

Plotted along the time-line (time trace), the sequence of conceptual tools used shows that sketching [S] was done fairly regularly over the assignment period (a total of 60 sessions). Words [W] were most frequent in the early phase of conceptualisation whereas computing [C] was more evenly spread. The single modelling [M] session occurred roughly in the middle of the ideation process.

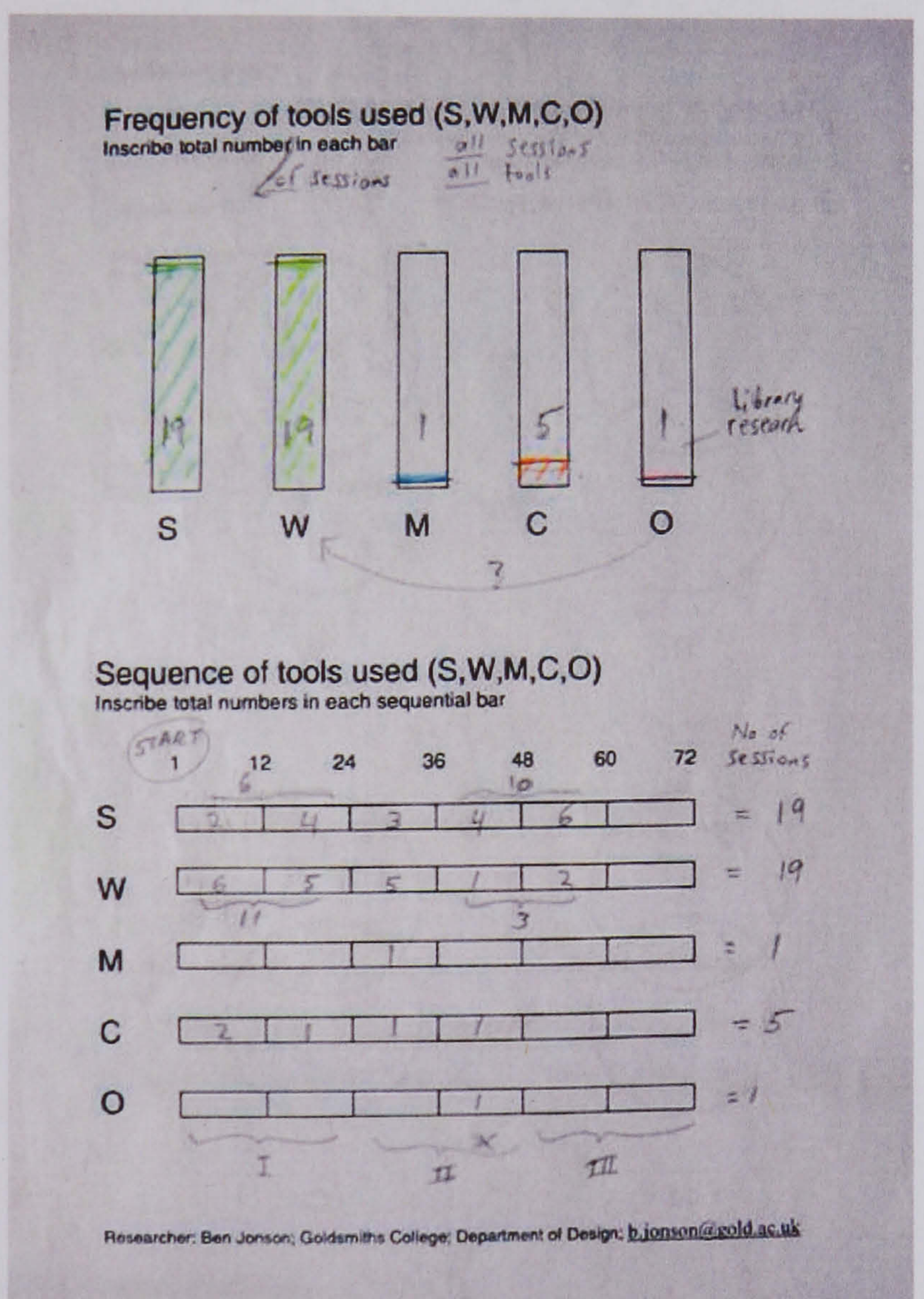


Fig. D:5 Frequency and sequence of tools used

Modes of communication

The data on modes of communication ("I" and/or "We") revealed that sketching [S], modelling [M], and computing [C] were exclusively in the "I" mode. In contrast, words [W] were almost equally distributed between the "I" and "We" modes, that is, words were used as a tool for self-expression as well as for communication with others (Figure D:6).

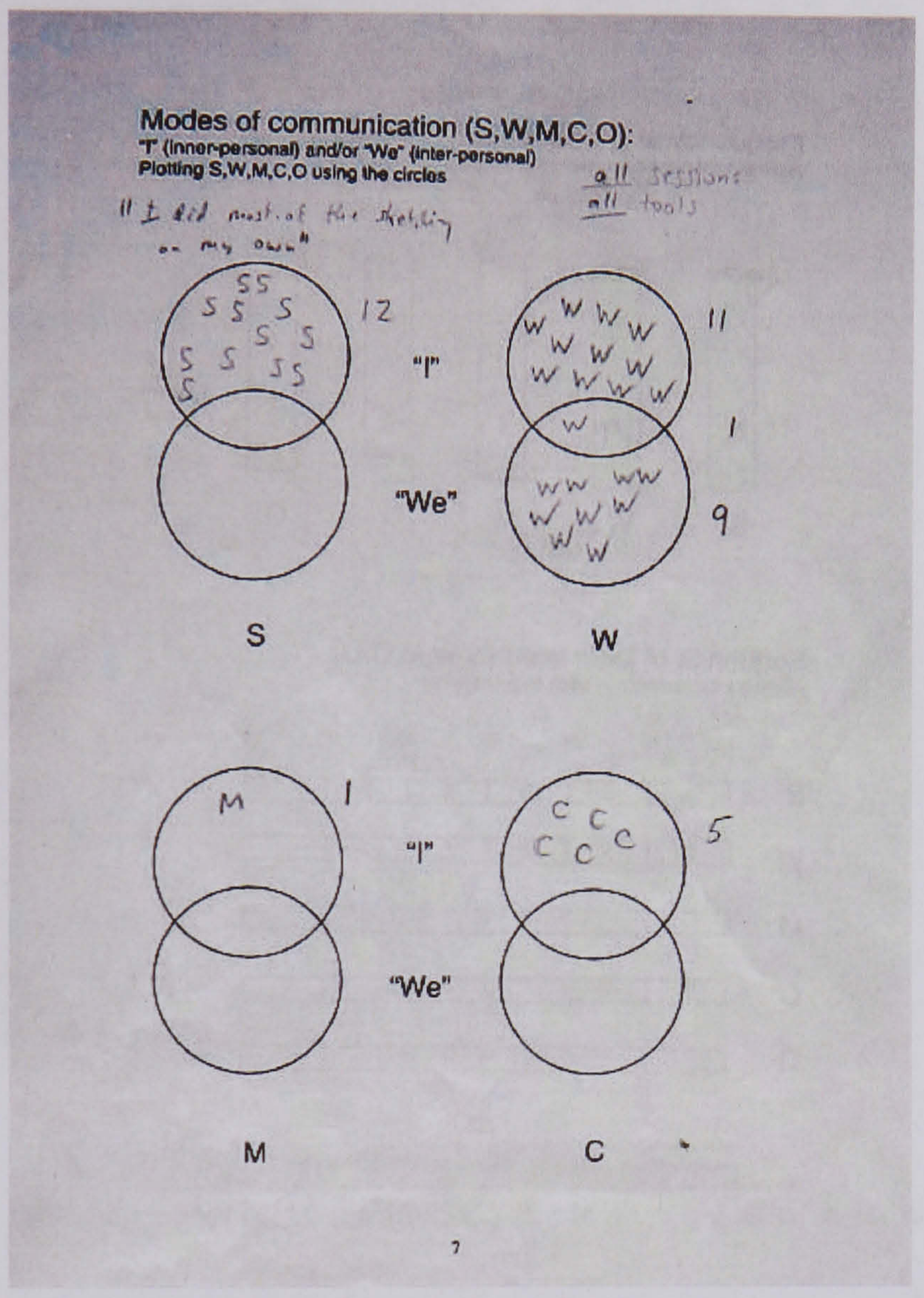


Fig. D:6 Modes of communication
"I" (inner-personal) and/or "We" (inter-personal)

Reasons why tools were chosen

Looking for the reasons why the most important tools were used, it emerged that the most frequent reason given was "personal preference", or, S = 9; W = 11; and C = 2 (choice b; Figure D:7). The second most recorded reason was "essential tool", or, S = 4; and W = 1 (choice a; Figure D:7). Tutor/peer influence and assessment criteria had an overall influence on the project according to the interview statement, but not on the choice of tools used, which reflected how most tools were used because of personal preference.

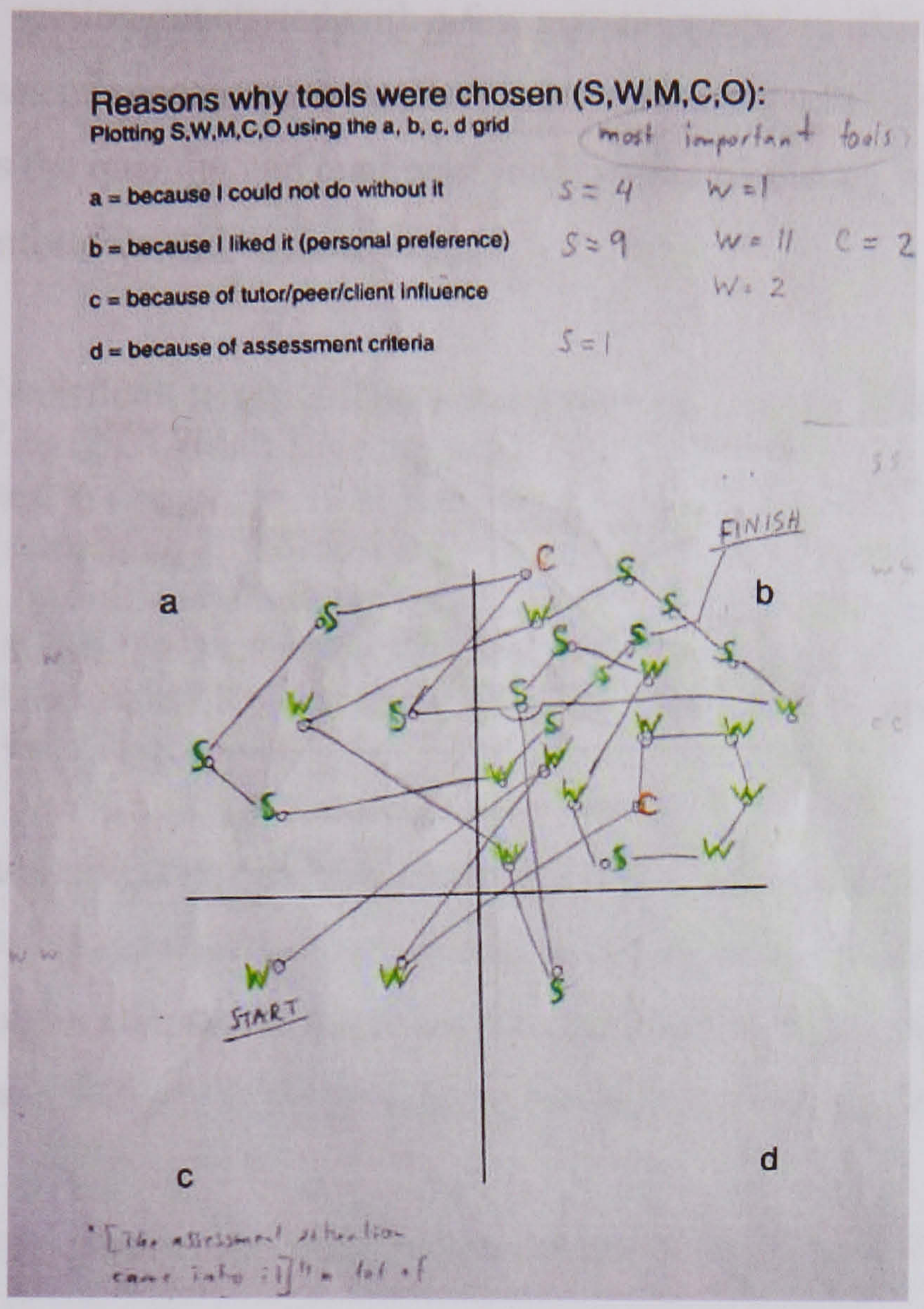


Fig. D:7 Reasons why tools were chosen
Plotting the most important tools using the a, b, c, d grid

a = because I could not do without it (essential tool)
b = because I liked it (personal preference)
c = because of tutor/peer/client influence
d = because of assessment criteria

Interview findings

The Self-analysis protocol effectively acted as a preliminary to the interview. That is, the protocol did not just prepare for the interview but also helped cross-check the interview statements in a way that amounted to 'an approximation to the method of participant observation' (Zimmerman and Wieder 1977; in Bell 1999). As a result, the transcribed interview revealed some rich descriptions and explanations that were not based on verbalisation alone but corroborated or, occasionally, refuted by the Self-report.

The interview session got started with a few general questions about the project progressively focusing on uses of conceptual tools. However, when asking specifically about idea generation to try to assess the quantity and quality of ideas produced during the project, the participant seemed uncomfortable and became vague.

> 'That's difficult to say ... There was a definite struggle after the research. I had this idea of the design. I didn't have the product. I knew what I was looking at, a particular thing I wanted to design for … At that point it wasn't so much a product as a situation, to solve something … There were a lot of written ideas. Quite a few initial ideas ... Quite a lot … I would say about ten ideas … before I came to design the bowl … I probably came across different ways, different ideas to redesign, re-innovate this bowl, which would be another five-six ideas. But they did differ how deep I went into them before some were discharged'.

This somewhat ambiguous response confirmed that it would not have been a fruitful approach in terms of reliability and validity to try to evaluate or assess the volume, variety or originality of ideas as such at the conceptual stage (see Chapter *Methodology*). Instead, the focus would be on uses of ideation tools, which the participant had captured in the Self-analysis protocol.

Thus the most important conceptual tools were sketching [S] and written and spoken words [W].

> 'Sketching for me was the most useful because it is just something you can work quickly. Written words are almost like sketching. It got that element in it of a sketchbook when you are jotting down ideas or something and it is that process of thought'.

The combination of sketching and words (S+W) was also recorded (Figure D:3).

> 'A lot of it began as written and spoken words within group discussion …or chatting to a tutor or a friend about the project. It was quite helpful. Then it spilled out into sketching, and almost a bond between sketching and written words'.

The participant described uses of computing [C] in a variety of ways:

> 'I used it for some research … Net research gave new directions. I think [the Internet] can be overused quite easily, because it is so user-friendly. You click at a button and you get all this research in front of you ... I used it more in the presentation of the whole project so it wasn't so much for the developing of ideas. It was the presentation of ideas, for example video. So it was really useful for communication of the result. So for me it wasn't a conceptual tool … But I used video and that was part of the conceptual phase'.

Only one modelling [M] event was recorded. However, in the interview this event was said to be only a vague attempt:

> 'I would have liked to use model-making because the end-design was a product ... but the project was also about the idea behind it ... I focused more on the idea'.

There was only one recording of "other tool" [O]. This was a sole visit to the library to do literature research.

> 'I was using computers for this and noted it down as research which spurred my conceptual design'

However, this event was better described as a word event [W] and transferred as such for the final analysis.

The participant had recorded landmark events, or "Aha!" moments and described them thus:

> 'The major ones were when I was exploring what product actually to look at to redesign. Everything else was quite gradual'.

> 'There were great moments [the participant points at markings made in the grid in the protocol in Week 3] when I sort of found the information I had gathered helped me to develop ideas and really think, "Yeah". I was working through the project in my head, thinking about it and from there it spread out into the sketchbook'.

Strengths and weaknesses of conceptual tools

The participant was specifically asked about the benefits and drawbacks of each conceptual tool used. From selecting key words, the response highlighted the following (Table D:1):

	Strengths	*Weaknesses*
Sketching	Effective visual communication. Something you can work quickly.	Going stale, or getting bogged down. Be too tunnel vision with it.
Words	To get other people's ideas and reactions at an early stage.	Group chats every week tend to throw you off your trail.
Computing	Graphics software for presentation and clarification of ideas.	Overuse of Internet because too easy to use.

Table D:1 Strengths and weaknesses of tools

Conclusion

Significantly, the Pilot showed that conceptual activity could be traced and recorded along the timeline in a way in which the Self-protocol did not seem particularly intrusive or interfering with uses of conceptual tools in the design process. The combination of the Self-analysis protocol and the Interview protocol revealed that there was generally a good correspondence between actual and described uses of conceptual tools that suggests that the two protocols together were a trustworthy (reliable) instrument for data gathering. Thus the recorded outcome was not just a set of numerical data but included rich verbal and non-verbal descriptions that provided authentic (valid) research material for meaningful interpretations.

From a methodological perspective, in designing the Pilot, I found similarities between research design and problem solving in design, problems that are often thought of as "ill-defined", or "ill-structured" (see Chapter *Methodology*). That is, how designers try to articulate something not yet fixed but becoming, through the process of iteration or trial and error, of roughs, refinements and detailing, in what Burns calls 'progressive focusing' (Burns 2000). In this, by asking straightforward questions such as, "how is it done?" or, "what is needed?" the Pilot design process was both flexible and pragmatic. But the approach to the Pilot design was also defined through the literature review, which, together with practical concerns, progressively turned the Pilot into a viable launcher for the multiple case study.

However, in interpreting the Pilot data, a few inconsistencies emerged in the interview. For example, was Internet search to be recorded as words [W] or computing [C]. As essentially an information medium it seemed to make sense to regard the use of the Internet as words [W]. More significant was the ambiguity about the role of computing [C] as a conceptual tool. Did the participant actually use computing for ideation? It was used for search on the Web but that was more aptly described as using words. Or, was the computer essentially used as a presentation tool for ideas? For example, on one hand, the participant said he used the computer 'but not in the conceptual phases'. On the other, 'I used video and that was part of the conceptual stage'.

According to the guidelines, uses of any digital medium were to be recorded as computing [C]. Yet the ensuing ambiguity exposed how verbalisation of the design process might fail to accurately describe what actually goes on in design work. That is, the interview revealed what is commonly experienced as the gap between what we do and what we say we do. Therefore, and although reflective practice may increase understanding of uses of conceptual tools (Schon 1985), it does not necessarily exclude uncertainty about how we ideate. Therefore, and although, say, drawings can be regarded as 'extrapolations of the traces we leave in the world' (Penone in Zegher 2004:101), we may well reflect or dwell upon what we have been doing without fully understand why. True, ambiguity might have been clarified by posing additional questions in a follow-up interview, but this would have happened at a later stage when there would have been an increased risk of post-rationalisation. Therefore, on balance, I would suggest that data inconsistencies should to be treated sensibly as "missing data" rather than "system failure" (see Chapter *Methodology*).

Arguably, then, the lack of consistency between the Self-report and the interview data had less to do with shortcomings in the design of the protocol, or in the interview technique. Rather, it exemplified the difficulty of keeping track of how we actually use the digital medium, notably when engaged in activities that might be referred to as *computer-aided ideation*, CAI, which is a new and rather unexplored field in both practice and research. This suggests how computing [C] is blurring the boundaries between conceptual and presentation tools.

From a usability point of view, the protocol, according to the participant, did not interrupt or interfere with the design process in any noticeable way. Also, it was apparent that the transferring of "raw" data from the Self-analysis protocol into charts in the Interview protocol enhanced transparency and understanding of uses of conceptual tools. Therefore, as it turned out, the Pilot fulfilled a learning objective too (see Chapter *Findings Y1 Students*).

In short, the Pilot provided an effective, non-obtrusive and meaningful data gathering technique that illuminated the impact of digital technology on uses of conceptual tools, particularly on uses of sketching. Moreover, the Pilot, in encouraging critical reflection, offered the participant insight into his own usage of conceptual tools, and therefore increased awareness of design ideation. In this, the Pilot turned out to be not just a method *about* research but also *for* design. Or, in the words of the participant: 'Wow! I didn't know I was going about conceptualising like that'.

E: FINDINGS AND DISCUSSION

Y1 Student group

Drawing with the first-year students

Concurrent with the pilot study (see Chapter *Pilot*), as part of my teaching on the BA design programme at Goldsmiths College, I ran a number of introductory drawing workshops for first-year students, in the autumn term of 2002. The workshops consisted of five sessions lasting three hours each, and were intended to give the students the opportunity, as novice designers, to refresh and expand on their pre-tertiary drawing skills and experiences. In this, the emphasis was on free form, which was appropriate for the overall aim of the first-year design programme that focused on "the Personal". Therefore, the students were encouraged to use a wide range of freehand drawing mediums, working both on their own and collaboratively, and both in and outside the studio.

For example, the students explored the dynamics of drawing by folding paper planes ("Do"), writing down the folding instructions ("Undo"), swapping instructions with each other, then reconstructing and testing the planes ("Redo"). They experienced the physicality of drawing on a large scale through "line marking" with tissue paper on the college sports ground, inspired by the Uffington White Horse (bronze-age hill carvings on the Berkshire Downs). They investigated the relationship between two- and three-dimensional representations through the combination of plasticine modelling and observational drawing.

I also thought of integrating freehand sketching with the computer induction programme for the first-year students, which was relevant to my research question on the impact of digital technology on conceptualisation. However, such potential collaboration across analogue and digital mediums did not materialise, which reflected the lack of digital resources and different approaches to teaching and learning among the teachers of the BA programme.

Although the outcomes were not formally assessed (peer-group learning), the workshops were part of the curriculum. Yet attendance was irregular with only around half of the students taking part in all five workshops (about ten per cent did not take part at all). There were many reasons for this. The student evaluation sheets revealed that half the participants thought the workshop content to be "interesting" whereas the other half marked it as "fairly interesting". Similarly, there was roughly a half/half split between those who would have liked to see more emphasis on formal drawing exercises, including technical drawing and life classes, and those who thought the content was too similar to a foundation course. This posed a dilemma both from a teaching and learning perspective (learning styles). Yet, it reflected the diverse backgrounds of the first-year students, which manifested itself not only in a wide range of existing drawing skills, but also in students' attitudes, needs and expectations of drawing.

The student feedback, however, showed that most participants were interested in some form of drawing activities as part of the course syllabus, which also echoed voices in industry bemoaning the dearth of drawing skills among young designers (see Chapter *Introduction*). However, freehand drawing, as distinct from technical drawing, has been an on-going controversial issue since the 1960s, when formal drawing classes often came to represent inhibition, rather than creativity. Or, dissatisfaction with art education in general with its criticised 'low level of intellectual discourse and self-understanding' (Walker 1998:233). This suggests that the way teaching and learning drawing is structured and contextualised influences both the practice and status of drawing in design schools. Or, *What is sketching for?*

Ideation workshops

Reflecting on the outcomes of the drawing workshops and the findings of the pilot study (see Chapter *Pilot*), and inspired by the literature on sketching (see Chapter *Literature review*), I decided to widen the drawing agenda for the first-year students in the following spring term. Therefore, I situated drawing-for-design in the context of design ideation. That is, the workshop focus was on conceptualisation, or ways designers generate, develop and communicate ideas, with the proposition that sketching was only one of many conceptual tools available to the designer. Moreover, the proposition reflected how ideation has long been central to design.

> 'Design is seen as a matter of generating ideas then testing them, modifying and improving where necessary. So, design education becomes a matter of learning how to generate ideas and learning how to test them, thus solving a lot of problems as to the shape of the design process itself' (Broadbent, in Fowles 1979:15).

Therefore, I proposed to the students to explore ideas through "sketching by other means", in what I call *sketcherly ways of designing* (see Chapter *Literature review*). For this purpose, I designed and carried out a series of ideation workshops, which had three aims: First, to encourage the students to generate and develop ideas through the exploration of conceptual tools (*learning objective*). Second, to test how effective the workshop format was for ideation activities and to what extent it could accommodate different learning styles (*teaching objective*). Third, to find out how the outcomes of the workshops might illuminate the research question on the impact of digital technology on uses of conceptual tools (*research objective*).

There were four workshops, each with a different ideation theme inspired by Fashion, Architecture, Graphic and Product design, which reflected the non-specialist, multidisciplinary design curriculum at Goldsmiths. Moreover, the chosen themes corresponded largely to the domains of the multiple case study (see Chapter *Findings Y2 students and practitioners*). The ideation tasks, then, were to generate and present ideas for:

- *a fashion accessory* (Fashion)
- *a single studio space* occupying no more than a square metre floor space (Architecture)
- *a campaign-logo* for "Save-the Ozone-layer" (Graphics)
- *a walking aid* for disabled people (Product)

Methodological strategy

To meet the objectives of the workshops, the participants were asked to record their uses of conceptual tools in a protocol, or self-report (reflection-in-action), combined with a questionnaire (reflection-on-action), which was an adaptation of the approach in the pilot study (see Chapter *Pilot*). Thus it was intended that the participants would learn about their own ideation processes through critical reflection.

But although the aim of the self-report was similar to that of the pilot self-analysis protocol, that is, a means of capturing uses of conceptual tools, the actual design of the report differed somewhat. This was because each workshop was an *intensive* ideation activity allocated a short, pre-set time, in contrast to the pilot project, which spanned several weeks. As a result, the self-report was laid out in a grid of nine numbered squares with each square representing fifteen minutes of ideation activity (Figure E:1; for the full protocol, see *Appendix E:1*). Thus the protocol covered two hours and fifteen minutes of conceptual activity, which was the maximum time set aside for each ideation assignment. The choice of a coding unit of fifteen minutes was thought to be neither too short nor too long. It also made up an effective graphic grid. However, the recording of conceptual tools was not a stopwatch activity, as might have been the case in an experiment under controlled conditions (see Chapter *Methodology*).

Consequently, as I circulated among the participants during the workshops ("walk-about observations"), I noticed that the recording of conceptual activities took place at different intervals. That is, most participants marked their self-reports more or less every fifteen minutes. But there were a few who did the recording in the middle or towards the end of the assignment, particularly when they used a single tool over a longer period. Given the relative short time set aside for each assignment, however, I judged there was little risk in participants recording the "wrong" information regarding their uses of conceptual tools, either deliberately ("obstructing behaviour") or through forgetfulness ("post-rationalisation"). However, this assessment was necessarily based on trust between researcher and participants. Trustworthiness, then, effectively amounted to a reliability test of the chosen data gathering technique, which was also reflected in the fact that only two self-reports were rejected for being incomplete.

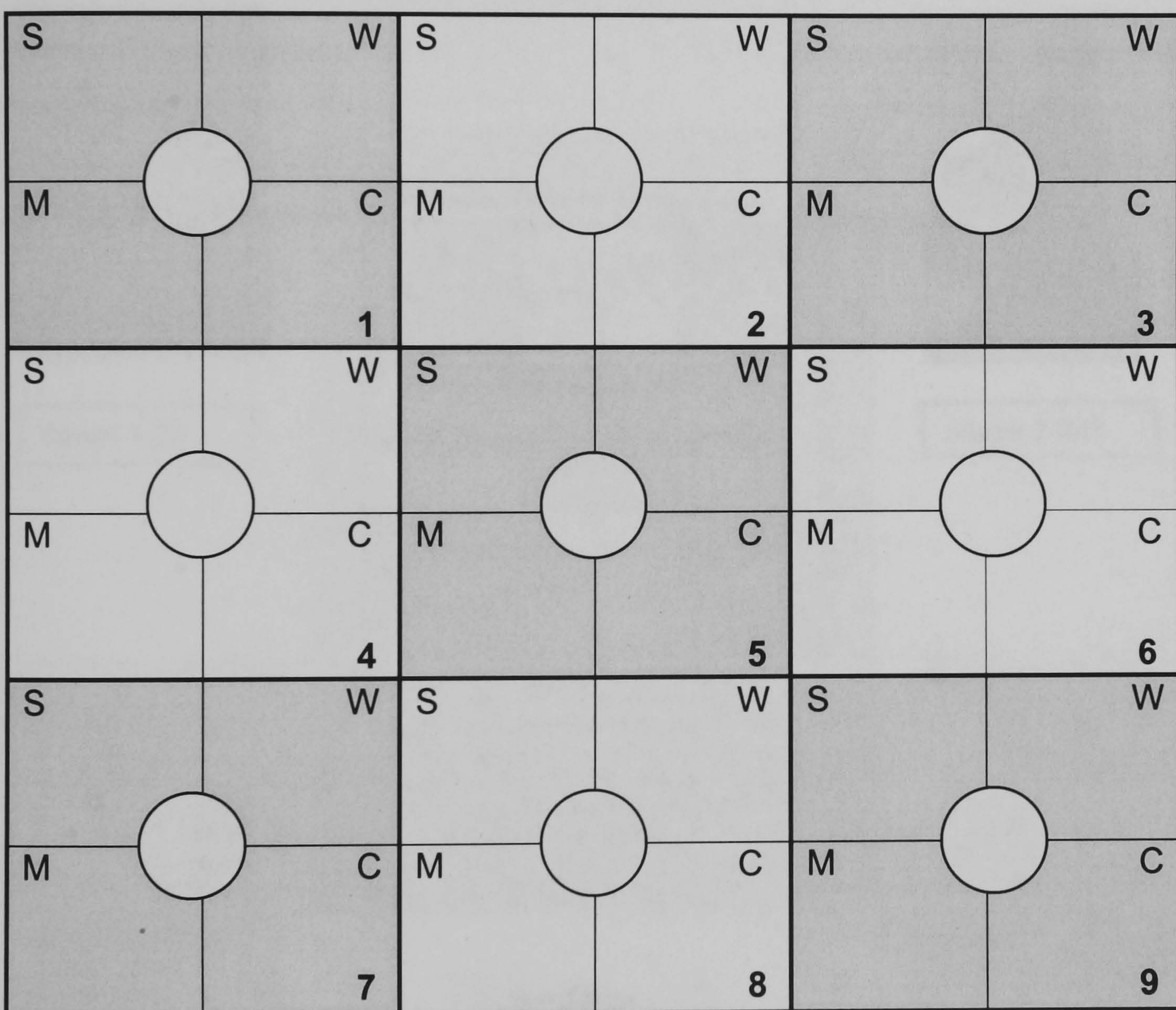
However, the instructions for recording uses of conceptual tools were the same as for the Pilot, and were included in the Guidelines for the self-report (Figure D:2). Similarly, the coding information in each square was the same. That is, each square was a time- and event-based coding unit for the four categories of conceptual tools: sketching [S], words [W], modelling [M] and, computing [C]. The participants could also indicate the reason(s) for the tool(s) chosen in the inner circle of each square (Figure E:1).

Therefore, any freehand drawing including doodling were considered to be sketching [S]. Words [W] meant both spoken and written words. Library and Internet searches also counted as words. Any activity involving direct manipulation of materials, say card, metal, cloth or plasticine, was categorised as modelling [M]. Any digital work, including scanned and digitally manipulated freehand sketches or ready-made images, was classified as computing [C]. Again, and similar to the Pilot, a footnote apparatus was added to the self-report, in which the participant could add conceptual tools other than [S], [W], [M] and [C], or any other information the participant saw fit (Figure E:1).

The relatively large number of participants (33 students producing 82 individual reports, see below *Administration*), together with the intensive Y1 study schedule, meant that there was not sufficient time to carry out individual interviews. However, it was important to capture the thoughts on ideation also after the events (reflection-on-action), not as post-rationalisation but as an opportunity for the students to reflect and comment on the workshop activity (*learning* *objective*). Also, the questionnaire was thought to illuminate learning styles (*teaching objective*) as well as providing additional research material (*research objective*).

Therefore, the self-report included a one-page structured questionnaire, which each participant completed at the end of the assignment. The questions, however, were open-ended which resulted in a range of answers, from just a few words to lengthy sentences. Occasionally, students left a blank line. Nevertheless the responses reflected the thoughts of the participants *immediately* at the end of each ideation task.

REFLECTION-IN-ACTION
Each numbered square (1-9) represents one 15-minute session worked.



Footnotes: Using the square numbers as reference (1-9), add other tools, special circumstances or "landmark events" ("Aha!") you experienced during the sessions worked.

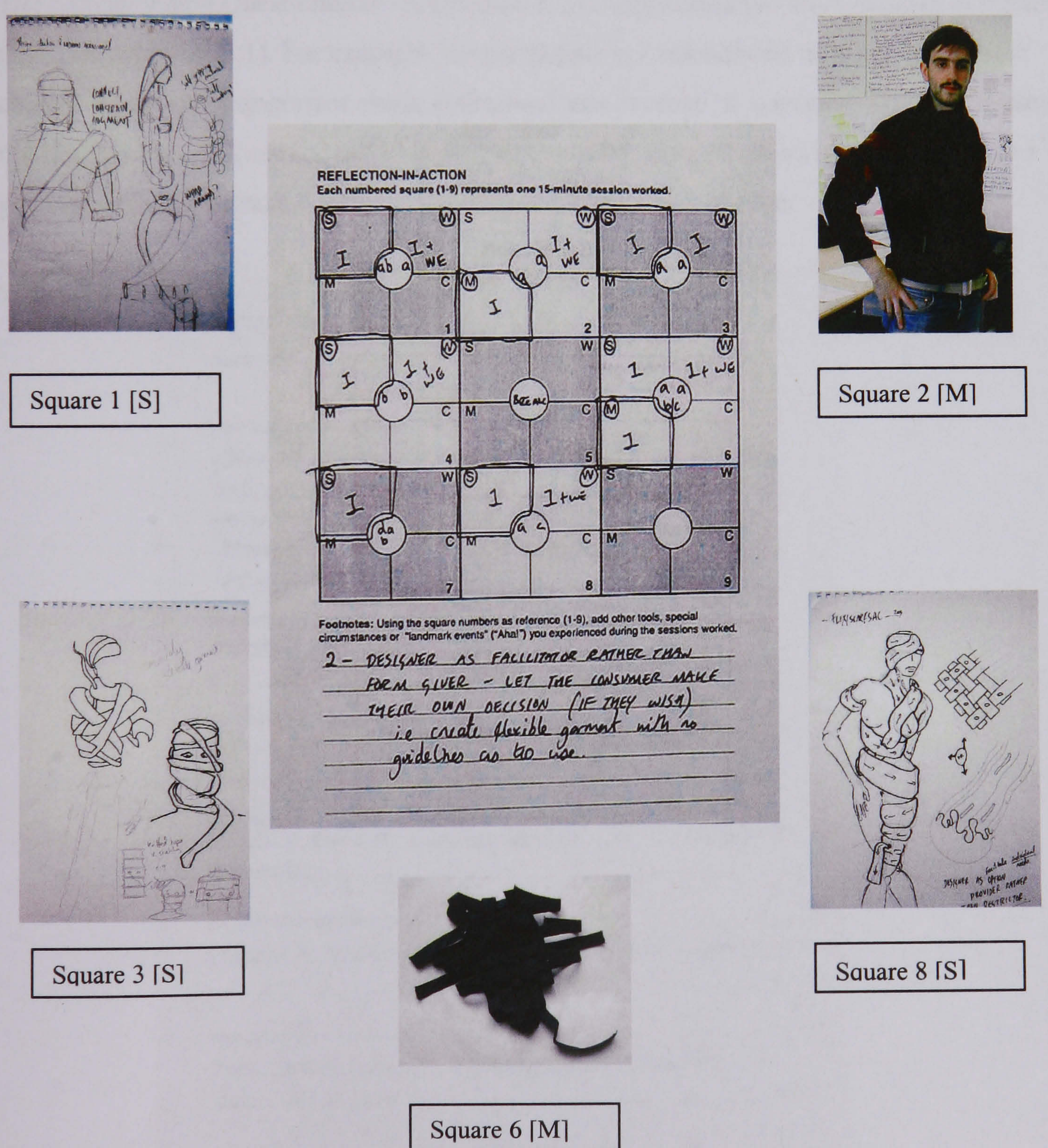
....

....

....

Fig. E:1 Ideation Self-report

The wording of each workshop brief followed a format that was deliberately kept very short and open-ended to encourage the participants to experiment and take creative risks (discovery method). For example, 'Generate and present ideas for a *fashion accessory*, in any style or material using any conceptual tool(s) such as sketch modelling, computer graphics, annotated sketches, words etc.' (Fashion Ideation Workshop; for all assignment briefs, see *Appendix E:3*). The task was then to trace and record uses of conceptual tools used, as exemplified below (Illustration E:1).



Ill. E:1: Tool Tracking (Fashion)

Although the research objective was not to look for links between conceptual tools and ideas in terms of volume or quality, the illustration (Ill. E:1) exemplifies what kind of ideation outcomes could be achieved with various conceptual tools. Thus the participant got started, in Square One, with sketching [S] and words [W], as annotated sketch and talking to others (marked as "I" and "I + We" respectively). Then, in Square Two, the idea was actually tested with a found piece of fabric ("body wrap"), which was recorded as sketch modelling [M]. Thereafter, in Square Three and Four, there were more sketching [S], and words [W]. After a coffee break [Square Five], there followed more sketch modelling [M], this time using different fabric [Square Six]. The assignment was rounded up [Square Seven and Eight] with sketching [S], and words [W].

The corresponding Questionnaire (Illustration E:2) corroborated the recorded data in the self-report (Illustration E:1). For example, the participant got started with drawing, which was considered the most important single conceptual tool because 'it is an easy way to communicate my ideas to myself' (marked as "I" in Square One). But also, 'it offers infinite flexibility + possibilities'. In contrast, CAD was not used because of lack of time.

REFLECTION-ON-ACTION

QUESTIONS:

What tool(s) did you get started with, and why?

DRAWING, BECAUSE IT IS AN EASY WAY TO COMMUNICATE MY IDEAS TO MYSELF.

What tool did you find the most important, and why?

DRAWING, → IT OFFERS INFINATE FLEXIBILITY + POSSIBILITIES

What tool(s) did you use because of personal preference?

ELASTICS, AS IT IS STRETCHY AND MALLEABLE

What tool(s) did you not use because of lack of skill or practice?

CAD, NO TIME OR FACILLITIES REALLY

What tool(s) did you find the least appropriate for this assignment, and why?

CLAY. I THOUGHT I WOULD NEED IT BUT IT PROVED POINTLESS

How did you communicate your ideas ("I" and/or "We")?

THROUGH DRAWING, EXAMPLES + WRITING + SPEECH.

What did you learn from this assignment?

THAT IDEAS CAN BE ACTUALISED QUICKER THAN ONE WOULD EXPECT

Ill. E:2: Questionnaire (Fashion)

Administration

The participant students had open access to all college facilities, which meant that they effectively could choose where to work and by which means. But also, the participants could decide how much time and effort they wanted to spend on each project within the total time allocated (breaks were allowed). That is, the workshops were characterised as self-directed study.

Each workshop started with an introduction, and ended with a presentation in the general studio. In between, the participants were free to use all the college facilities, including metal, wood, and textile workshops and computer room, all in close proximity to each other, and within one building on campus. Thus, in my combined role of tutor and researcher, I met the participants as a group only at the beginning and at the end of each workshop. However, as I circulated between the various locations open to the students, I could observe how the workshop activities evolved. In this, however, I kept a low profile to minimise any influence I might have on the ideation activities. This was important because I knew the participants from the drawing workshops in the previous term and therefore the participants might perceive from my presence that there was a "hidden" drawing agenda in the ideation workshops. It was therefore crucial to allow the students as much conceptual freedom as possible in the teaching and learning environment, giving them what might be called "a passport to ideate". The emphasis on conceptual freedom was also a reason for not assessing the idea outcomes as such. This was important because I was looking for the impact of digital technology on uses of conceptual tools, rather than the impact on the volume or quality of ideas.

Therefore the freedom to choose "where and how" to ideate was essential. This made further sense since the participants had had induction to computer graphics, the handling of workshop tools and materials, and the use of the Internet and the library. However, it was left to each student to make use of the open-access facilities. As a result, the students chose to work in various locations, including the general studio, throughout their assignments. This meant that students sometimes shared facilities or tools, for example, spontaneously teaming up in the workshops, or at a computer station. Similarly, there were students who gathered in the college café, in what might be described as brainstorming activity ("chat room") or, occasionally, worked from home, in nearby halls of residence. Thus the diversity of ways and places illustrates how ideation occurred in a *distributed learning space* both inside and outside the studio. In this, a combination of reflective practice and peer-group learning built the teaching and learning environment under trustworthy, non-controlled conditions.

At the end of each assignment, and after the questionnaire had been answered, all the participants gathered in the general studio to present their ideation outcomes to the group. This was an informal, non-assessed roundtable event lasting about twenty minutes whereby the participants presented and discussed their ideas using a variety of verbal and non-verbal expressions of their choice such as spoken and written words, freehand sketches, sketch models and computer generated images (peer-group learning).

Participants

33 (of the 44) first-year students attended at least one of the four design ideation workshops in the spring term of 2003 (for a list of the participants, see Appendix E:2). As a result a total of 82 project assignments were completed and returned for inclusion in the case study.

Distribution of assignments by domain:

Domain	*Number of assignments completed*
Fashion	28
Architecture	21
Graphics	21
Product	12
Total assignments	*82*

Number of assignments per student	*Number of students*
All four assignments	4
Three assignments	13
Two assignments	10
One assignment	6
Total students	*33*

Of the 33 students, 21 were female and 12 male (for list of participants, see *Appendix E:2*).

The workshops were aimed at all the first-year students. However, and although a register of attendance was kept, there were no sanctions for non-attendance. That is, full engagement in the workshops was thought sufficient for achieving the learning objective (peer-group learning).

The drawback with this arrangement was poor attendance. That is, numbers decreased from 28 students in the first project (Fashion) to 12 in the last (Product). The decline may suggest that students were reluctant to take part in the workshops, and therefore the protocol study, in the first place, or they grew tired of it. This is fair criticism, but compulsory attendance might have had a negative influence on students' motivation and behaviour, and therefore on learning and research outcomes (reliability), because, after all, both depended on the participant students' goodwill and therefore trust between participants and the researcher. True, fluctuating attendance made comparison between the four workshops difficult (*research objective*). However, and although not a survey of statistical significance, the self-report protocols were sufficiently large both in numbers and richness of data to illuminate uses of conceptual tools as part of the overall research study.

Self-report usability

The quotes below are from the questionnaires and illustrate participants' uses of conceptual tools as well as their thoughts on the ideation projects and the method of self-reporting.

The overall usability and usefulness of self-reporting was generally acknowledged by the participants with only one participant finding the self-report intrusive to the ideation process, but then only partly (Student 9).

> 'I find it awkward to reflect every 15 minute session though I find it useful at times' (Questionnaire Student 9).

> '[I learned] to note down everything that comes into my head as it may at some point come useful' (Questionnaire Student 22).

> '[I saw] how others approach work and idea generation in the initial stage of a project. [It gave] a more detailed realisation of how I do and should work' (Questionnaire Student 21).

> '[I learned] the importance of experimenting and playing with materials' (Questionnaire Student 19).

Analytical technique

The open access and self-directed learning environment meant that the students' self-recording of uses of conceptual tools could not be observed in a systematic or controlled way, as might be the case in an experiment under laboratory-like conditions. Moreover, the research material from the protocols, questionnaires and presentations were not sample data of statistical significance (quantitative method), but rich descriptions (qualitative method). Also, the subjective nature of individual ideation processes meant that the interpretation of the findings was influenced by the post-modern qualitative research agenda, which emphasises qualities such as trustworthiness and authenticity, rather than the traditional criteria of reliability, validity and generalisability (Guba and Lincoln 1989, see also Chapter *Methodology*).

From this perspective, the participants were considered trustworthy and their recordings credible and therefore the protocol data gave a fairly authentic picture of uses of conceptual tools throughout the assignments (situated research). Accordingly, the analytical technique, based on self-reporting, may be described as protocol analysis in which the protocols and questionnaires both constituted primary data. But the technique may also be thought of as a cross-case synthesis in which each workshop is considered an individual case. That is, a research synthesis that may amount to aggregating findings across a series of individual cases (Yin 2003).

To illuminate uses of conceptual tools in the four assignments, and how they might differ from each other, averages of tool usage were calculated. This was simply done by adding total numbers of single tool usage from the self-report data divided by total numbers of assignments, and for each ideation assignment. The averages, then, made comparison possible between the distribution of conceptual tools according to tool category, that is, Sketching [S], Words [W], Modelling [M], and Computing [C] across the four project domains, that is, Fashion [FA], Architecture [AR], Graphics [GR], and Product [PR]. The averages were also used for a time series analysis, or 'an analysis of the patterning of data over time' (Robson 1993:383). That is, the frequency of uses of the conceptual tool was tracked along the timeline ("time trace") to see how the different tool categories were distributed over time (see findings below). Therefore, the analysis focused on uses of tools over time and by domain, rather than the quantity or quality of ideas. In addition, a tool-by-gender analysis was conducted to see if there might be any gender bias in tool usage.

Findings: Tools by domain

Raw data from the self-reports were transferred into tables and charts using dedicated software. Thus table E:1 represents the total numbers of conceptual tools (tool events) as recorded in the self-reports by project domain, that is, Fashion [FA], Architecture [AR], Graphics [GR] and Product [PR]. For example, the total number of sketching [S] events in the fashion project [FA] was 116. Of these, 39 were events in which sketching [S] was used as an essential conceptual tool (figures in bracket). Averages (Av) were then calculated (essential tools in bracket). Thus, the sketching tool [S] was used 4.1 times on average (Av) in the fashion project [FA] or, 1.4 when considered an essential conceptual tool. A tool, according to the guidelines, was considered essential if the participants thought they could not do without that particular tool.

All 1-33	FA	Av	AR	Av	GR	Av	PR	Av	Total
SKETCH	116 (39)	4.1 (1.4)	110 (61)	5.2 (2.9)	79 (36)	3.8 (1.7)	67 (36)	5.6 (3.0)	372 (172)
WORD	87 (36)	3.1 (1.3)	68 (31)	3.2 (1.5)	63 (23)	3.0 (1.1)	52 (26)	4.3 (2.2)	270 (116)
MODEL	81 (32)	2.9 (1.1)	44 (19)	2.1 (0.9)	13 (6)	0.6 (0.3)	7 (2)	0.6 (0.2)	145 (59)
COMP	8 (6)	0.3 (0.2)	21 (10)	1.0 (0.5)	70 (29)	3.3 (1.4)	13 (10)	1.1 (0.8)	112 (55)

Table E:1 Tools by domain

The figures in Table E:1 were converted into bar charts in Figures E:2 and E:3.

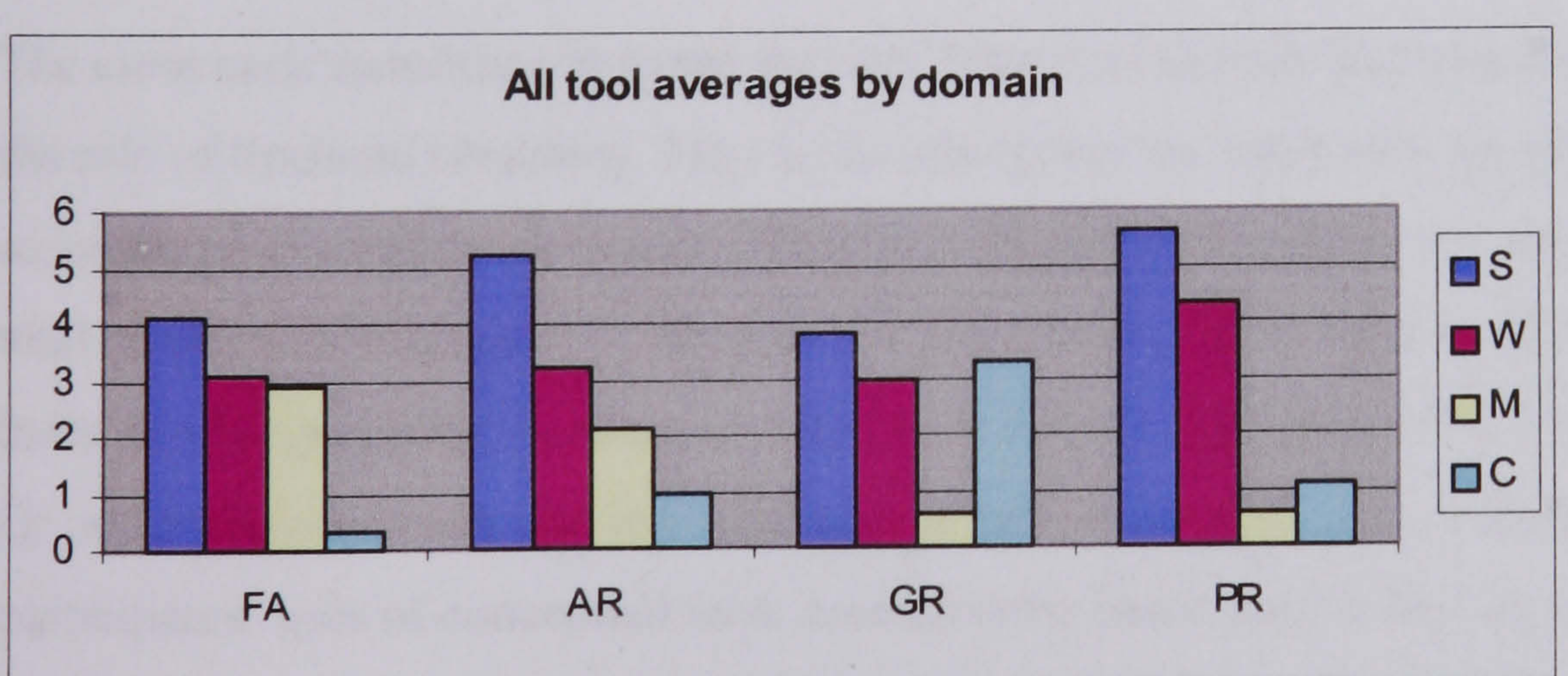


Fig. E:2 Tools by domain

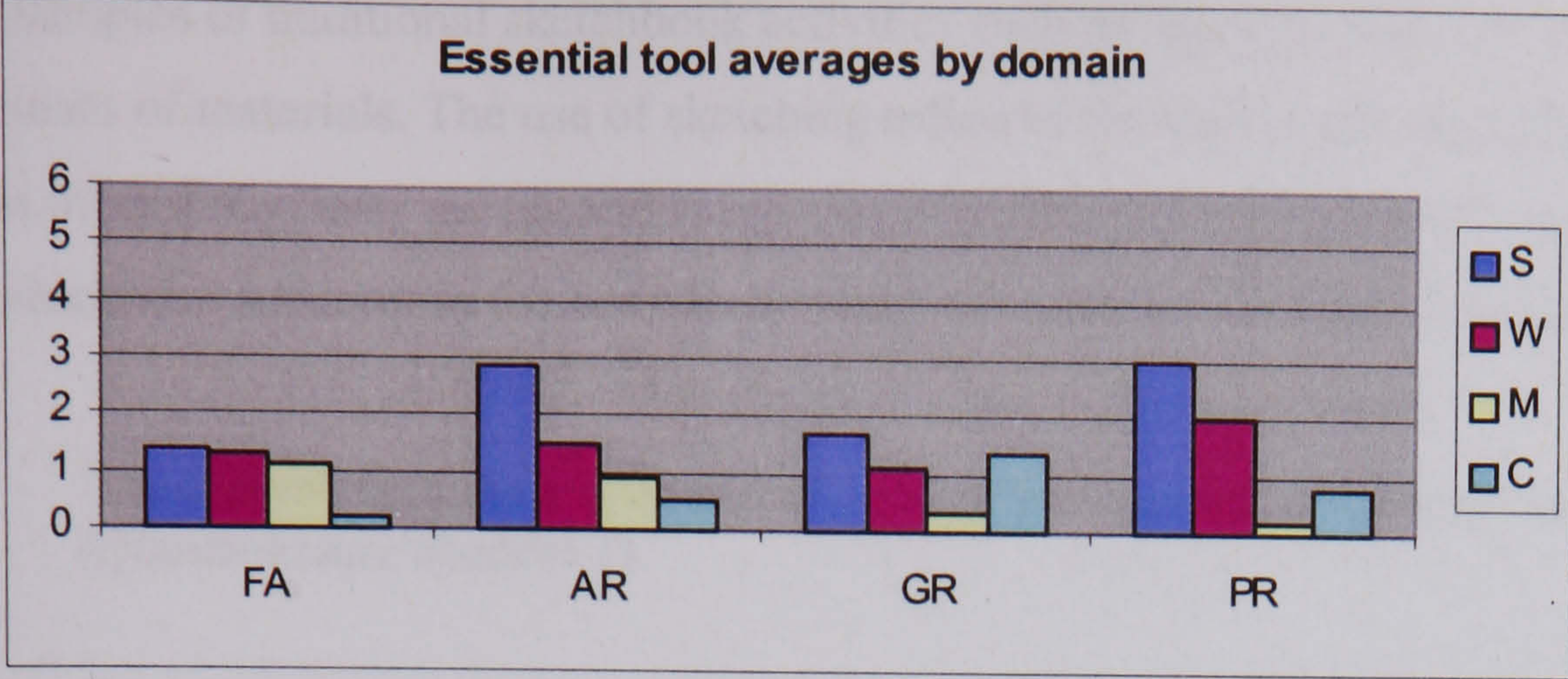


Fig. E:3 Tools by domain

Most used single tools

Sketching [S] emerged as the most used single conceptual tool in all the assignments, across the domains. Written and spoken words [W] were the second most used tool in all the workshops but for the graphics assignment [GR], in which computing [C] was the second most used ideation tool. The modelling tool [M] was the third most used in the fashion [FA] and architecture [AR] projects, whereas computing [C] was the third most used in the product design [PR] project. These patterns were repeated in the recordings of essential tools. No other tools than sketching [S], words [W], modelling [M] and Computing [C] were recorded by the participants, which suggests that the choice of tools offered in the protocol was sufficient to cover conceptual activities among first-year students. (This was also the case with the second-year student in the pilot study, see Chapter *Pilot*).

The close correspondence between the user pattern of all tools and essential tools emphasised the role of freehand sketching. That is, sketching was the most used single tool whether recorded as an essential or non-essential tool. But although there were big differences in the total numbers of tools used by domain, the proportion (ratio) between all tools and essential tools was fairly similar, or ratios of 0.46 [S], 0.43 [W], 0.41 [M] and 0.49 [C] (Table E:1:Total). Or put differently, each tool was used almost half of the time as an essential tool. Yet, the participants' uses of conceptual tools seemed to be based largely on trial-and-error where they experienced ideation as an explorative process. This further suggests that the teaching and learning style of the workshops resembled the discovery method.

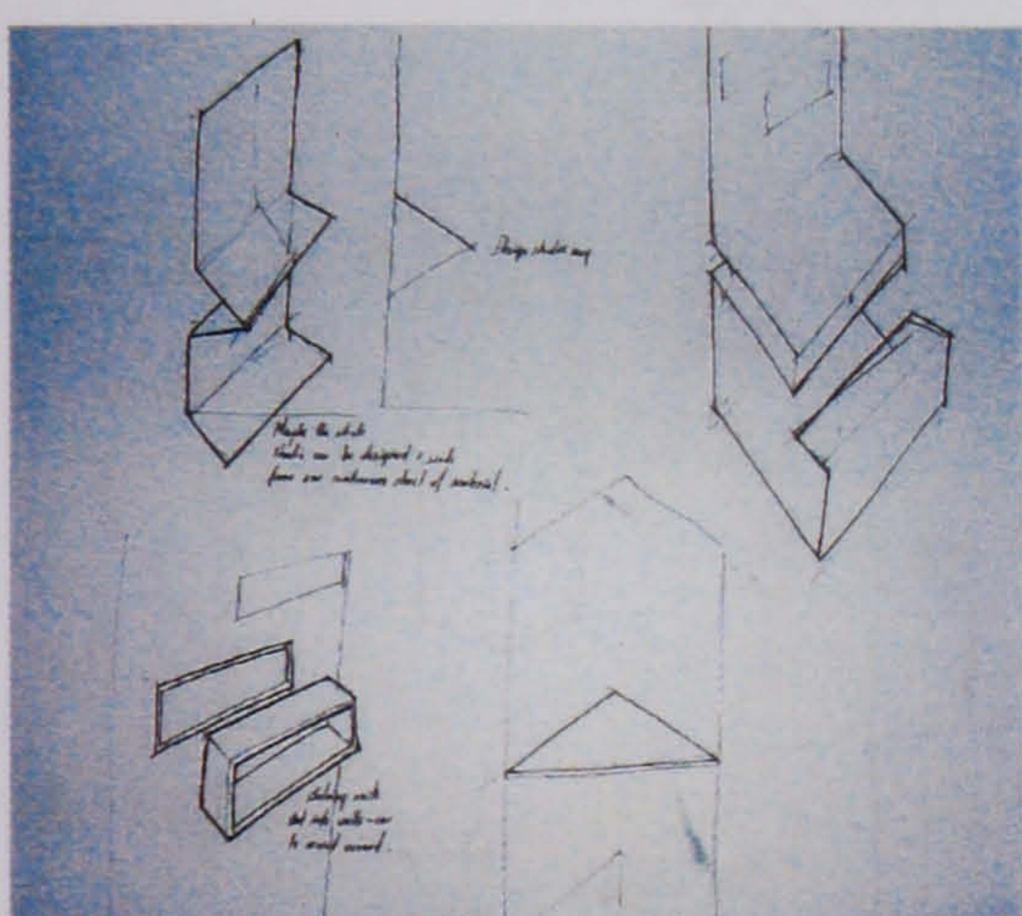
Sketching

Sketching [S] came out top in all four domains, and both in terms of all tools and essential tools (Illustration E:3, and Illustration E:4). In this, sketching included the annotated sketch and many examples of traditional sketchbook activities such as research notes, cut outs and collected pieces of materials. The use of sketching reflected the traditional strengths of the medium, such as immediacy, easy access and speed (see Chapter *Methodology* and Chapter *Literature review*), which was apparent in the comments made by students in the questionnaires.

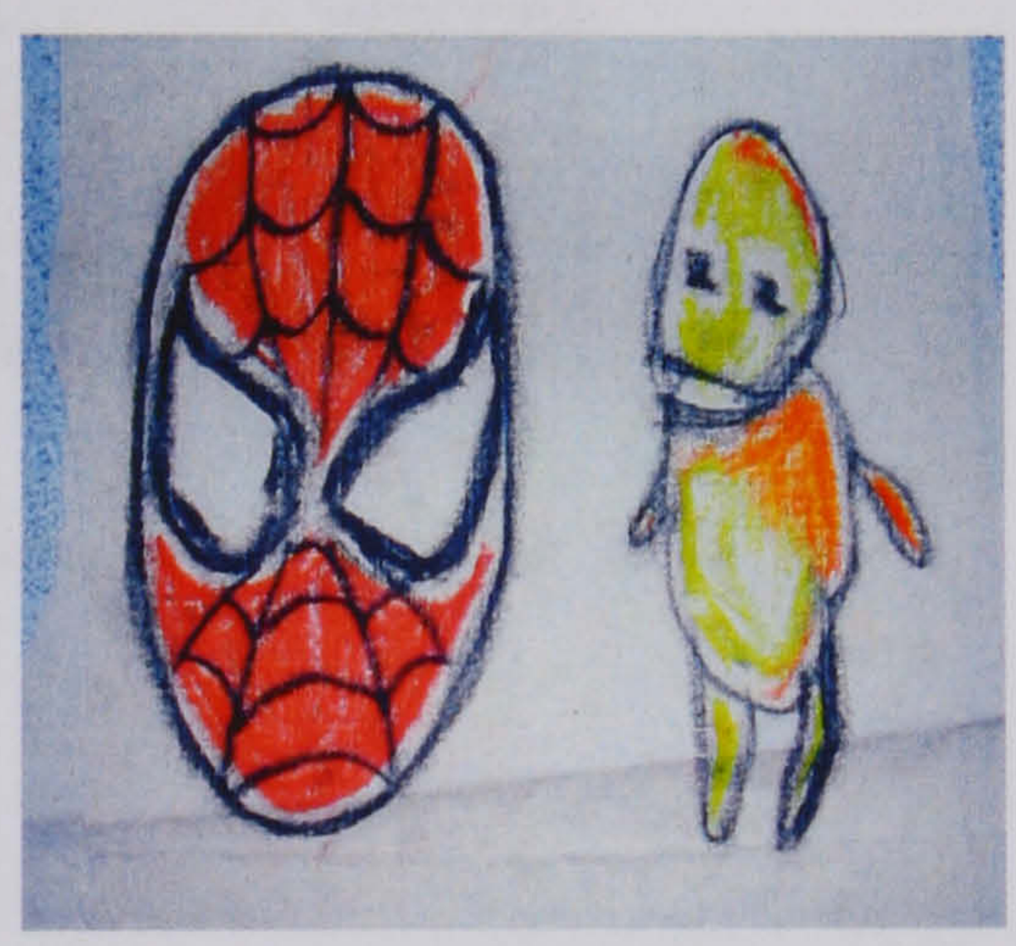
> 'Quick sketching done with pen and paper allowed me to come up with loads of ideas' (Questionnaire Student 1).

> 'Sketching – I find it frees up my ideas' (Questionnaire Student 19).

> 'I feel most comfortable with pencils. It lets my head/body move freely when I think' (Questionnaire Student 26).



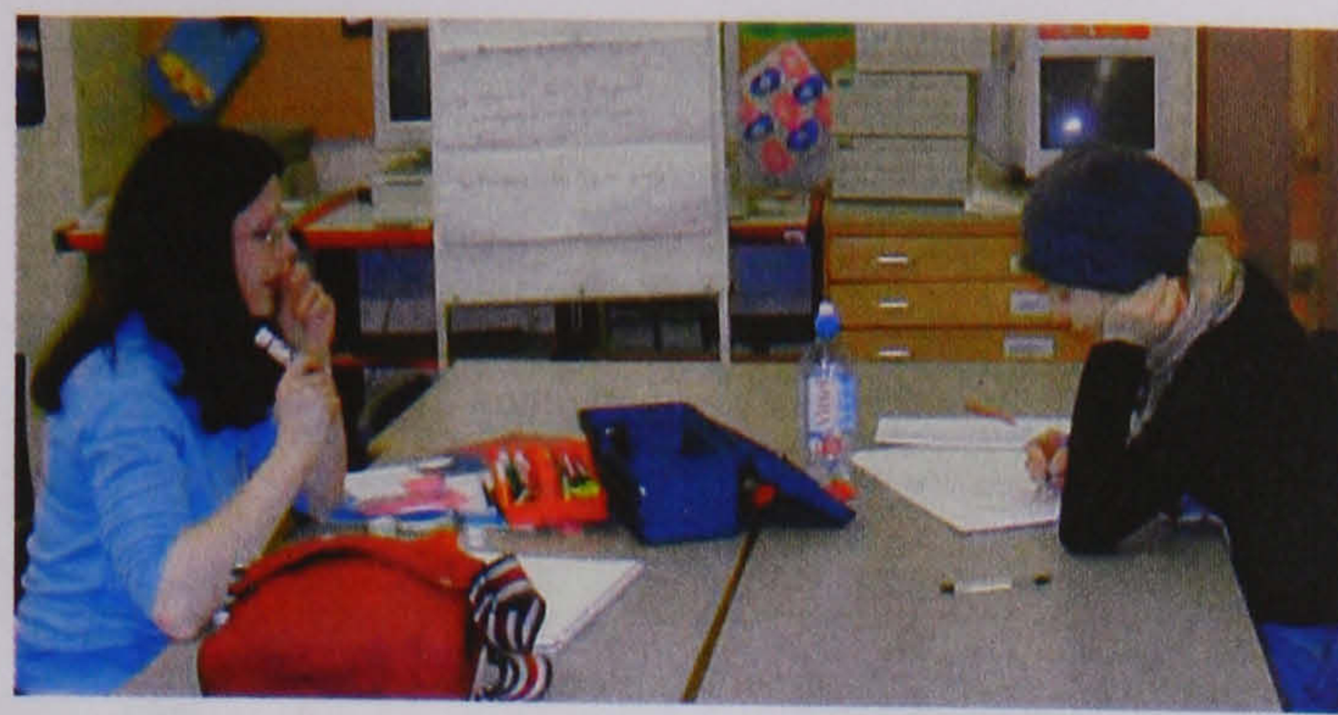
Ill. E:3 Sketching on A4 paper (AR)



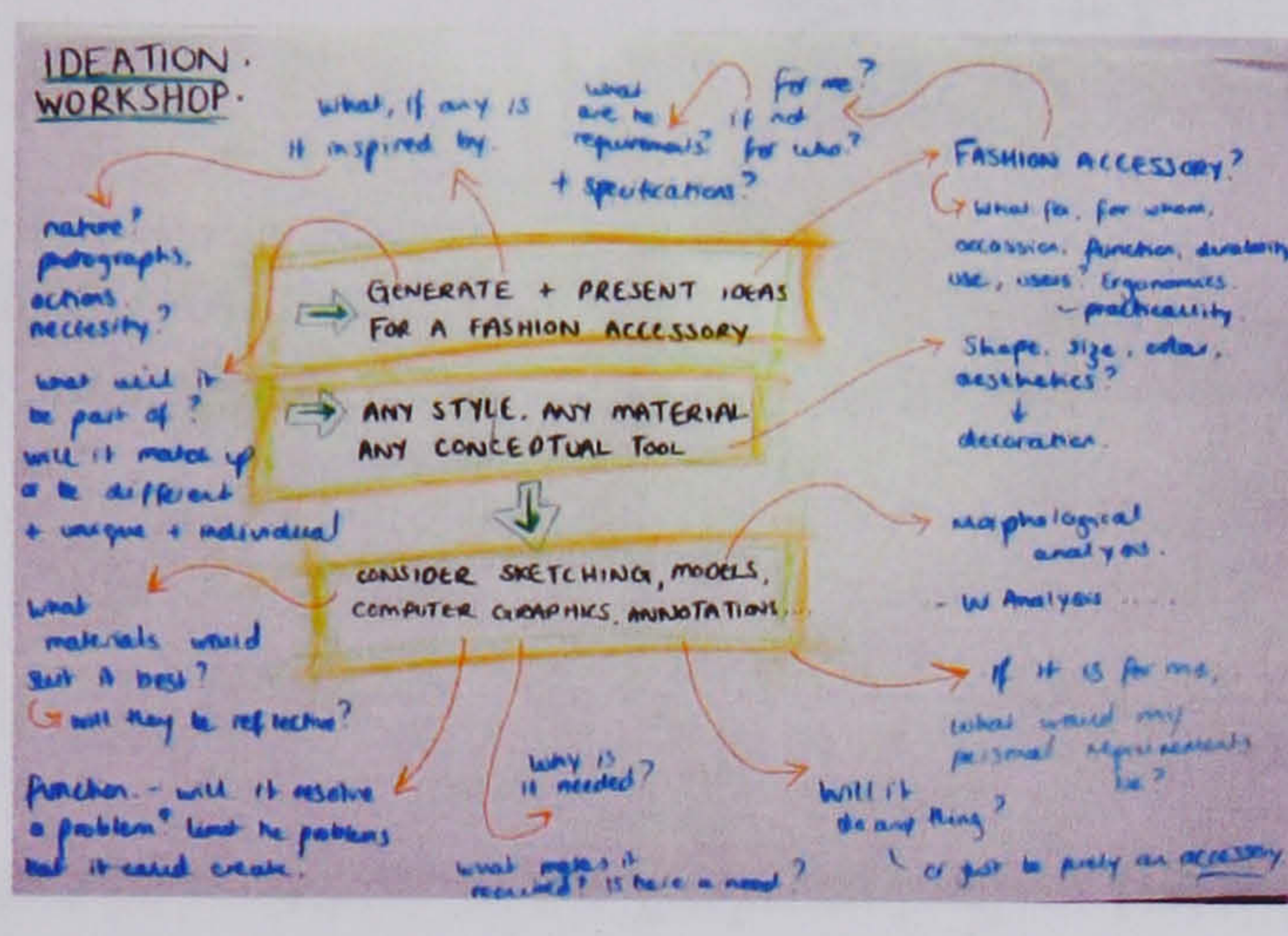
Ill. E:4 Sketching on cloth (FA)

Words

The emergence of words [W], as the second most used single tool but for the graphics project [GR], illuminated the role of natural language in ideation as well as the social aspect of designing. For example, the participants verbalised their ideas (chatting and brainstorming) in spontaneous group situations (Illustration E:5) as well as using words in a wide variety of diagrams (mind mapping) and annotated sketches (Illustration E:6). However, the strength of verbalisation [W] in the ideation process, which, on reflection, makes common sense, has been commented on less in the literature (see below *Discussion*).



Ill. E:5: Words (Brainstorming)



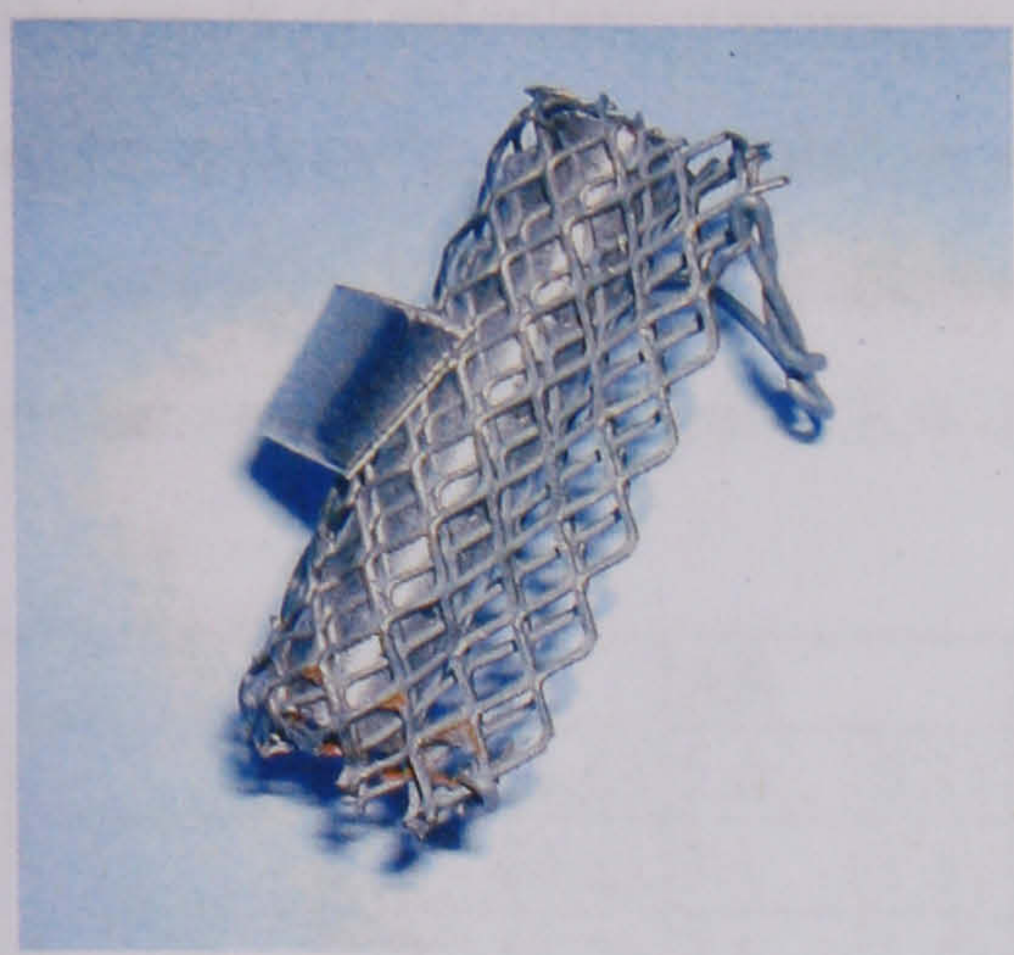
Ill. E:6: Words: Mind mapping, A3 paper (FA)

Modelling

Modelling [M] was particularly strong in the fashion [FA] and architecture [AR] assignments (Illustration E:7 and Illustration E:8). This suggests that direct manipulation of material (cloth, metal, card etc.) was an essential activity when generating ideas for a physical object, which had strong tactile and self-referential elements. For example, students used sketch modelling to generate and develop ideas for fashion accessories to be attached directly to the body, such as bracelets or hats [FA]. Or they knocked together little sketch models of single studio spaces [AR]. Even in the graphics project [GR] students chose to ideate in the sketch-modelling mode creating 3-D logos, which suggests that the open, non-prescriptive learning context encouraged experimentation where students went beyond the flat medium of conventional graphics.

> 'Sketch modelling showed production potential and reality' (Questionnaire Student 5)

> '[Most important tool was] sketch modelling; materials helped to create ideas by their limitations' (Questionnaire Student 4).



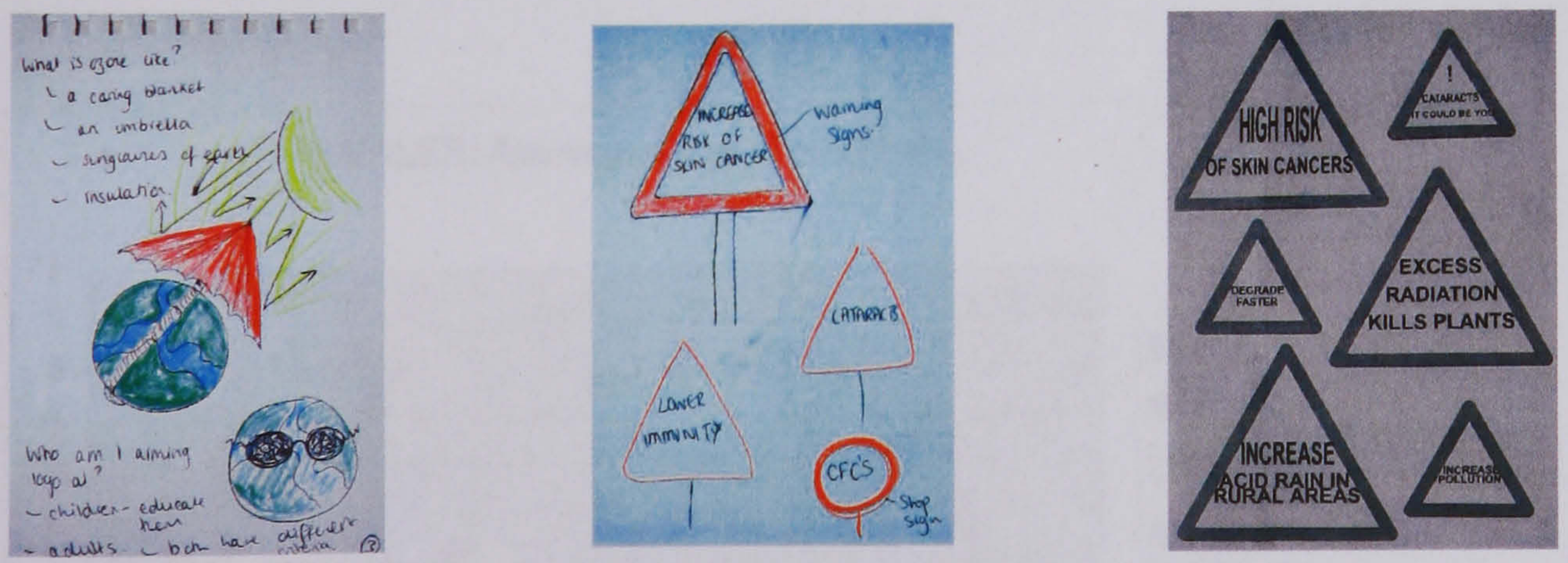
Ill. E:7: Sketch modelling (FA)
Finger ring (wire and steel sheet)

Ill. E:8: Sketch modelling (AR)
Card, foam, wire and plastic

Computing

Computing [C] was used particularly in the graphics project [GR] (second most used single tool), and particularly for text and image manipulation that at times resembled collage-making (Illustration E:9). In contrast, it was hardly used in the fashion project [FA]. However, a design tutor told me that in her teaching experience, since the introduction of digital technology, the graphically inclined textile design student used the computer for ideation too.

'[I used] computer because I wanted to manipulate an image' (Questionnaire Student 9).



Ill. E:9: Analogue/digital sketch development. From left to right (GR).

Tools by gender

The result of calculating averages of uses of ideation tools according to gender, both as "all tools" and as "essential tools", is shown in Tables E:2 and E:3, for female and male students respectively. Numbers in bracket represent "essential tools". The corresponding figures in chart format are shown in Figures E:4, E:5, E:6 and E:7.

	FA	AR	GR	PR
S	4.9 (1.6)	5.6 (3.1)	3.9 (2.1)	6.3 (3.6)
W	2.8 (0.8)	3.1 (1.5)	2.6 (1.3)	4.6 (2.4)
M	3.0 (1.2)	2.6 (1.4)	0.7 (0.4)	0.8 (0.1)
C	0.1 (0.1)	0.7 (0.1)	3.9 (1.4)	0.3 (0.1)

Table E:2 Females: tool averages

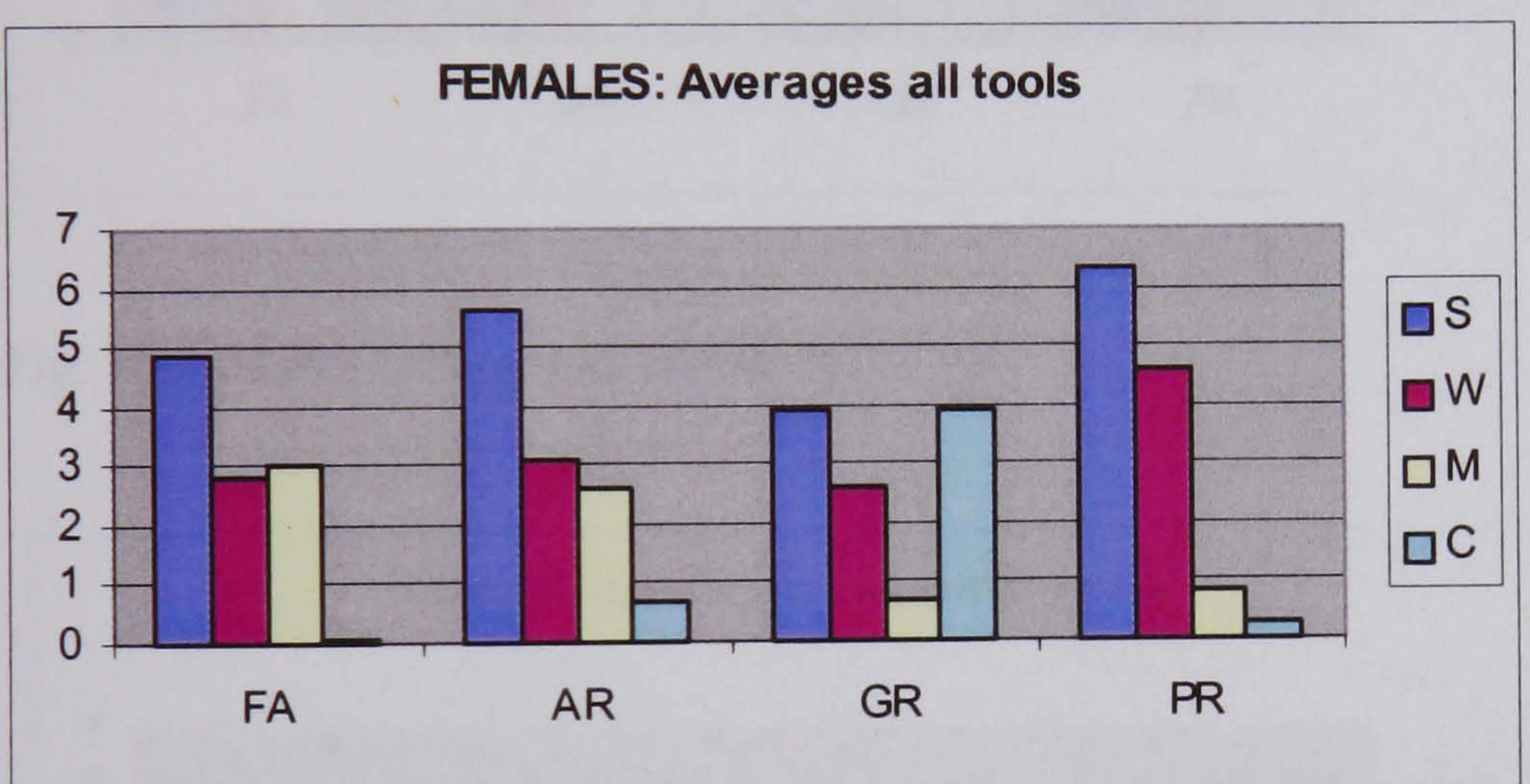


Fig. E:4 Females: Averages all tools

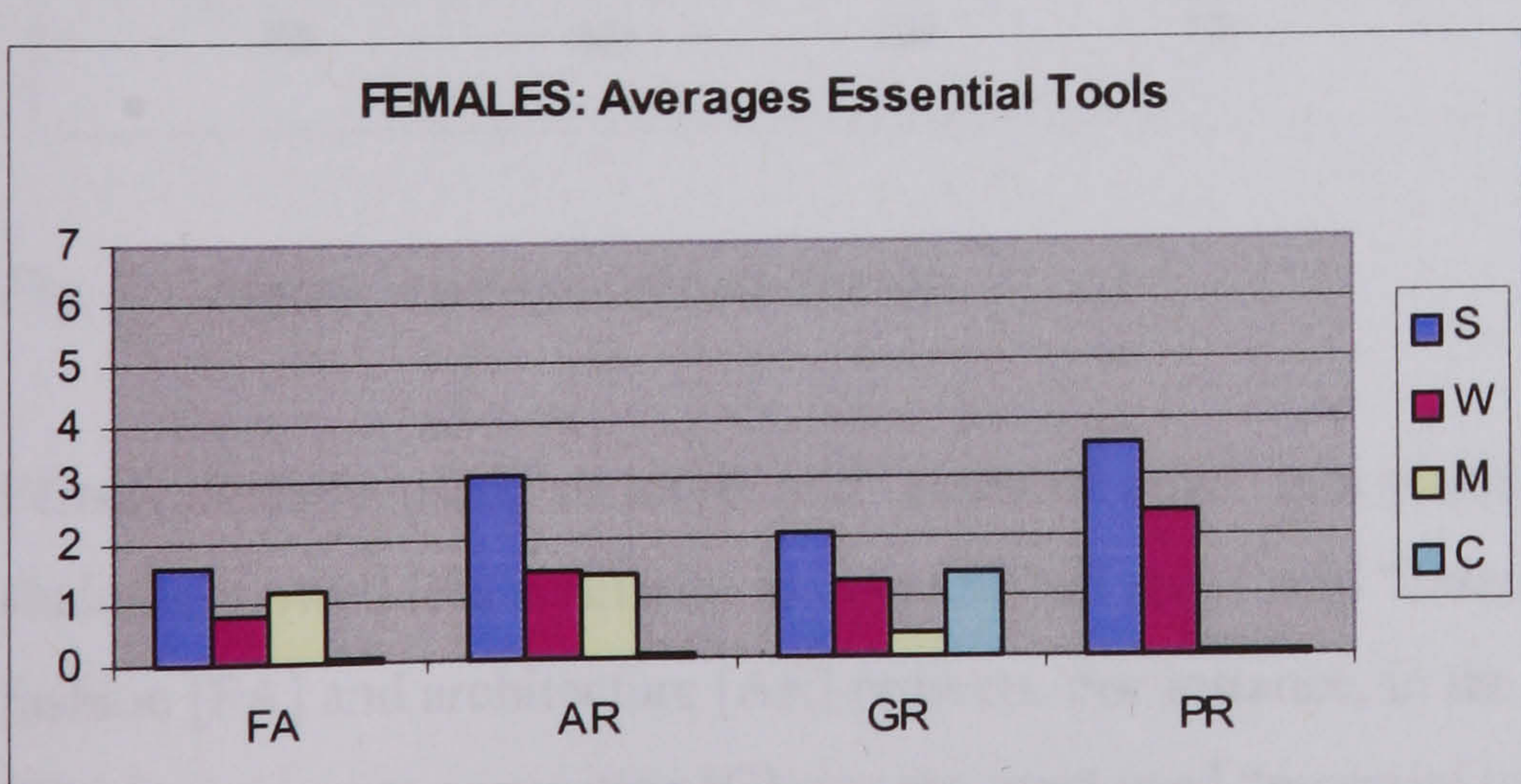


Fig. E:5 Females: Averages essential tools

	FA	AR	GR	PR
S	3.1 (0.8)	4.6 (2.6)	3.3 (0.7)	4.3 (1.8)
W	3.5 (1.9)	3.5 (1.4)	4.0 (0.5)	3.8 (1.8)
M	2.8 (1.1)	1.3 (0.1)	0.3 (0.0)	0.3 (0.3)
C	0.5 (0.4)	1.5 (1.1)	2.0 (1.3)	2.3 (2.3)

Table E:3 Male average tools

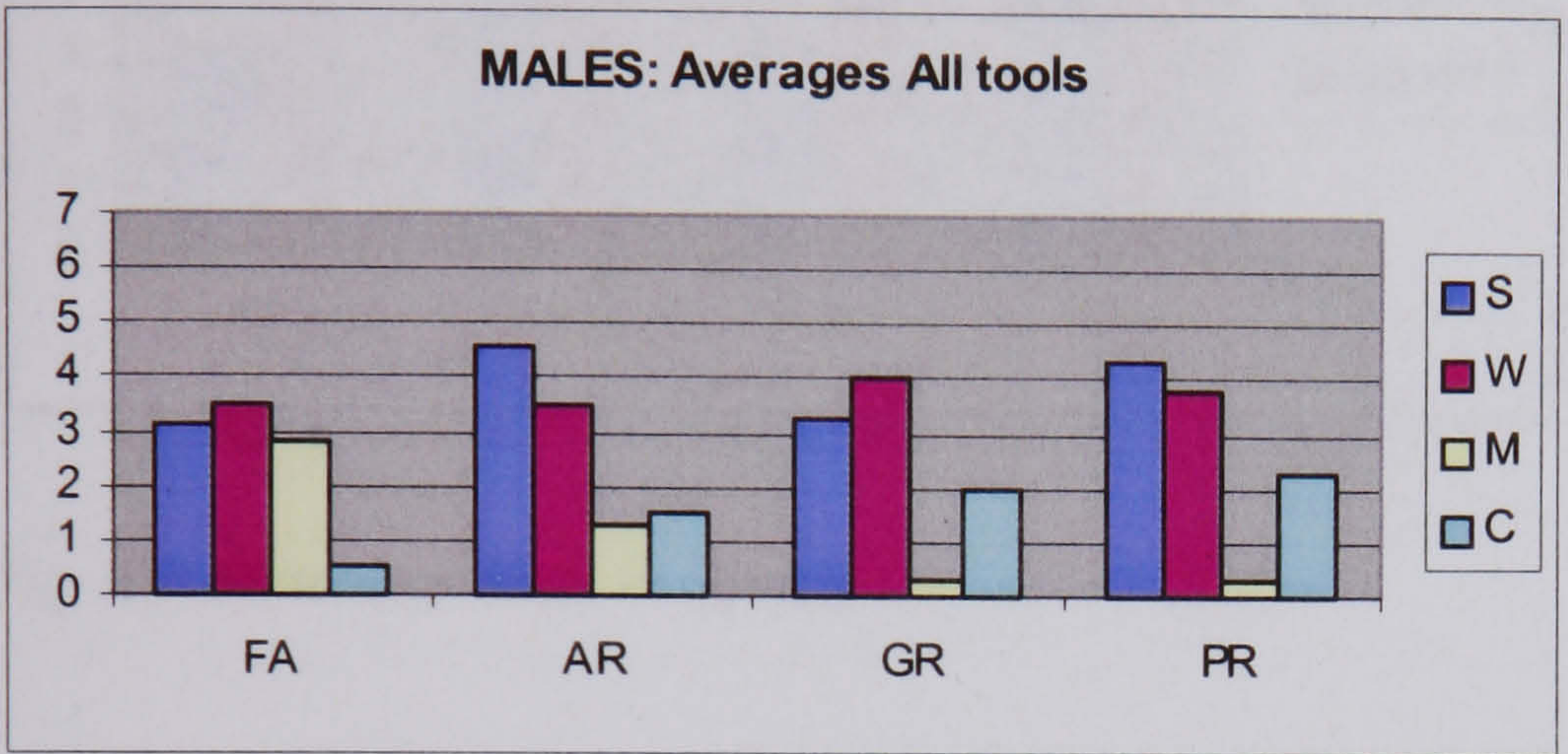


Fig. E:6 Males: Averages all tools

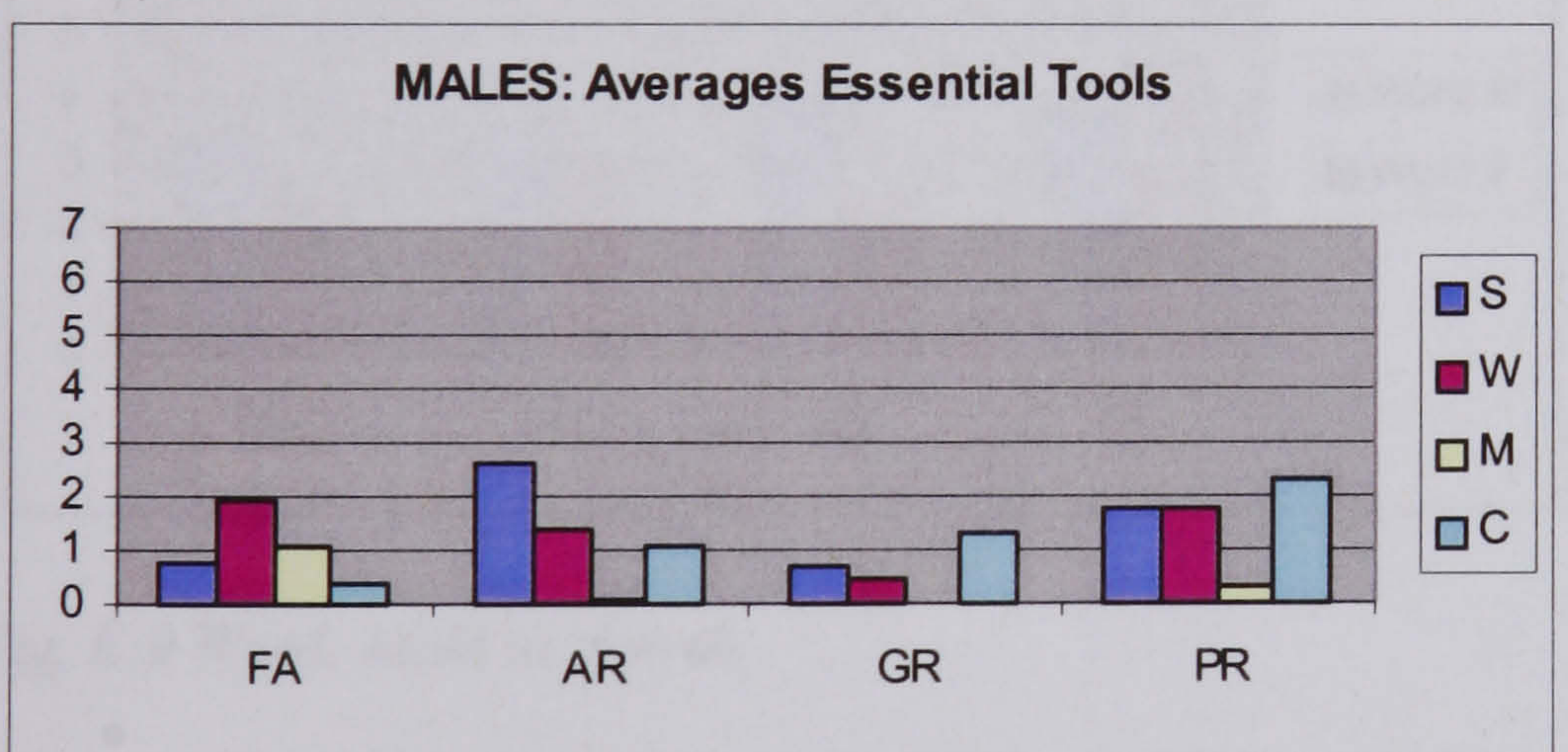


Fig. E:7 Males: Averages essential tools

Female students used "all tools" and "essential tools" in a similar pattern. In contrast, male students showed less similarity in usage of "all tools" and "essential tools" apart from the fashion [FA] and architecture [AR] projects. For instance, in the graphics [GR] and product [PR] assignments computing [C] was the most used "essential tool" but only the third most used tool in the "all tool" category (Figures E:6 and E:7).

Figures E:8, E:9: E:10 and E:11 show the gender difference between sketching, words, modelling and computing, as averages of all tools.

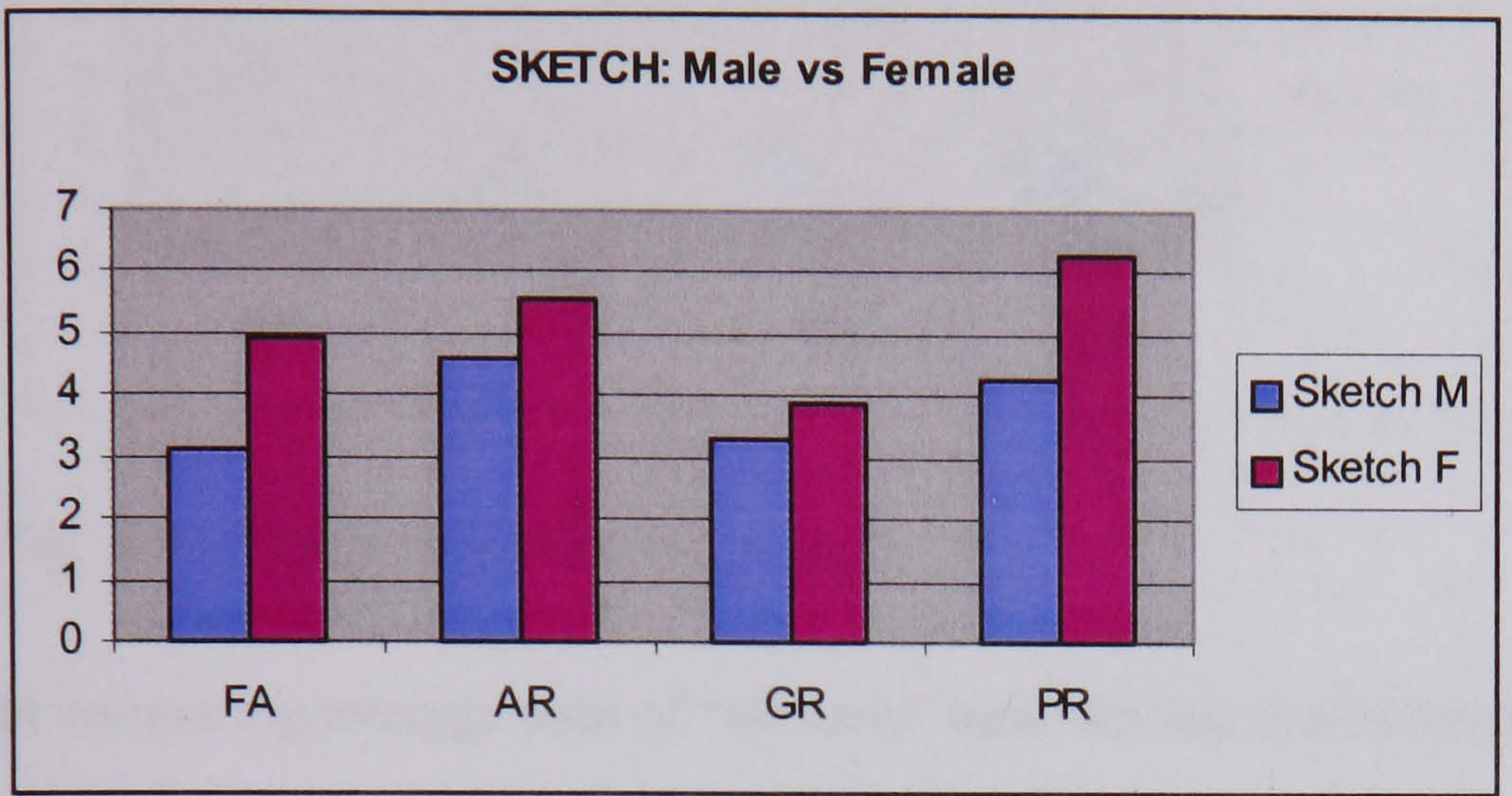


Fig. E:8 Sketching: Male vs. female

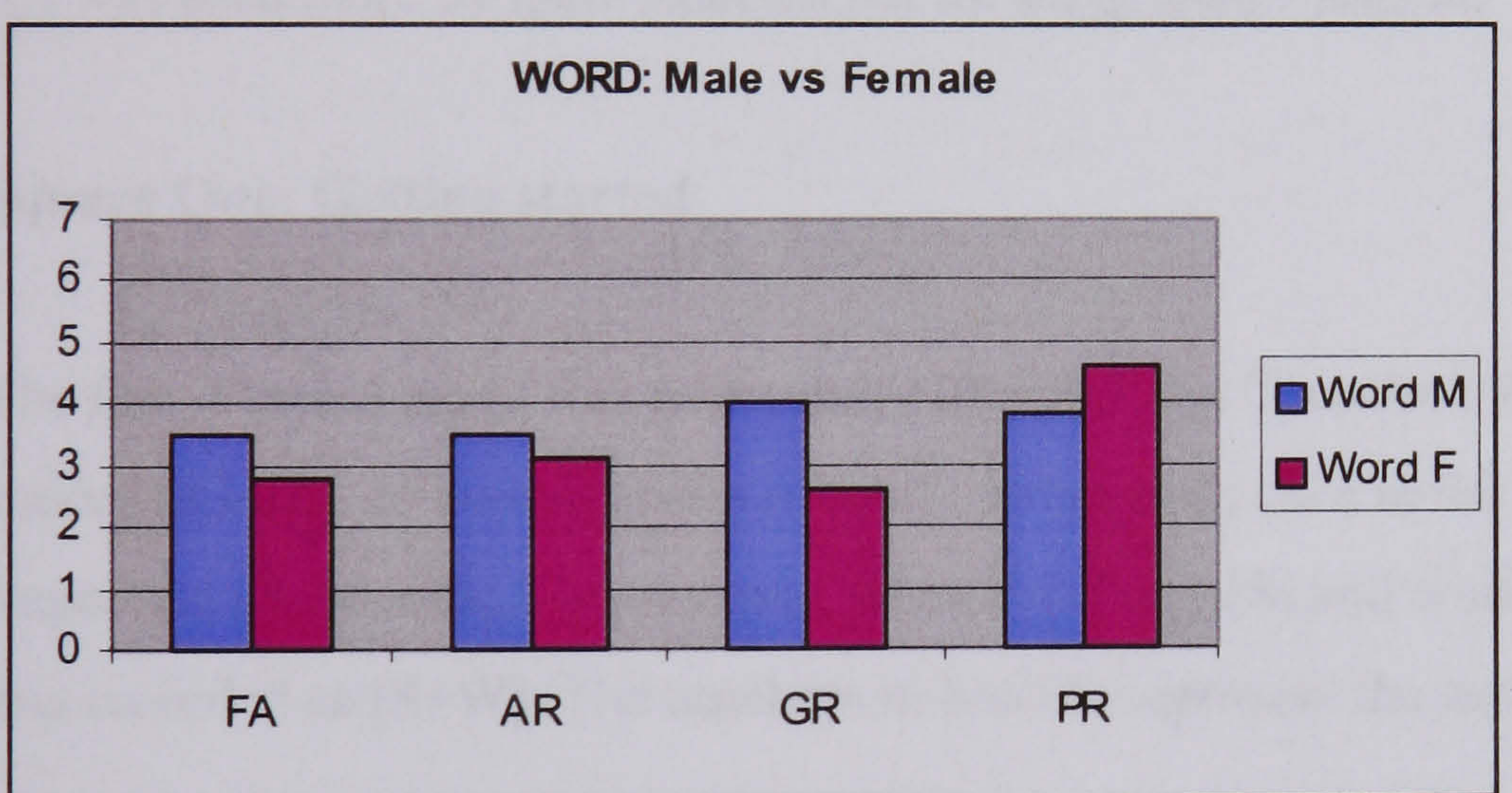


Fig. E:9 Word: Male vs. female

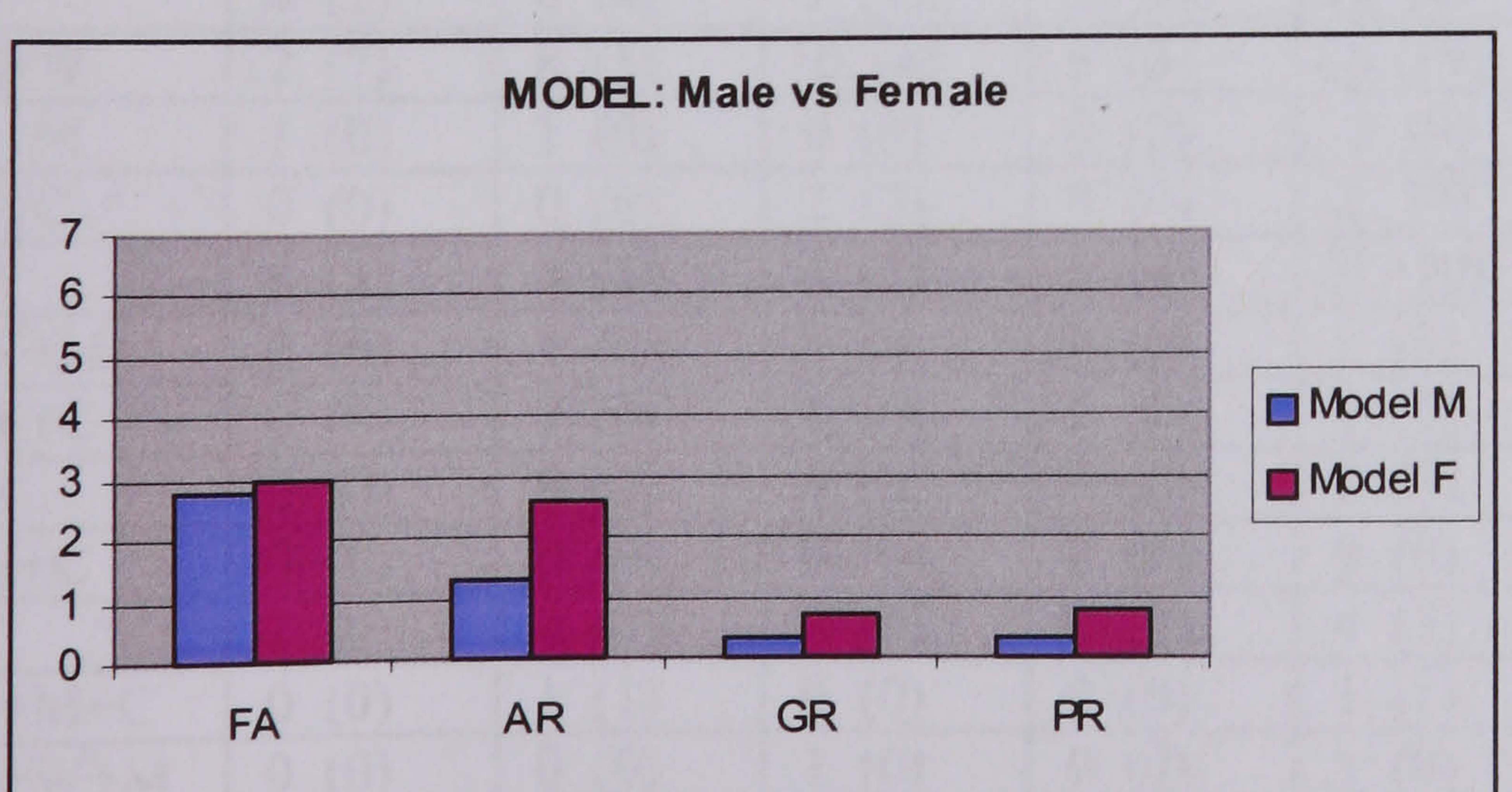


Fig. E:10 Modelling: Male vs. female

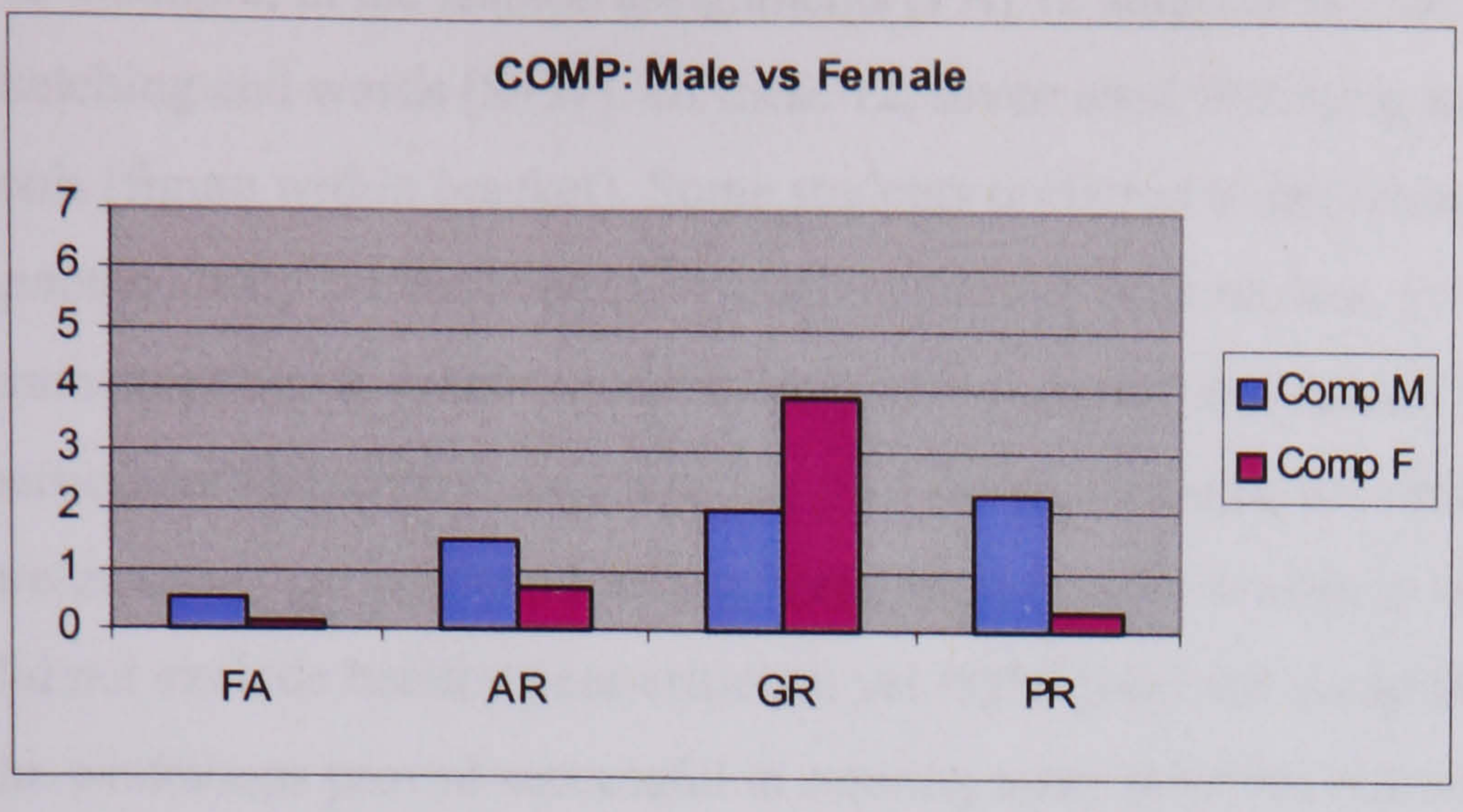


Fig. E:11 Computing: Male vs. female

In comparing average uses of "all tools" between males and females, female students did more sketching [S] in all four projects. Words [W] were used more often by male students but for the product design project, in which female students were slightly ahead. Female students used modelling [M] more often than male students, notably in the architecture project. Computing [C] was used more by male students but for the graphics project.

Square One: Getting started

The first ideation move was particularly illuminating. Therefore Table E:4 shows what single conceptual tool, or combinations of tools, participants used in the first fifteen minutes of respective assignment. For example, when sketching [S] and words [W] were used together, this was recorded as [S+W]. The numbers in bracket represent the number of essential tools.

	FA	AR	GR	PR	TOTAL
TOOL					
S	4 (1)	6 (4)	1 (1)	1 (0)	12 (6)
S+W	12 (7)	8 (5)	10 (4)	5 (3)	35 (19)
S+M	1 (0)	1 (0)	0 (0)	0 (0)	2 (0)
S+C	0 (0)	0 (0)	2 (2)	0 (0)	2 (2)
W	8 (3)	4 (1)	4 (2)	5 (4)	21 (10)
W+M	0 (0)	1 (1)	0 (0)	0 (0)	1 (1)
W+C	0 (0)	0 (0)	0 (0)	1 (1)	1 (1)
M	2 (0)	0 (0)	0 (0)	0 (0)	2 (0)
M+C	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
C	1 (0)	0 (0)	3 (3)	0 (0)	4 (3)
S+M+C	0 (0)	1 (1)	0 (0)	0 (0)	1 (1)
S+W+M	0 (0)	0 (0)	1 (0)	0 (0)	1 (0)
TOTAL	28 (11)	21 (12)	21 (12)	12 (8)	82 (43)

Table E:4 Square One: Getting started

For example, in the fashion assignments [FA] 12 students got started using the combination of sketching and words [S+W]. Of these 12, seven used sketching and words [S+W] as *essential* tools (figure within bracket). Some students preferred to get started on their own whilst others spontaneously set out in pairs or small groups of three or four, in what could be described as brainstorming, or *synchronous reflection-in-action* ("chat-rooms"). But although each participant had to produce his or her own design concepts for the end-of-assignment presentation, participants freely referred to each other's work in case they had collaborated. This did not exclude healthy peer-criticism yet highlighted the social aspects of designing in which the workshops proved successful in steering away from the risk of the "exclusiveness" or "possessiveness" of ideas.

> 'I got started with words to define and focus my ideas' (Questionnaire Student 13).

> '[I got started] using spoken and written words, brainstorming' (Questionnaire Student 1).

> 'Drawing and writing in conjunction are quick ways of jotting down ideas' (Questionnaire Student 15).

Modelling [M], in Square One, was used in two assignments (FA), whereas students went straight to computing [C] in four assignments, of which three were graphics [GR] (Table E:4).

> '[I got started with] computer because it's quicker and more precise'
> (Questionnaire Student 2).

> 'The least appropriate tool was computer modelling – too soon, too limiting'
> (Questionnaire Student 13)

The pie charts below show the single use of sketching [S], words [W], modelling [M] and computing [C] as well as the combination of sketching and words [S+W] as proportions of total tools and total essential tools respectively (Figures E:12 and E:13). Other tool combinations are represented by "Other" (see Table E::4).

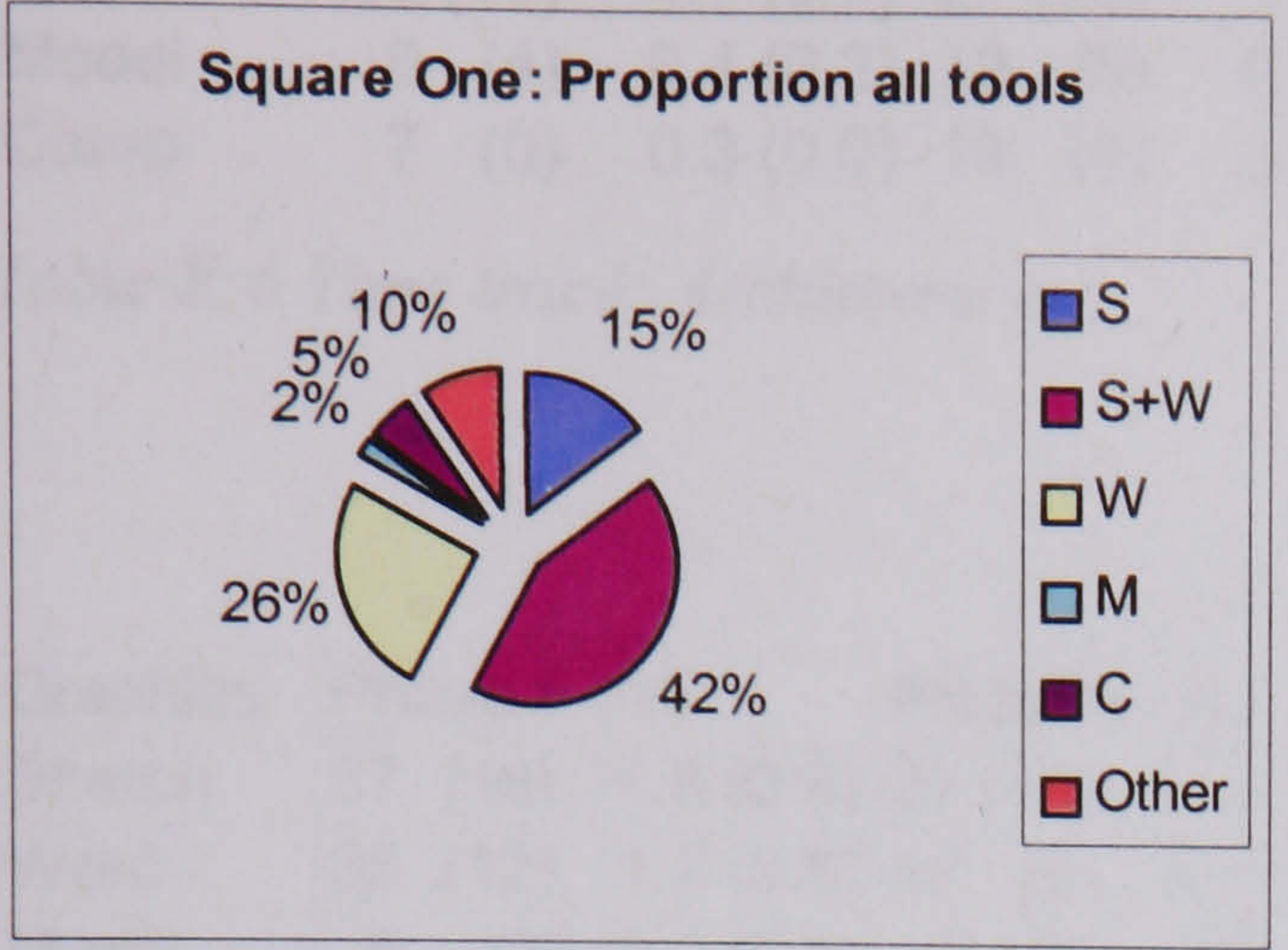


Fig. E:12 Square One: all tools

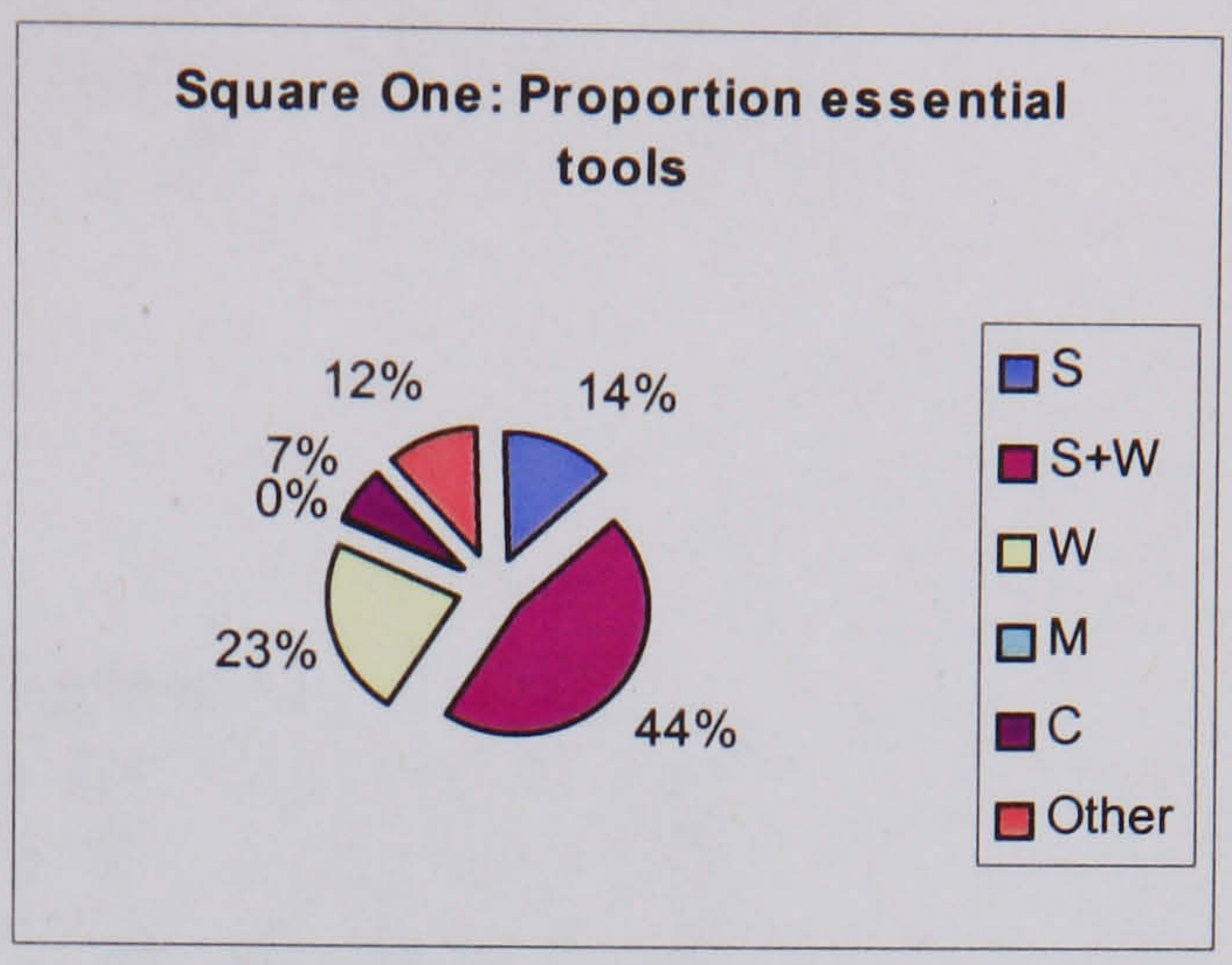


Fig. E:13 Square One: essential tools

The pie charts illuminate how words [W] on their own were the most used single conceptual tool for getting started, or around a quarter of all tools used. The comparable figure for sketching [S] was around 15 per cent. Modelling [M] and computing [C] were little used. Remarkable, however, is how the combination of words and sketching [S+W] was the most used ideation tools for getting started in all projects (Table E:4). Thus the sketch and word combination, [S+W], accounted for just over 40 per cent of all ideation tools used in Square One. Moreover, the pie charts show how usage of sketching [S], words [W], modelling [M] and computing [C] as well as the combination of sketching and words [S+W], was largely the same whether measured as a proportion of all tools or of all essential tools (Figures E:12 and E:13).

Time Trace

Tables E:5, E:6, E:7 and E:8 represent the sequential distribution of conceptual tool events in the four domains (FA, AR, GR, and PR), both in total numbers and averages, as traced (recorded) by the individual students in the self-reports. For this purpose, each project of two hours and fifteen minutes duration was divided into three phases, the beginning (I), the middle (II), and the end (III). Thus each phase consisted of 45 minutes of self-directed ideation activity. The trace of essential tools is shown in bracket, both in total numbers and averages.

Fashion	Phase I	Av	Phase II	Av	Phase III	Av	Total
Sketch	50 (17)	1.8 (0.6)	32 (13)	1.1 (0.5)	34 (9)	1.2 (0.3)	116 (39)
Word	50 (24)	1.8 (0.9)	25 (9)	0.9 (0.3)	12 (3)	0.4 (0.1)	87 (36)
Model	20 (7)	0.7 (0.3)	36 (14)	1.3 (0.5)	25 (11)	0.9 (0.4)	81 (32)
Comp	4 (2)	0.1 (0.1)	4 (4)	0.1 (0.1)	0 (0)	0.0 (0.0)	8 (6)

Table E:5 Time trace: Fashion

Architect.	Phase I	Av	Phase II	Av	Phase III	Av	Total
Sketch	44 (25)	2.1 (1.2)	38 (20)	1.8 (1.0)	28 (16)	1.3 (0.8)	110 (61)
Word	35 (15)	1.7 (0.7)	21 (10)	1.0 (0.5)	12 (7)	0.6 (0.3)	68 (32)
Model	8 (4)	0.4 (0.2)	12 (5)	0.6 (0.2)	24 (10)	1.1 (0.5)	44 (19)
Comp	7 (0)	0.3 (0.0)	10 (6)	0.5 (0.3)	4 (4)	0.2 (0.2)	21 (10)

Table E:6 Time trace: Architecture

Graphics	Phase I	Av	Phase II	Av	Phase III	Av	Total
Sketch	37 (16)	1.8 (0.8)	27 (15)	1.3 (0.7)	15 (5)	0.7 (0.2)	79 (36)
Word	36 (12)	1.7 (0.6)	18 (9)	0.9 (0.9)	9 (2)	0.4 (0.1)	63 (23)
Model	6 (2)	0.3 (0.1)	5 (2)	0.2 (0.1)	2 (2)	0.1 (0.1)	13 (6)
Comp	21 (9)	1.0 (0.4)	23 (10)	1.1 (0.5)	26 (10)	1.2 (0.5)	70 (29)

Table E:7 Time trace: Graphics

Product	Phase I	Av	Phase II	Av	Phase III	Av	Total
Sketch	22 (12)	1.8 (1.0)	24 (11)	2.0 (0.9)	21 (13)	1.8 (1.1)	67 (36)
Word	27 (14)	2.3 (1.2)	13 (5)	1.1 (0.4)	12 (7)	1.0 (0.6)	52 (26)
Model	0 (0)	0.0 (0.0)	3 (0)	0.3 (0.0)	4 (2)	0.3 (0.2)	7 (2)
Comp	5 (3)	0.4 (0.3)	4 (3)	0.3 (0.3)	4 (4)	0.3 (0.3)	13 (10)

Table E:8 Time trace: Product

Converted into graphs, the following charts emerged (Figures E:14, E:15, E:16, E;17, E:18, E:19, E:20, and E:21)

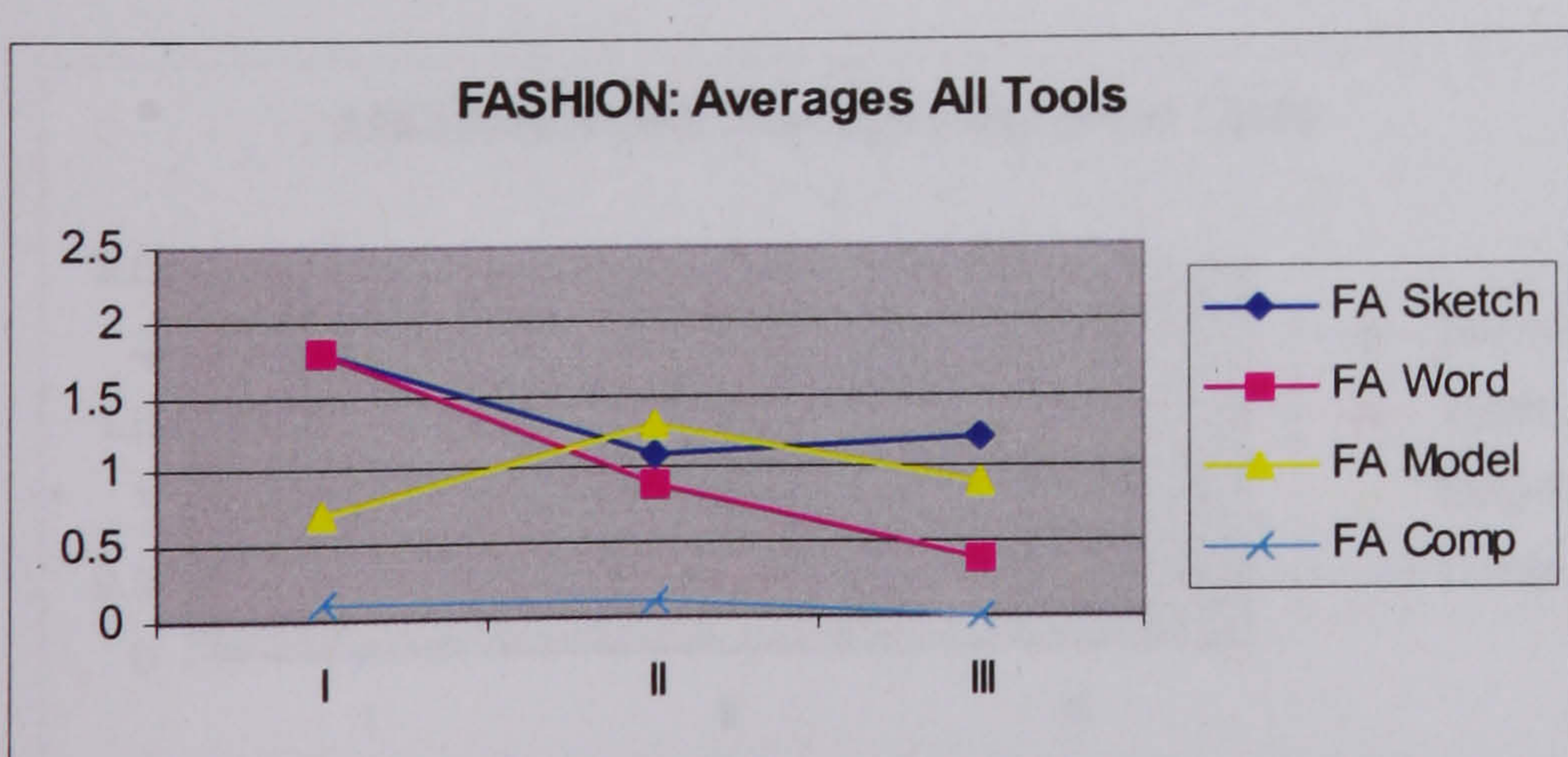


Fig. E:14 Time trace: Fashion (all tools)

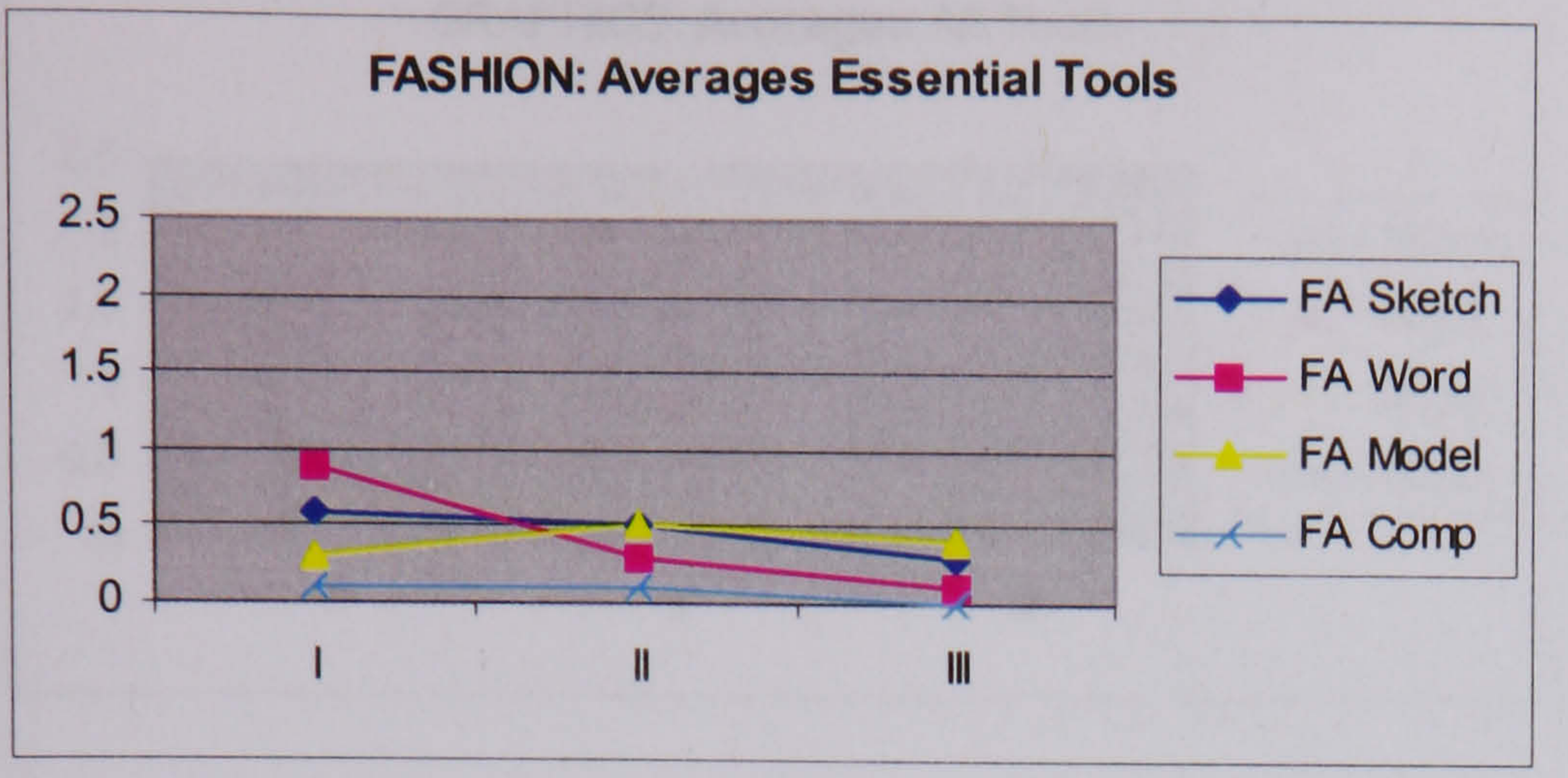


Fig. E:15 Time trace: Fashion (essential tools)

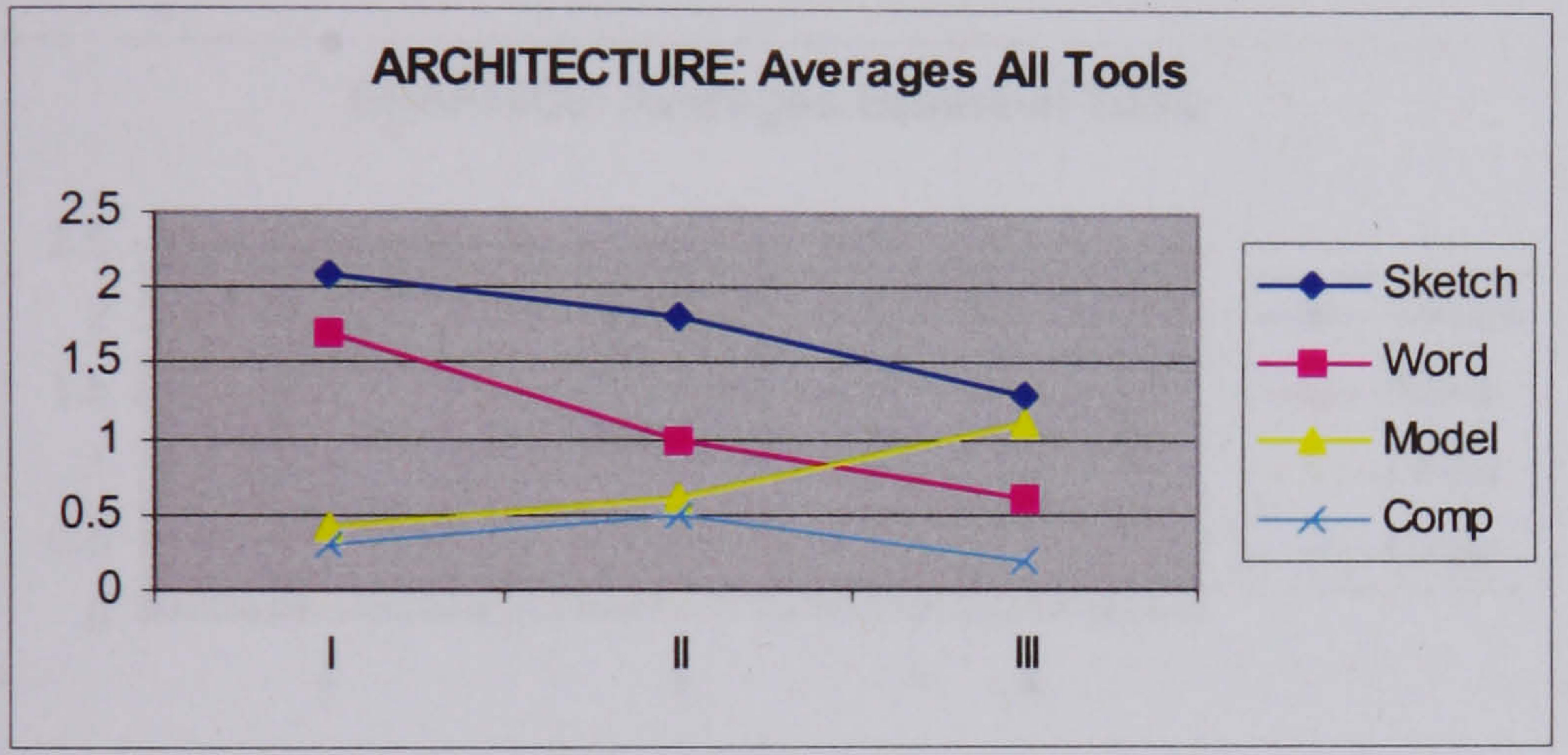


Fig. E:16 Time trace: Architecture (all tools)

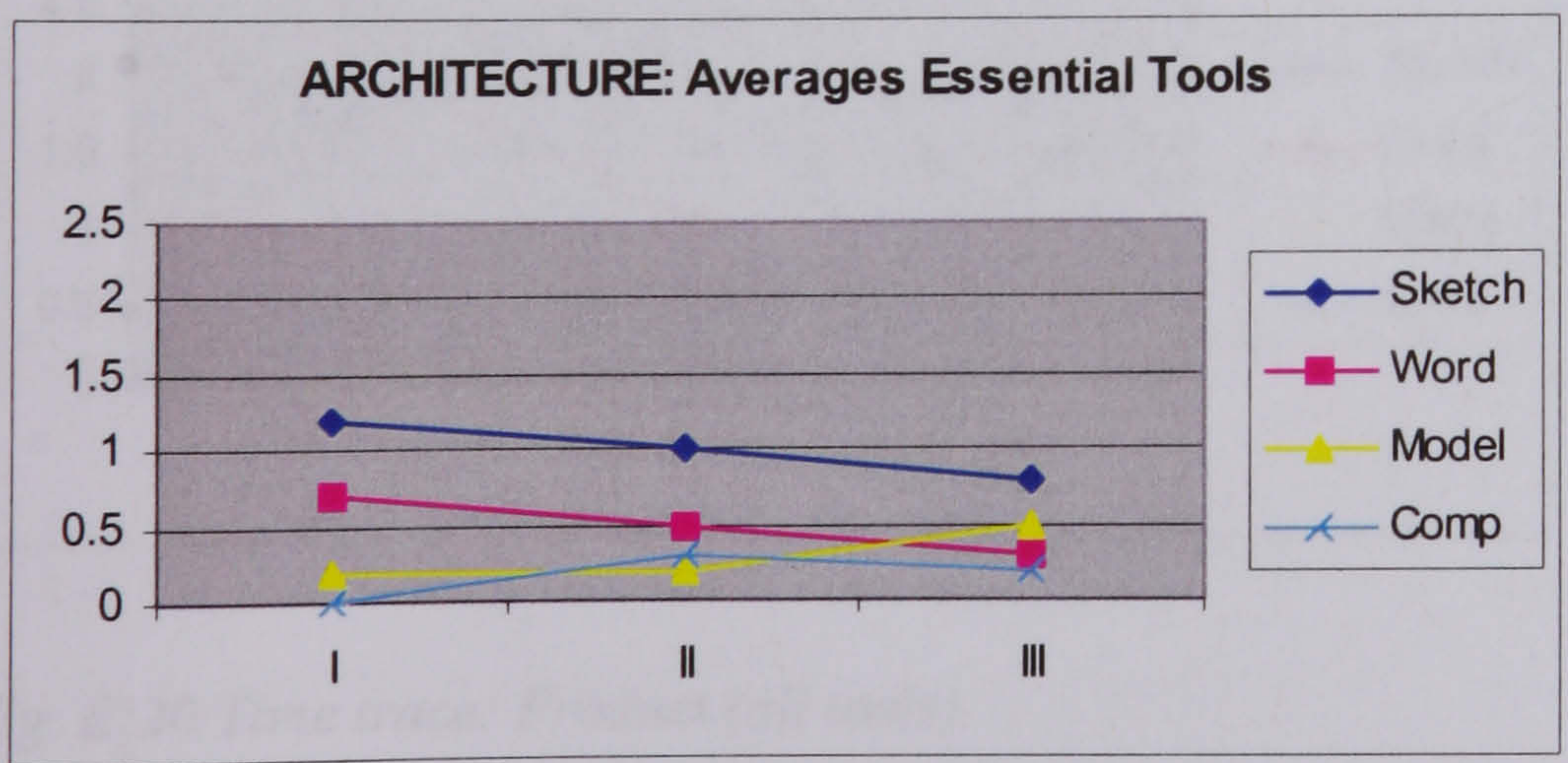


Fig. E:17 Time trace: Architecture (essential tools)

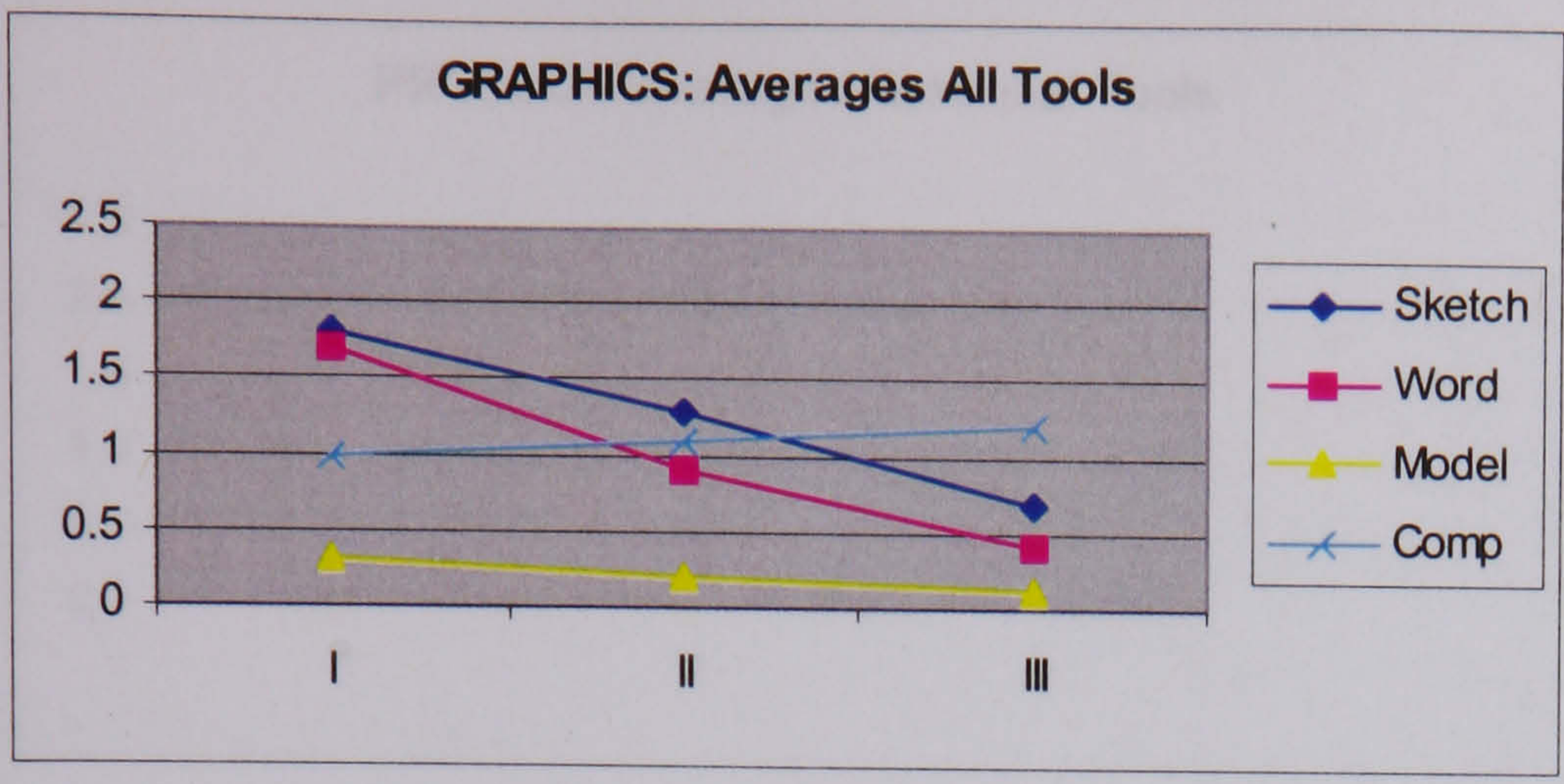


Fig. E:18 Time trace: Graphics (all tools)

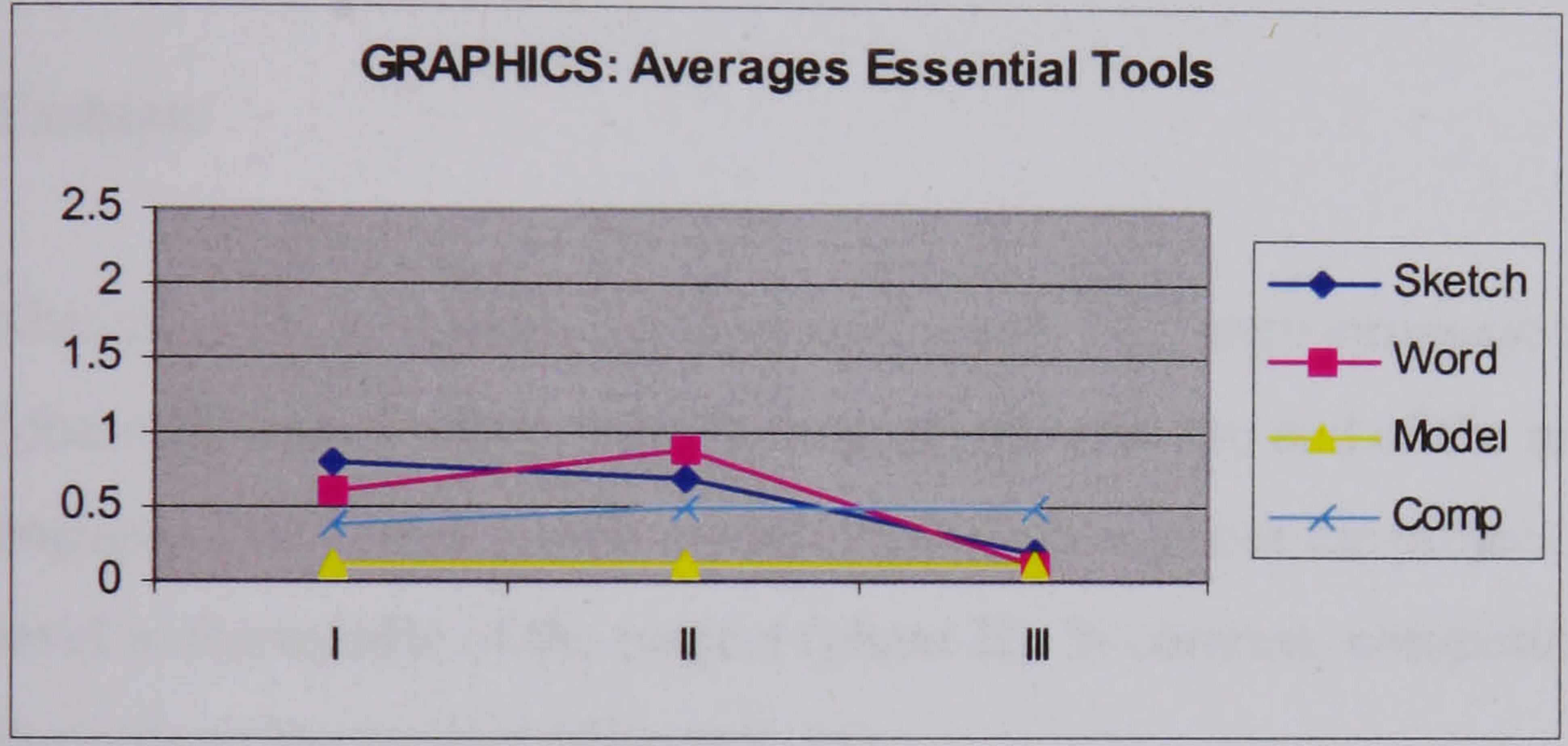


Fig. E:19 Time trace: Graphics (essential tools)

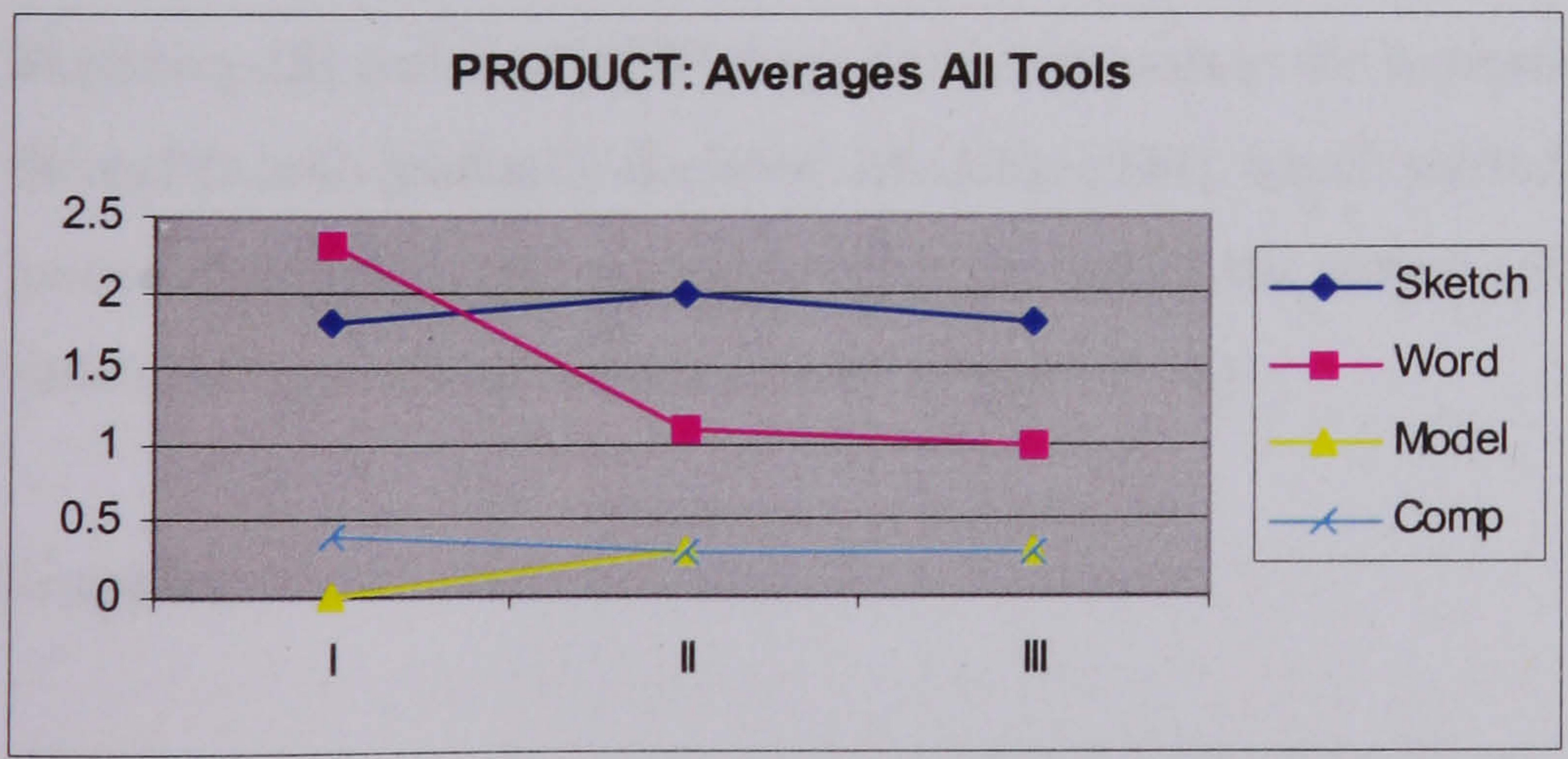


Fig. E:20 Time trace: Product (all tools)

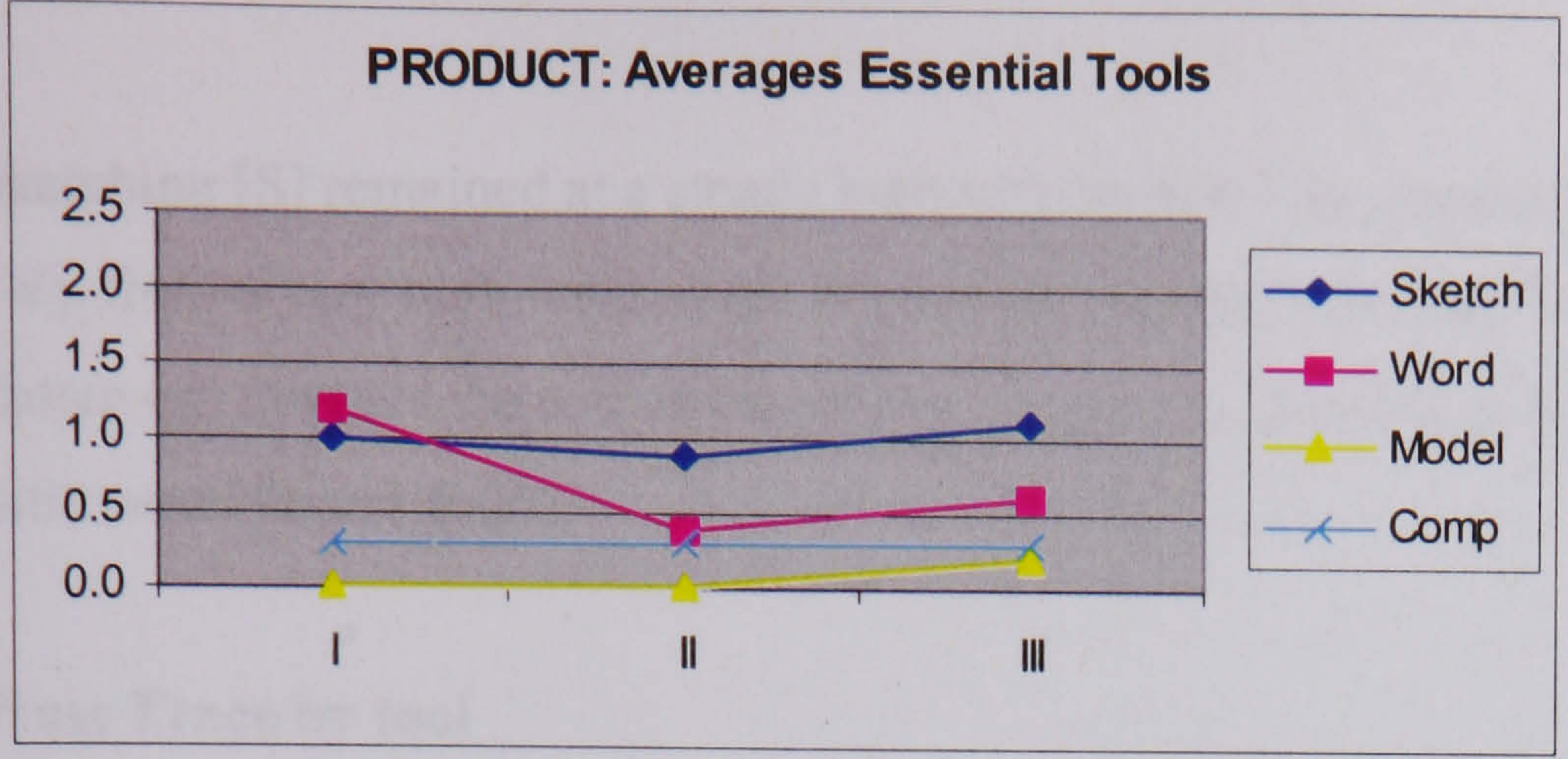


Fig. E:21 Time trace: Product (essential tools)

Time Trace by domain

Fashion

Sketching [S] and written and spoken words [W] were strongest in the beginning of the project (phase I), with words notably tailing off towards the end of the project (phase III). Students engaged substantially with modelling [M] throughout the project reaching its highest activity level in the middle of the project (phase II). In contrast, computing [C] was almost negligible throughout the project (Figure E:14).

Architecture

Sketching [S] and words [W] were dominant tools at the beginning of the project (phase I), thereafter both gradually declined. Modelling [M], which started at a low level (phase I), gained momentum and peaked towards the end of the project (phase III). Computing [C] was little used throughout the assignment (Figure E:16).

Graphics

Sketching [S] and words [W], from a high activity level in the beginning of the project (phase I) declined in the middle (phase II) and towards the end of the project. Words [W], however, as an essential tool, peaked in the middle of the project (phase II). Modelling [M] remained at a low and equal level throughout the project, whereas computing [C] stayed at a steady high level throughout (Figure E:18).

Product

Sketching [S] remained at a steady high activity level throughout the project, whereas words [W], from a very high level in the beginning, dipped in the middle of the project (phase II) to flatten out towards the end of the project (phase III). Modelling [M] and computing [C] were little used (Figure E:20).

Time Trace by tool

Sketching

On average, and throughout the project, sketching [S] was the most used tool in the architecture [AR] and the product design projects [PR]. It dropped off most noticeably in the graphics project [GR].

Words

Words [W] was the most used tool overall in phase I of the product design project [PR] but as an essential tool peaked in phase II of the graphics project [GR].

Modelling

Both overall and as an essential tool modelling [M] was most used in the fashion project [FA] but for the end of the project (phase III) when it was slightly more prominent in the Architecture project [AR]. It played a small part in the graphics [GR] and product design projects [PR].

Computing

Both overall and as an essential tool computing [C] was mainly used in the graphics project [GR], and throughout the whole of that project. In contrast, it was hardly used at all in the fashion project [FA], and was only a minor but steady activity in the product design project [PR]. It was the least used tool in the architecture project [AR].

Averages of all project tools

Table E:9 shows the time trace of averages of all and essential tools for all four projects. The numbers in bracket represent essential tools.

Phase	Sketch	Word	Model	Comp
I	1.9 (0.9)	1.8 (0.8)	0.4 (0.2)	0.5 (0.2)
II	1.5 (0.7)	0.9 (0.5)	0.7 (0.3)	0.5 (0.3)
III	1.2 (0.5)	0.5 (0.2)	0.7 (0.3)	0.4 (0.2)

Table E:9 Time trace: Tool averages all projects

The numbers in Table Y1:9 are shown as charts in Figures E:22 and E:23.

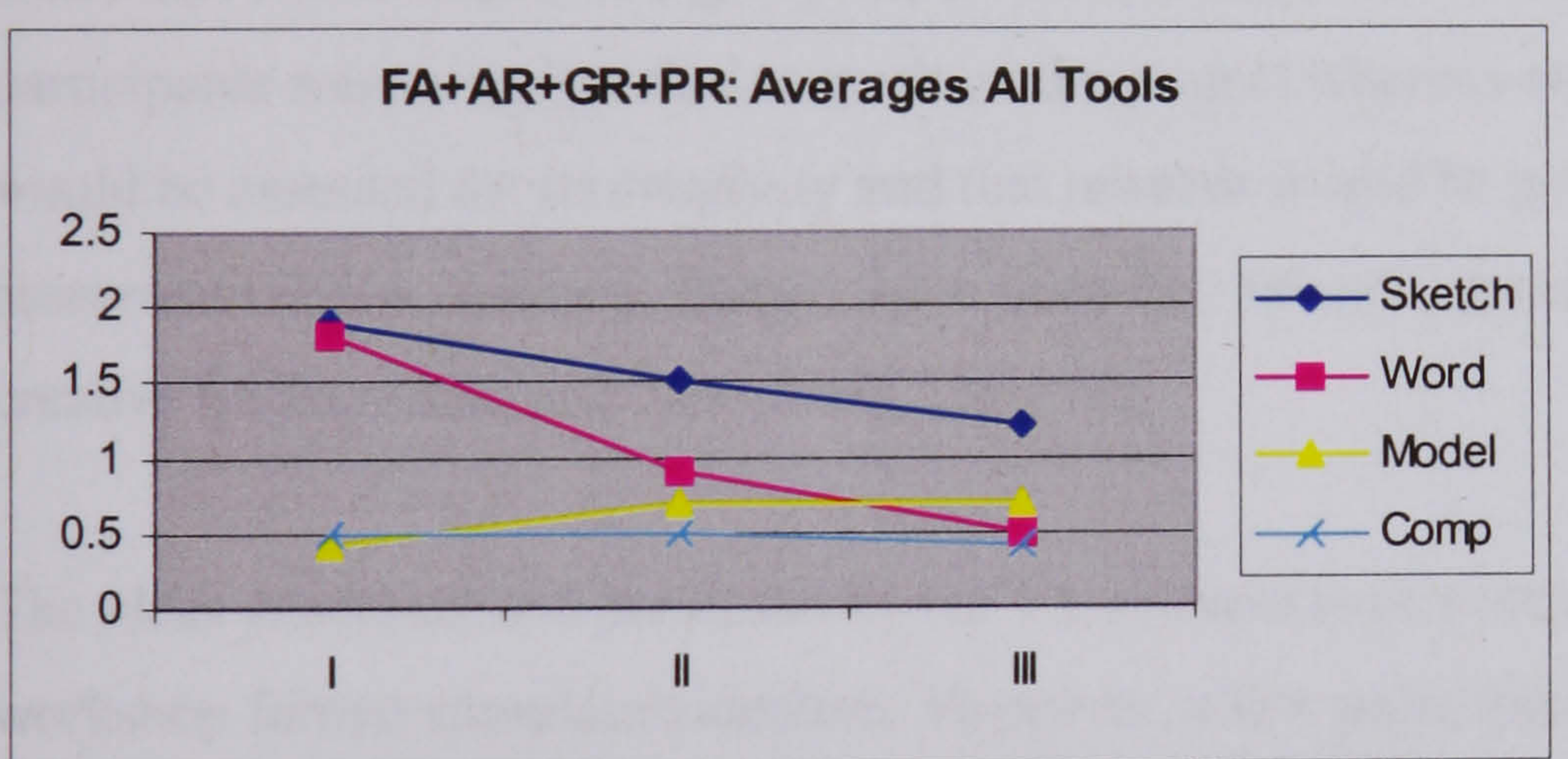


Fig. E:22 Averages all tools

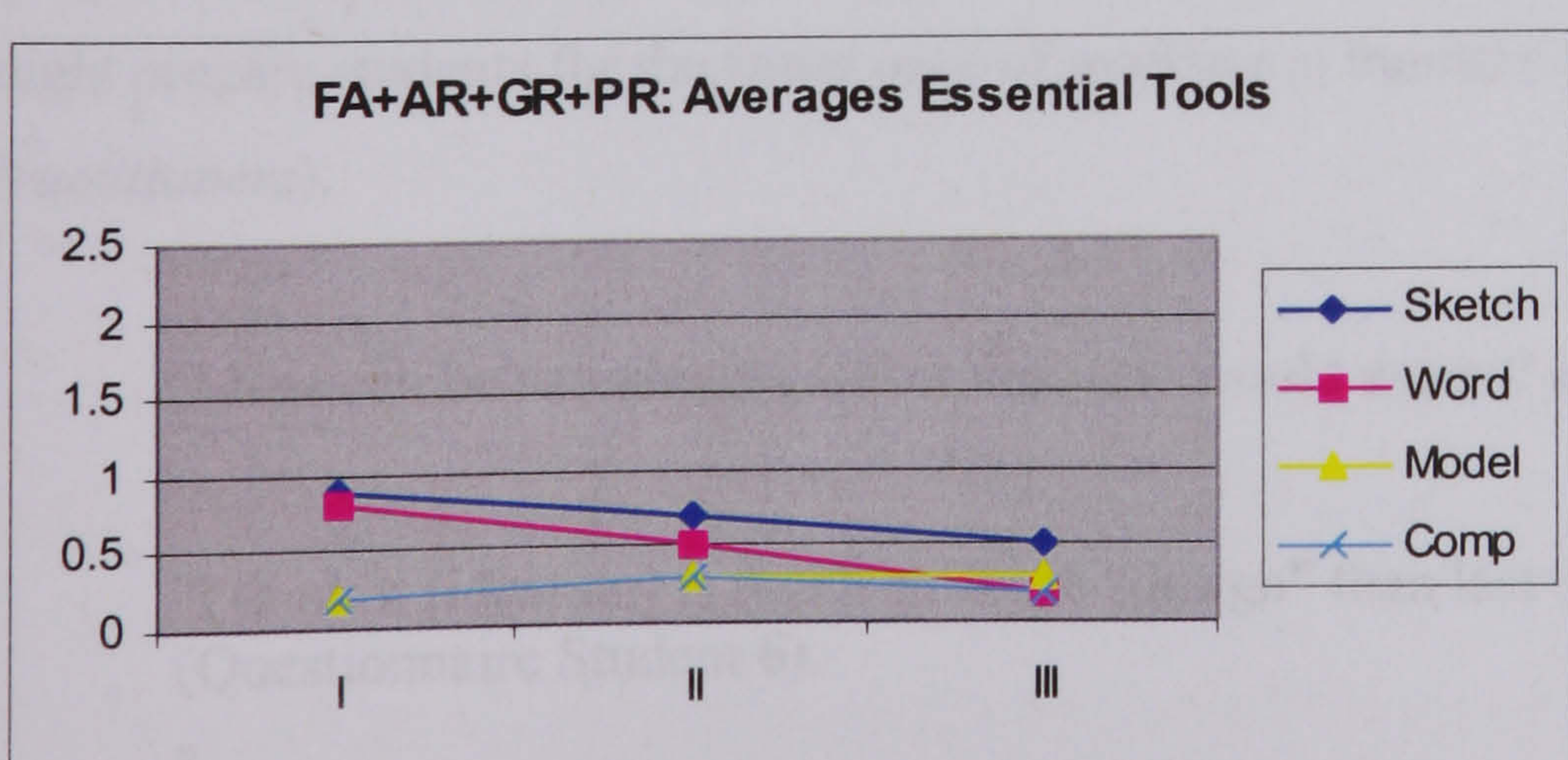


Fig. E:23 Averages essential tools

Of the individual charts, that of architecture [AR] matched best the combined chart [FA], [AR], [GR] and [PR], both in terms of "all tools" and "essential tools". That is, sketching [S] and words [W] were the dominant conceptual tools in the early phase [I] of the ideation process but their use decreased thereafter, and notably words. Uses of modelling [M] increased, from a low point, slightly in the mid-phase [II] where it remained towards the end of the project. Computing [C] remained fairly static at a low level throughout the project.

Discussion

The workshop outcomes were not assessed in terms of volume, variety or originality of ideas, so there were no "winners" or "losers" in the ideation tasks. This was deliberate to encourage ideation and to avoid bias towards any particular conceptual tool but also because assessment of creativity is notoriously subjective (Lawson 1990). Furthermore, the non-judgemental approach reflected findings in psychological research, which suggest that external rewards can deter creativity. For example, in a group experiment, when asked to create artistic products, some participants were simply asked to work on the project whereas others were told that their project would be assessed for its creativity and that rewards would be given. Experts, in a "blind" assessment of the products, judged those from the "reward" group to be significantly less creative (in Bernstein and Nash 1999:275-276).

The ideas generated and presented by the Y1 students over a very short time suggest that the workshop format stimulated ideation. Moreover, a few participant students suggested that if they could get so much out of a two-hour long design project, why spend days if not weeks on single projects. This further suggests that short ideation projects may feature as a regular part of design course curricula, perhaps even in compulsory schooling. Moreover, such short projects might prepare students for the faster pace of working in industry (see Chapter *Findings Y2 and Practitioners*).

> 'Ideas can be actualised quicker than one would expect' (Questionnaire Student 12).

> 'I think it [ideation] is much closer to "design" than last term [drawing workshops]' (Questionnaire Student 6).

> 'I liked the pressure of time limit' (Questionnaire Student 2).

'Working under pressure is exciting and more productive' (Questionnaire Student 8).

In each workshop, it was quite common for the students to get started through brainstorming working in pairs or in threes or fours. The pairing occurred while using any conceptual tool(s). The spontaneous collaboration highlighted both the team and social aspects of designing, and how interaction could both stimulate and enable ideation.

> 'I don't usually work in groups to generate ideas, but it can open up a lot of possibilities I hadn't even considered' (Questionnaire Student 19).

In all the assignments there was evidence of freehand drawing and modelling skills in the form of sketches and sketch models, which showed that novice designers were capable of expressing even complex ideas solely through analogue means. In contrast, relatively few participants used computers during the projects, which reflected the generally low entry-level of computing skills among the participants. In this, computing was mainly used for image manipulation or digital collage-making using PhotoShop™. The relative low use of computing in most assignments was unexpected considering the everydayness of PCs and multimedia. However, participants seemed frustrated by their lack of computer skills, for instance, commenting on the difference between "the look" of freehand and digital (scanned) sketches, where digital images were sought after because they made the ideas look more 'refined' or 'finished' compared to the 'raw', or 'coarse' look of sketches. This suggests that there was a gap between the participants' expectations of using digital technology and their learning experiences. However, the frustration also caused the students to explore other conceptual tools.

> 'I don't find that I could go straight to it [computer] to communicate my ideas in a short space of time' (Questionnaire Student 18).

> 'Although I used computers briefly to create abstract sketches I would find creating a 3D model too time consuming in comparison to an actual (physical) model' (Questionnaire Student 21).

> 'I used computer ... make drawings more refined than conceptual' (Questionnaire Student 22).

The gender issue

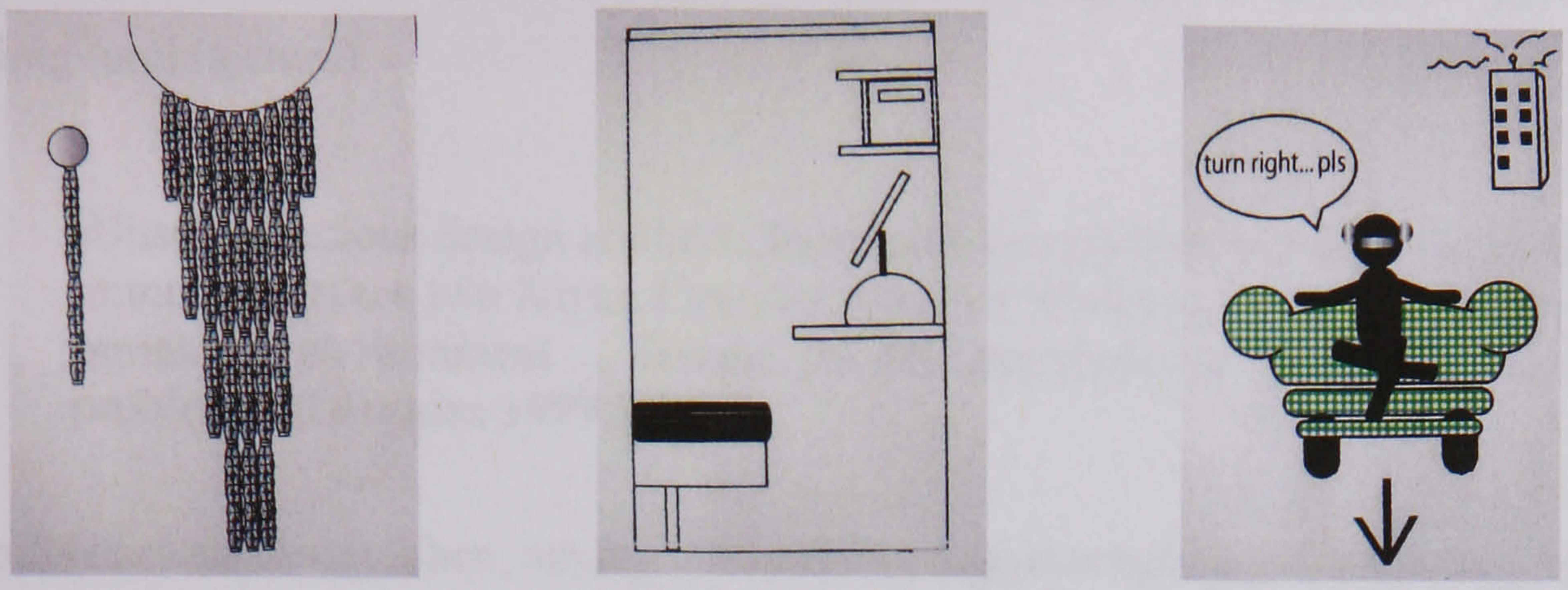
The findings were not statistically significant which limit generalisations. Yet, they nevertheless illuminated gender differences in uses of conceptual tools. For example, the female students did on average more sketching [S] than their male peers in all four projects (Figure E:8), whereas the male students used words [W] more often for conceptualisation in three out of the four projects (Figure E:9). That males were more "conceptually talkative" than females was somewhat surprising from a general view on gender differences, and difficult to explain, but cautions against stereotyping gender in terms of abilities and aptitudes. Similarly, male students used computing more often that their female peers, except in the graphics project, where the roles were reversed (Figure E:11). Again, this was not easy to account for, particularly at a conceptual level, although, cautiously, it might reflect how males, as shown in spatial tests, are more apt than females at manipulating three-dimensional objects (Pinker 2002).

However, and cautioning against generalisations, such tests tell us little about specific design populations such as Y1 students. Moreover, there may be a risk in trying to translate any gender bias into positive discrimination in design schools because to do so suggests another form of judgmental approach to teaching and learning design. However, on a positive gender note, changing female status, knowledge and attitudes in general, both socially and professionally, has resulted in larger numbers of female students going into design schools, as evidenced in the workshops, where 21 of the 33 participants were female.

Diversity of student backgrounds and skills

The different skill levels observed in the workshops mirrored the diversity of backgrounds and experiences of the participants, most of whom were straight from A-level or foundation courses in art and design, although a handful were mature students (25+). Most students had a British education, but there were also those educated abroad, from the EU and overseas. But, again, it would be risky to generalise about uses of conceptual tools according to ethnic or cultural backgrounds of the students.

For example, it is sometimes said that non-UK students have a more solid foundation in traditional design skills (vocational training), such as drawing. However, I observed that the participant most disparaging of freehand drawing during the assignments was an overseas student who openly held "I hate drawing", preferring the digital medium, rather than pen and paper in the three workshops he took part in (FA, AR, and PR). In fact, this emerged as the most striking example of "going first to the computer for ideation", that is, without prior freehand sketching. (Illustration E:10).



Ill. E:10: Computer-aided ideation (A4 printout: FA + AR + PR)

The general lack of computing skills, however, seemed to encourage improvisation and playfulness through analogue tools, for instance, by drawing ideas for fashion accessories directly onto the wrist [S+W], (Illustration E:11), or experimenting with "found objects" [M], such as wire or discarded sweet wrappers (Illustration E:12). In this way, the ideation workshops encouraged experimentation and new ways of representing and presenting design ideas, in contrast to more conventional methods of teaching and learning, such as "this is how it is". The high degree of improvisation in the workshops contrasted, however, with ideation processes in the multiple case study (se Chapter *Findings Y2 and Practitioners*).

Ill. E:11: Body fashion

Ill. E:12: Found objects

Ideation as unselfconscious design

The participants generated and developed ideas in a multitude of ways, from brain storming to solitary sketching, from conversation to manipulating materials and digital images, which suggest that ideation was a mix of making, feeling, and thinking including a great willingness to improvise. In this their approaches to designing resembled what is known in the design literature as 'unselfconscious design', or the prevalent form of design prior to it being taught in design schools or becoming a distinct profession, for instance, the vernacular tradition in building (architecture).

> 'Unselfconscious design is direct. Its response to problems is immediate. This immediacy takes two forms. First, the designer works with materials taken from his immediate environment ... Second, the designer responds immediately to design problems' (Louridas 1999:523).

Unselfconscious design, then, among Y1 students, suggests how knowledge may be a desirable, often necessary but not a sufficient ingredient in designing at a primary level. Therefore, at this level, no particular single tool seemed conclusive to ideation, either in terms of expressiveness or inventiveness. That is, a simple process can generate complex products (Cross 1982). Or,

> 'Unselfconscious design presents a paradox: the quality of the result does not square with the designer's lack of design knowledge' (Louridas 1999:525).

This suggests that novice designer knowledge is declarative, rather than procedural, that is, and to borrow from behavioural and cognitive learning theories, knowledge that consists primarily of propositions, or ideas, rather than knowledge that can be thought of as knowing *how* to do something (Rieber 1994).

That novice designer knowledge is declarative, rather than procedural, may also suggest that novice designers' cognitive actions are "unstructured", rather that "structured". Kavakli and Gero (2002), who compared design performance between an architecture student (novice) and a senior architect (expert), found the expert more productive through highly focused attention ('structured cognition') whereas the novice's attention was widely distributed and defocused ('unstructured cognition'). Thus they concluded that the difference in the structured cognitive activity 'may explain the novice's success in creating novelty and the expert's success in performance called expertise' (Kavakli and Gero 2002:39). Transferring the findings of Kavakli and Gero to the context of the ideation workshop seem to suggest that the Y1 students' playful interactions with conceptual tools produced rich "discoveries" that compared with the architect student's success in creating novelty. This further suggests that ideation is an unstructured, rather than a structured cognitive process, which may have an effect on the impact of digital technology on conceptualisation, and notably CAD as a sketching tool (see Chapter *Literature review*).

However, cognitive unstructuredness does not necessarily mean lack of any structure, in a similar way to how disorder is not the absence of all order but, as can be observed in the child's playroom, rather 'the clash of uncoordinated orders' (Arnheim 1971:13; see Chapter *Literature review*). It may also be described as a kind of artistic structure that 'evolves not in a single line of thought, but in several superimposed strands at once' (Ehrenzweig 1993:xii). Thus the novice's success in creating novelty may express creativity that 'requires a diffuse, scattered kind of attention that contradict our normal logical habit of thinking' (Ehrenzweig ibid.).

Creativity as defocused attention, as argued by both Ehrenzweig, and Kavakli and Gero (op. cit.), therefore suggests that Y1 students' discoveries emerged from ideation processes that were largely intuitive (playfulness and improvisation), rather than logical. This, in turn, may partly explain why computing (vector drawing packages), as a structured and mediated language (human-computer interaction), was little used as a conceptual sketching tool, although design experience and the skill factor would have to be accounted for too (see Chapter *Literature review*).

Moreover, in this unstructured scenario the workshop format was advantageous because as a placeholder for ideation, and in allowing for a pluralistic approach, it supported one of the aims of empiricism, defined by Whitehead as: 'to find the conditions under which something new is produced ("creativeness")' (in Deleuze and Parnet 1987). This suggests that the workshop activities were not just approached pragmatically or hands-on, but retained a philosophical perspective as articulated by Ehrenzweig in his notion of artistic structure (op. cit.), which furthermore echoes that of Deleuze's multiplicities, or manifolds.

> 'There are lines which do not amount to the path of a point, which break free from structure – lines of flight, becomings, without future or past, without memory, which resist the binary machine' (Deleuze and Parnet 1987:vii, 26).

Ideation, then, as expressed by the Y1 students, and captured in the self-reports, reflected a state of flux, rather than a solid-state process, which characterises much of software drawing packages (see Chapter *Literature review*).

Furthermore, in bridging the known and the unknown through imagination, and in using metaphor, some of the Y1 student's ideation activities, at times eclectic or serendipitous, might have been perceived through the looking glass as nonsense. That is, nonsense as opposed to science-sense, as mirrored in *Alice in Wonderland* where 'Carroll's uniqueness is to have allowed nothing to pass through sense, but to have played out everything in nonsense' (Deleuze 1998:22). However, for the non-sense, rather than science-sense, to happen, the workshop findings suggest an approach to teaching and learning that also allow for cognitively unstructured activities in the form of short, open-ended, non-assessed ideation projects (see Chapter *Literature Review*).

Idea expectation

However, the participants' unselfconscious approach to designing was revealed not only in their interplay with physical materials (sketching [S] and modelling [M]), but also in their interaction through spoken words [W], in brainstorming or by simply talking to each other. This approach showed similarities with the application of new thoughts, which Dorner has called the 'picture-word-cycle'.

> 'By putting [an image] into words you will almost certainly produce a lot of alternative pictures. The "benefits of chatting" ... are based partially on the inherent necessity to communicate one's idea and thus unconsciously to launch the "picture-word-cycle"' (Dorner 1999:409).

Moreover, the picture-word-cycle may explain why, in Square One, the most used ideation tools across project domains were sketching [S] and words [W] in combination [S+W] (Figures E:12 and E:13). This ideation pattern was corroborated when all conceptual tools used across domains were accumulated and traced over time (Figure E:22 and E:23). However, the dominance of sketching [S] and words [W] in phase I gradually tailed off in phase II and III, and most notably for words. This suggests that words [W] were most needed at the very start of the assignment when uncertainty and ambiguity were probably most acutely felt by the participants. Or,

> 'In general the initial idea is rough, incomplete and abstract – the details are missing and the idea is more a cloud than a definite outline' (Dorner 1999:408).

In contrast, modelling [M] and computing [C] tools were used more evenly during the assignments. This suggests that the students, when using these tools, might have to overcome a certain initial inertia, and therefore had to make an effort in "setting up" those tools. That is, once the students had decided to engage with modelling tools or to log onto the computer, their effort involved a kind of mental and physical "set-up cost" or "investment" from which they expected a certain return before abandoning those tools. The frustration of not getting a return from their computing efforts, as expressed by some participants, might be explained by the-set-up analogy.

Getting started with sketching [S] or words [W], however, needed little effort; pen and paper were easily at hand for scribbling, and words are always there ("open your mouth"). The analogy with investment, therefore, suggests that designing might be formulated as a strategy that involves a "calculated" set-up cost of conceptual tools that takes into account variables such as skills, time, experience, peer pressure, willingness to experiment and assessment criteria. However, and although not used in a computational sense, the notion of calculating the set-up cost for conceptual tools may seem an overly rational or cautious approach in the context of ideation that would go against the grain of unselfconscious design and trial-and-error. Yet, daydreaming (doodling!), spontaneity (gone fishing!) or hunch making (take a chance!) could be described as risk-taking variables too.

However, accepting that the participants had a fair choice of conceptual tools, within the constraints of the physical design environment (external factors) and their aptitudes, skills and experiences as novice designers (internal factors), did they subtly calculate the set-up costs for the tool(s) that would offer the best creative outcome? Or, did they pick tools mainly on a trial-and-error basis? Or, did they go for what was the most expedient for the task in hand, in what can be referred to as "the principle of least effort"? Or, in terms of adaptive morphology:

> 'There is usually an attempt to accomplish things with the least effort and with the most successful results possible. This is the common direction of all things in a general movement toward economy' (Williams 1981:74).

This line of thought might suggest a morphology of conceptual tools in which each tool is perceived of as having an optimal level of design related performance. However, optimisation suggests a rational, measurable design process, which seems to exclude a more intuitive approach in which ideation is more akin to unstructured thinking, as already suggested. However, optimisation, which is inherent in computer programming, is a factor behind research for the development of computer-aided sketching, in which, ideally, the pen and paper sketch would be made redundant (see Chapter *Literature review*).

Ideation and natural language

The participants' usage of sketching combined with words [S+W] suggests an important alliance of visualisation (imaging) and verbalisation (talking), what Schon calls 'the language of design' (Schon 1983). Parallel ways of conceptualising [S+W], further suggest that sketching [S] as an ideation tool on its own was insufficient at times and therefore needed verbal backup. But also the reverse, that is, how conceptualising with words alone was limiting because, as argued by Dorner, if ideas are put into words too quickly they may break down the dynamics of thought.

> 'These germinal phases, what can be regarded as rapid and partially unconscious recombination of images, may result in "sudden insights" and shouldn't be disturbed by attempts to verbalise' (Dorner 1999:411).

Dorner's observation was also reflected in a student's comment:

> 'The least appropriate tool was talking to others – it was just distracting' (Questionnaire Student 19).

However, there were situations when talking to others was crucial, for example, in the product design task (PR), where words [W] reached the peak as a single tool (Figure E:2), because of what was experienced as an unfamiliar design context (walking aid).

> 'I found the context quite tricky' (Questionnaire Student 32).

Yet spoken words are the most common means of human communication (natural language) hence, 'Words ... are employed by many designers in conceptualising designs' (Lawson and Loke 1997:183). Moreover, the participants, as novice designers, may have found words [W] particularly helpful as they had not yet developed a comprehensive design language or a body of design experience to draw from, or gained full competence in specific tool usage, such as sketching, modelling and computing.

> 'Talking with other students always helped' (Questionnaire Student 21).

Furthermore, spoken words [W] were essential for the participants to understand and interpret the values and knowledge embedded in the ideation assignment, as reflected in how words [W] featured prominently in getting started on the project, that is, in Square One (Figures E:12 and E:13), or in the first phase of the assignments (Figures E:22 and E:23).

Furthermore, the strength of words [W] when conceptualising was observed when the participants simply got started by chatting or brainstorming with each other, which seemed advantageous because: 'verbalisation helps in finding the weak parts of your ideas' (Dorner 1999:409).

Moreover, verbalisation suggests that design can take the form of narrative. Perhaps there was a need among students for "telling a story", when generating, developing and communicating ideas. The narrative, then, reflects how we in most everyday situations exchange ideas through words, and that 'narrative is one of the fundamental sense-making operations of the mind' (Lodge 1986:141). Moreover, the narrative is contingent on conceptual tools, or, 'implicated in narrative constructions of the self is the design device' (Coyne et al. 2002:280). Therefore, natural language might be underestimated or taken for granted when observing and documenting designers at work because language is one of the 'basic implements by which we progress from the world of mere sensation to the world of intuition and ideas' (Ernst Cassirer, in Dripps 1997:93 note 4).

But also, the interplay between graphical representation and spoken and written words, described by Tomes as the translation problem in a negotiating process, has remained little researched (Tomes et al.1998). This is in contrast to the growing interest in graphic user interface (GUI), where the reductive system of screen icons (in resembling pictograms of ancient peoples) may represent the trends towards a universal visual language driven by software. However, the need of verbalism in the design process has been recognised by interface designers. For instance, one such verbal interface is based on the concept of vague discrete modelling (Kuczogi et al. 2002). However, in the interface of the verbal and the visual it has been argued that, as the pace of life accelerates, verbal communication is being subsumed by visual communication: 'No one wants to wait any more ... Language is getting left behind in the rush' (Evamy 2003:11). Yet, the ideation workshops illustrated that, at least among novice designers, verbalisation [W] and visual [S] communication were comrades-in-arms, or partners in "telling" and "showing".

The translation problem also suggests that when words alone fail to convey meaning, sketching can express design intention through metaphor, the transfer of meaning through graphical representation and possibly written words, as in the annotated sketch. Similarly, sketch modelling may convey intention through artefacts. As a negotiating process, then, sketching may be closer to natural language and therefore to "thinking design", whereas sketch modelling would be closer to "making design". In evolutionary terms, from the archaeological fact that humans made tools before developing a higher level of awareness through language, the language link may explain how, as society becomes more design intensive, "thinking design", is gaining ground over "making design" in a digital design culture (see Chapter *Methodology*).

Moreover, this development can be seen in the evolution of industry and consumer markets, in the gradual shift from craft- to knowledge-based manufacturing, from selling to branding in post-industrial markets. For example, Nike™, the sports brand, relies on the interplay between visual (the "swoosh" symbol) and verbal representation (the name Nike). Yet, and although the Nike logo has visual impact, it is arguably the word "Nike" (written and spoken) that ultimately supports the power of the brand. Similarly, the importance of words is reflected in the history of design schools, in the shift from vocational to conceptually oriented curricula, from design practice to design studies, from asking "what" to asking "why"?

Sketching as speech

The translation problem highlights the relationship between words [W] and sketching [S] similar to that of language and speech. This relationship, or interdependence even, emphasises the social dimension of both design and language as can be seen when design ideas and artefacts are tested through everyday conversation with people or through text, say, in the many published books, learned journals and popular magazines on the subject of design. But the language-speech analogy may be taken further. According to Saussure's view of language as a means of communicating ideas, language is a social phenomenon collectively agreed on by a given culture, whereas speech varies according to the individual. 'It [speech] can be loud or soft, clear or slurred, formal or colloquial' (Schneider Adams 1996:134). Applying Saussure's differentiation between language ("collective") and speech ("individual") to the interaction between words and sketching, sketching then seems closer to speech, whereas drawing systems would have more affinity with language (see also Chapter *Literature Review*).

Moreover, if, as argued by Saussure, speech precedes language in the history of the individual, but language precedes speech in cultural history (Schneider ibid.), then sketching, as situated closer to speech than language, may reflect the history of the individual, rather than cultural history. In this sense, "ideation through sketching" may project the *persona* of the designer, or the autobiographical element of designing that reveals the designer's thoughts, feelings and behaviour. Furthermore, in a phenomenological approach to personality, as developed in Carl Roger's "Self Theory", ideation may become part of the 'self-experience', or 'self-concept, which is the way one thinks of oneself' (in Bernstein and Nash 1999:424).

The translation problem and the role of self were particularly illuminated in the product design assignment, which dealt with disability (ideas for a walking aid), a sub-field in design for which the students expressed their greatest lack of experience and tool competence.

> 'It is impossible to design this sort of thing [walking aid] without serious research into the nature of the disability' (Questionnaire Student 12).

> 'Disabled people would be the best people to design for disabled' (Questionnaire Student 8).

These comments illustrate the difficulty in improving the usability of a product (walking aid) when the designers cannot draw from their own "real-life" experience of using such a product. However, to compensate for the lack of first-hand experience, the participants used sketching in combination with words [S+W] to generate ideas to the extent that they were the most used single tools of all the workshop assignments (Figures E:2 and E:3). Moreover, they tended to collaborate with each other ("We" mode):

> 'More "We" this time because of lack of personal experience with disability' (Questionnaire Student 31).

Therefore, as part of "self-actualisation", ideation through a combination of non-verbal and verbal means [S+W] may reflect the artist's self-portraiture ("autobiography") in which the self-image of the artist may be achieved through a synthesis of word and image. Or,

> 'a quintessential statement of art as autobiography, of the artist's dual role as creator and created, of his authorship, and his presence in his own work' (Schneider Adams 1996:130).

Arguably, then, the participants effectively portrayed their self-image through ideation, in which they also seemed to add personal values to their ideas. The projected self-mage, therefore, was a significant outcome of the ideation workshops because the Y1 curriculum focused on "the Personal". Moreover, this suggests that ideation, in combining creativity and learning, is about 'personal growth', or 'becoming a person', a life-long task that 'cannot be done without having ideas' (Davies and Talbot 1987:24).

The outcome suggests that verbalisation (spoken and written words) is important in a digital design culture too, and, arguably, even more so, because the post-modern discourse is largely conceptually driven, that is, ideas translate into events and images, which can be read and analysed as text. Or,

> 'Semiotics continue to provide a vital apparatus for the analysis of texts – both verbal and visual' (Silverman 2001:200).

Moreover, from a semiotic perspective, and again to borrow from Saussure's distinction between language-speech, if sketching is perceived as closer to speech than language, this may also shed light on the relationship between ideation through analogue and digital means. That is, if sketching could be construed to be closer to speech ("individual"), drawing systems, in adhering to certain rules and conventions, would then be closer to structured language, that is, grammar ("collective"). In this sense, freehand sketching, as an *analogue signifier* would signify the individual, whereas CAD systems, as a *digital signifier* would signify the collective. Therefore, computing, as structure (grammar or, binary code), and therefore closer to language than speech, might help to explain why drawing packages, as a kind of a "grammar tool", and distinct form painting packages, were the least used conceptual tools by the students, except for graphics. This may further explain why, when the participants effectively projected their self-image through ideation, they did so mainly through sketching and words [S+W], which, arguably, are individual, rather than collective tools.

Moreover, the grammar analogy may partly explain why computing [C] was used mainly in the graphic design assignment, because graphics consist essentially of "building blocks" as a kind of "grammar elements" (type, font, size, geometric symbols, etc), which also made graphic design an early candidate for computer programming. Yet, the relative low use of computing [C] among the participants may also reflect their lack of computing experience, or poor human-computer interface. However, we cannot generalise from this and say that computing is a weak conceptual tool because the computer is not just a tool but also a creative medium. But if computing seems underdeveloped as a conceptual tool, this suggests the need for more research on computer-aided ideation, CAI (see Chapter *Literature review*).

However, the use of sketching [S] across the design domains evoked the "first principle" of the visual arts. Yet the visual arts have traditionally focused on the individual, or the autobiographical aspect of creation. This suggests how the traditional link between the visual arts and design emphasises the personal aspect of designing, as creation. Moreover, the personal aspect evolving around "speech" rather than "language" may again explain participants' preferences for using sketching [S] and words [W], rather than computing [C]. In this, the link to visual arts may have appealed to the participants because the Goldsmiths BA programme grew out of the College's fine art department. Therefore the participants may have identified themselves with the cultural and artistic, rather than the corporate end of the design spectrum. However, more specifically, to acknowledge the personal aspect of design ideation seems important for turning computing into a user-friendly conceptual tool, for example through personalised interface or individual programmability.

However, there may be a risk of focusing too much on the personal aspects of designing:

> 'How designing work is done, how thinking proceeds from a cloudy idea to a clear picture of a machine is dependent on a lot of personal and environmental conditions and on the characteristics of the task' (Dorner 1999:413).

Therefore, the many internal and external conditions at play in design highlight how designing is a collaborative activity. For instance, brainstorming and talking within the peer groups during the workshop assignments illuminated the positive social and critical effects of collaboration.

> 'Through talking and bouncing ideas around between us, we did not worry about odd ideas, we just carried on to the next idea knowing it's different. Having a small group meant that easily we got our ideas criticised' (Questionnaire student 40).

Summary and Implications

The most frequently used conceptual tools by the participants were sketching [S] and words [W], irrespective of design task. These tools were also most frequently used in getting started on the projects (Square One). Therefore visual representation and narration, two fundamental *sense-making* operations ("showing and telling") were dominant features, which suggest that both non-verbal and verbal skills are important for design ideation. Moreover, implied in uses of conceptual tools were narratives of self. Or, self was mediated through conceptual tools.

The decline in workshop attendance over time suggests that learning objectives as perceived by the participants did not necessarily correspond with those laid down in the curriculum. That is, there seemed to be a mismatch between participants' expectations of using drawing in a digital design culture and their learning experiences. Arguably, then, this could provide a window of opportunity to re-evaluate and re-examine the role of sketching in design schools including teachers' response to digital technology or, rather the teaching and learning relationships in analogue and digital modalities. Moreover, the drawing agenda in design schools may become part of the wider issue of "the management of expectations" among students and their teachers.

The combined tracing of all tools in all four projects over time revealed a sequential pattern of tool usage that most resembled that of the architecture workshop assignment. Arguably, then, the architecture ideation task best illuminated the distribution and frequency of conceptual tools used among all four projects. Interestingly, this finding reflects how architecture is traditionally regarded as the mother of all arts, embracing both two- and three-dimensional shape and form, but also at the forefront of using digital technology as well as a major field in design research.

The frequent use of sketching [S] or words [W] on their own or together [S+W], suggests, from a semiotic point of view, that sketching seems closer to speech, whereas drawing systems would have more affinity with grammar. In this, sketching, as an extended form of speech, may precede rule-bound technical drawing. Yet, in the digital design studio the reverse may be the case, that is, rule-bound drawing packages are being used without prior sketching. Arguably, then, there is a risk that the drawing packages, CAD, might squeeze freehand drawing in the sense of going too early to the computer, a concern also expressed by practitioners (see Chapter *Introduction*). However, the workshops did not corroborate this.

In fact, the workshop outcomes did not suggest any great impact of digital technology on conceptual sketching, with the exception of the graphics assignment. This, however, might be explained by how the participants, as novice designers on a general design programme, had not yet developed a digital design language appropriate for ideation. In this, their approach to designing resembled what is known as 'unselfconscious design', or the prevalent form of design prior to it becoming a distinct profession.

However, the small impact of computing on design ideation beyond the graphics assignment was not because the participants lacked interest in digital media. On the contrary, the participants seemed frustrated in not being able to use computing more extensively for ideation tasks. This suggests that they had not gained sufficient skills to turn the computer into an effective ideation tool beyond simple drawing or image manipulation, or searching on the Internet, which, however, counted as words. Thus it is open to further debate and research as to what extent computing can benefit design ideation, or *computer-aided ideation, CAI* (see also Chapter *Literature review*).

On the gender issue, the findings showed differences between male and female students in their uses of conceptual tools but it was not possible to draw any significant conclusions about the impact of gender in design schools and how it might have implications for ideation.

The potential of ideation workshops

The lack of advanced computing skills among the participants, as novice designers, suggests this was a missed opportunity for integrating analogue and digital mediums, encouraging the application of the widest possible range of conceptual tools. The ideation workshop seemed a suitable format for exploring such integration.

The spontaneous collaboration between participants at ideation level suggests that team and social aspects of design may be underestimated or underrated in course assignments. Again, ideation workshops might be a means of increasing awareness about conceptualisation across design domains. In this, tools were not so much connected to specific domains, rather they reflected *a culture of design ideation* where the visual and verbal modes of expression strongly interacted.

The self-report protocol proved an effective research technique for capturing the uses of conceptual tools. In this, the workshops responded not only to teaching and learning demand but also the research objectives in that the participants effectively became co-researchers. Or, 'The student functions as a design researcher while learning *about design*, in addition to *how to design*' (Oxman 2004:64).

Therefore, the two-hour ideation projects were long enough to achieve meaningful teaching, learning and research objectives. This suggests that small, short time-scale ideation projects, as part of design curricula, can be a means of encouraging improvisatory skills for developing the ability to design on the fly, or *ad hoc*. Short ideation workshops might also be an exciting and effective vehicle for collaboration between design schools and industry that would emphasise design as a learning environment bridging education and industry.

F: FINDINGS AND DISCUSSION

Y2 Students and Practitioners in industry

Participants

Using purposive sampling (see Chapter *Methodology*), the following multiple case study contains ten individual cases recorded by five second-year (Y2) design students and five design practitioners in the domains of fashion (FA), architecture (AR), graphics (GR), product (PR), and general design (DE). The students and the practitioners were matched according to design schools, that is, the practitioners had graduated from the same design schools as the current students, with the exception of product design where I was unsuccessful in finding a matching pair. The second year was chosen because that was the main teaching year and therefore the Y2 students were neither beginners nor fully-fledged designers. In contrast, the practitioners had been working in the design industry for at least a year since their graduation in 2001 or 2002. Thus they had gained some industry experience in their respective design fields yet, with their college experience at close range, not too settled in their practice. This was thought important in order to illuminate the most recent impact of digital technology in design colleges and professional practice, particularly as senior designers tended to hold rather established views of the role of conceptual sketching (see Chapter *Introduction*).

However, participation of junior rather than senior designers in industry also reflected how senior practitioners were less willing to take part directly in the protocol study. But even at junior level it proved at times difficult to find volunteers confirming concerns among design researchers that industry can be disinclined to engage in academic research at the creative end of design, that is, more than, say, answering a questionnaire or agreeing to an interview. This, however, might imply criticism by industry that design research may lack relevance for practice. This was in contrast to the design schools, where students were more readily interested, possibly because they could relate the case study to their own immediate learning situation, and therefore could see the potential benefit of participating.

The reluctance by industry to volunteer for research, however, did not only reflect attitudes of individual practitioners but also of management. For instance, I spoke to designers who were interested in the research issue but did not get the approval to participate from their studio manager, or board of directors. The main reason given for not wanting to participate was either "lack of time" or, "not having a suitable project at hand". But there might have been "hidden" motives for saying no because ideation reflects that which is not final and therefore ideas are not only susceptible to revision but also to personal doubt and dissatisfaction. Therefore, it is conceivable that practising designers did not want to expose personal working practices that also might be a comment on company policy, for instance, "what if I don't like sketching?" or, "everything is done on computers here". Moreover, they might have been apprehensive of divulging confidential studio information reflecting the strong competitive nature of the design industry. Or even, from a perspective of design as a "tribal" activity, there may be secrets, like ritual art, from which design researchers, like anthropologists, are excluded.

Reasons for not wanting to take part became clearer in the protocols and taped interviews because together they revealed more than just uses of conceptual tools. What emerged was designer traits and identity, in what might be seen as an *ideation profile* of each participant. However, despite the sensitive issue of revealing personal approaches to ideation, the outcome of the individual cases shows that self-reporting can be a method for elucidating first hand experience of situated design for the benefit of both researcher and participant (see below).

Administration

The outcome of the Pilot was applied to the multiple case study giving rise to only minor changes. Thus the layout of the grid was maintained in the self-analysis protocol although expanded from a single page to a double-spread to increase overview and ease of recording, as recommended by the pilot participant (*Appendix F:1*). Also, what was initially labelled "urgency" in the pilot protocol, when stating the reason for using a certain conceptual tool, was renamed "essential tool" to better convey the meaning of conceptual tools that the participant "could not do without". A few alterations were also made in the interview protocol (*Appendix F:2*). For instance, the pilot question on how many ideas were generated was left out as counting ideas might imply focusing on quantity (outcome), rather than uses of tools (process). Moreover, the pilot participant found it difficult to recall every possible idea that had gone through his mind during the project, which highlighted how ideas to be developed have to be externalised through conceptual tools.

The impact of digital technology on conceptual tools, as the primary research question, prompted two additional questions. First, "Have your use of conceptual tools changed over time?" This question aimed at capturing any change in uses of conceptual tools experienced by the participants either during their studies, or since they had left college for the industry (*history*). Second, "How do you see the future impact of digital technology on conceptualisation?" This question gave the participants the opportunity to speculate about the future role of computing as an ideation tool (*future*).

Another difference between the Pilot and the multiple case study was that a dedicated software program was used for producing charts for the thesis to enhance clarity of research data.

Thus largely repeating the pilot procedure and protocol format, participants recorded their uses of conceptual tools according to the issued guidelines. However, and although the multiple case study relied on volunteers, which implied trust between researcher and participant, self-reporting, as a subjective record-keeping process, can be inaccurate (see Chapter *Methodology*). Thus there were omissions. For instance, when a particular conceptual tool was recorded in the protocol without being specified as an "essential tool" (indicated with an "a"). Or, similarly, when the communication mode ("I" or "We") was left out.

Also, discrepancies emerged occasionally between protocol data and interviews, as was also the case in the Pilot. These omissions or inconsistencies were treated as "missing data". Yet, on balance, these gaps in protocol data were small and, moreover, could often be interpolated without significant loss of credibility (accuracy), bearing in mind that

> 'In the disorderly world of empirical research … observations do not jibe completely with interview data' (Huberman and Miles 1994:438).

The interviews were carried out on the participants' work premises, either in design schools or design offices as soon as the participants had let me know they had stopped recording conceptual activities for the case project. The audio-taped interviews lasted about 30 to 40 minutes and were transcribed by me on the same day of the interview to retain the feel of the interview situation. All participants answered all the scripted questions in the interview protocol, but the open-ended nature of each interview also stimulated non-scripted questions as the interview unfolded. This confirmed how case study interviews 'appear to be guided conversations rather than structural queries' (Yin 2003:89). Similarly, and repeating the pilot procedure, the transfer of raw self-reported data into charts in the interview protocol at the time of the interview provided a quick "at-a-glance" overview of uses of conceptual tools. However, the recorded protocol data were later checked for consistency and accuracy before being presented in the final thesis using dedicated software. As mentioned, a few omissions were then observed (see above).

Analytical technique

At the very beginning of each interview, and partly to put the participants at ease before the self-analysis protocol was examined, each participant was asked about his or her educational background. This was also an opportunity to ask the participants about their views on uses of conceptual tools in general. Therefore, they were asked to rate each category of conceptual tools according to whether the tools were 'Core', 'Useful' or 'Marginal'. The individual rating would then be checked against the actual recording of "essential" tools in the self-protocol (see below).

In order 'to corroborate interview data with information from other sources' (Yin 2003:92), the participants were asked to bring to the interview evidence of their uses of conceptual tools. Such evidence took the form of, for instance, freehand sketches, photographs, or computer printouts, as shown in the illustrations to this Chapter. Only one participant (the graphic practitioner) did not volunteer any illustrations. However, the reason for including the illustrations in the case study was not to judge, assess or evaluate the ideas generated but rather, and according to the research objective, to illuminate uses of conceptual tools. True, it has been argued that 'considering the quality of design outcomes … is a core issue in the [drawing research] field' (Purcell and Gero 1998:399). Yet, to judge the project outcomes in a rigorous, scholarly manner would have been both controversial and insensitive because, at the interview stage, the outcomes were ideas (propositions), or work in progress, rather than final plans, artefacts or systems. Moreover, the uniqueness of each project, and therefore case study protocol, reflected differences in skill levels and experiences of participating designers (see Chapter *Methodology*).

The shown illustrations, however, did add a vivid visual dimension to the rich verbal descriptions of tool usage as expressed in the self-analysis and interview protocols. In this way, the illustrations reduced the risk of an over-reliance on verbalisation in describing conceptual thinking and behaviour, which is a major criticism of the protocol analysis method when applied to design (see Chapter *Methodology*).

Not surprisingly the individual projects varied greatly in content, style, complexity and duration according to the specific briefs and circumstances under which the participants worked. As a result the length of the conceptualisation period within each project could not be prescribed. It was therefore left to the participant to decide when conceptualisation started and ended and therefore when to begin and stop recording ideation events. The recordings, then, raised the issue of validity and authenticity, that is, how reliable the self-protocol was as a research instrument as well as the trustworthiness of the participants (see below).

Differences in project duration also meant that in order to make meaningful comparison of the uses of conceptual tools between students and practitioners, and between design disciplines, a yardstick had to be construed and applied across the individual cases. This was achieved by calculating single tool usage as fractions of all tool usage for each case (tool distribution), and by dividing nominally each project into three phases (tool frequency, or time trace; see below). Thus the protocols provided data both in absolute terms, that is, how many times each tool was used, and relatively, that is, tool usage over time. By dividing each project into three nominal phases, the tracing of uses of conceptual tools could be presented graphically, which improved clarity (see time trace charts below). This approach differed from the time-trace carried out in the Y1 student study where all the assignments had a fixed time limit, which enabled simple averages to be calculated for interpretative purposes (see Chapter *Findings Y1 Students*).

However, the counting of tools was not primarily a quantitative exercise (quantitative research) but done to illuminate conceptual tool usage (qualitative research) from which, and according to the method of purposive sampling analytical, rather than statistical generalisations might be made (Yin 2003). This approach, moreover, took into account the risk of generalising from case study. Noblit and Hare, for instance, have 'cautioned against aggregating or averaging results across cases, in order to avoid misinterpretation and superficiality' (in Huberman and Miles 1994:435).

The shortest time for recording individual uses of conceptual tools was less than a week (practising fashion designer), whereas the longest spanned just over eight weeks (practising architect). However, the individual projects, and therefore self-reporting got started at different times, which resulted in the gathering of research data lasting effectively nine months, rather than the six months initially planned. The protracted data gathering process meant that time and effort for data collection were somewhat underestimated confirming how 'the data collection process for case studies is more complex than the processes used in other research strategies' (Yin 2003:106). But also how 'qualitative studies tend to have a peculiar life cycle, one that spreads collection and analysis throughout the study' (Huberman and Miles 1994:430). However, it was crucial not to "hurry-up" participants in any way, because under adverse circumstances 'an interviewee may not necessarily co-operate fully in answering questions' (Yin 2003:72). Moreover, participants, after all, are doing the researcher a favour (Bell 1999). Furthermore, the extensive period of case data collection confirmed how, when 'interviewing key persons, you must cater to the interviewee's schedule and availability, not your own' (Yin 2003:72)

By allowing the participants to carry out the self-recording in their own time (self-pacing), as the individual design projects required, the control over data gathering was relinquished. As a result, the interaction between researcher and participant had to be flexible. 'Your behaviour, and not that of the subject or respondent, is the one likely to be constrained' (Yin 2003:72). Such constraints embodied in case study might also explain why many behavioural observations at close range are carried out in closed environments under laboratory-like conditions, as exemplified by Goel (1995; see Chapter *Methodology*).

Usability, usefulness and reliability of self-reporting

The pilot finding that the self-report, as a kind of diary, or observational log, could be regarded as a preliminary to interviewing (Burgess 1981), was repeated and therefore made credible in the multiple case study (validity). Thus the Self-report, together with the Interview protocol, and similar to the diary-interview method, effectively acted as 'an approximation to the method of participation observation' (Zimmerman and Wieder, in Bell 1999:149). Moreover, and again repeating the pilot finding, all participants found the Self-report easy to fit into their daily work sessions without interfering with the design task ("usability"). This suggests that the Self-report met the reliability test. That is, self-reporting, as a data gathering technique in which the participants effectively were co-researchers, was able to capture consistently uses of conceptual tools in ten individual cases. The outcome, then, suggests that the technique might be repeated successfully in a larger multiple case study.

The criterium for the reliability test was the consistency in the observation through time, or *diachronic* reliability (Kirk and Millen, in Silverman 2001:225), but also *synchronic* reliability, that is, reliability that could be assessed through triangulation, that is, through interviews as well as observation (ibid.). Furthermore, reliability could be claimed from the fact that the protocol was based on the participant's interaction with conceptual tools (reflection-in-action) confirming that self-reporting was as an appropriate method for situated research, that is,

> 'taking the action (move) as the "unit for studying design" also gets us much closer to the activity of design as experienced by designers' (Dorst and Dijkhuis 1996:269).

Situating the research as close to the design activity as possible benefited the participants too. Therefore, all but one participant considered the co-research task worthwhile in that it increased their awareness of the role of conceptual tools in the individual ideation process ("usefulness").

The "exceptional" case in respect of usefulness was the general design practitioner who felt that although the self-reporting was not difficult (usability), it was not very useful. 'It doesn't reflect my process. It was too rigid' (see case *General Design Practitioner* below). Asked how the protocol might be improved, the participant thought 'it could have been a more organic format', but, when asked further, could not elaborate what "organic" in this respect might entail. Although each "ideation process" is highly individualistic, and in this case had a strong conceptual content with only a "visionary" material outcome at the self-reporting stage, it is also fair to say that any grid-based research instrument would, by design, have a certain "rigour" built into it. That is, the purpose of the grid, as a data collection technique, was to capture uses of conceptual tools systematically and rigorously.

Yet, the exceptional case highlighted the difficulty of recording an individual design activity within a highly conceptual context for which a systematic, rigorous approach might be less suited. This may be particularly relevant when the complexity of the design task has not been fully formulated, which was the case with the general design practitioner who had written a speculative brief which might be described as an interactive art installation (see case study below). Therefore, in such cases, the grid might need to be replaced by a more dynamic model yet to be designed and tested that would allow for greater flexibility when self-reporting. However, such difficulties may also reflect a change in participants' attitudes to on-going self-reporting, for instance, they might get tired of it (cf. the fall in ideation workshop attendance).

However, in terms of research methods, the line between "rigour" and "rigidity" can be fine, which emphasises the importance of checking self-reporting outcomes by other means, or so called triangulation. This was achieved in the exceptional case in that the Self-report effectively served as a preliminary to the interview thereby providing a procedural reliability check on the self-reporting. In this way, the exceptional case contributed to the study in a meaningful way, similar to the other cases. That is, although the participant found self-reporting "not useful", the overall finding of that particular case nevertheless illuminated the ideation process. Therefore, the Self-analysis protocol, as here applied, could be described generally as a means for not only recording, or *constructing* conceptual events but also for *deconstructing* the ideation process, whereas the interview protocol *reconstructed* the process. This suggests how the two protocols combined revealed a kind of *do-undo-redo* ideation/research process resulting in a "whole", rather than a "fragmented" picture of what had happened.

Overall, the multiple case study confirmed the findings of both the Pilot and the Y1 student case study in terms of usability and usefulness of self-reporting (see Chapter *Pilot* and Chapter *Findings Y1 Students*). This was evidenced when participants were asked in the interviews: 'Did you learn anything from self-reporting?' For example:

> 'I can see these kinds of [conceptualisation] patterns, how and which tool I've been using. What was important, if it was just me, or with another person. Maybe I can put that on any other things I do, on a computer base mainly.' (Practising graphic designer).

> 'It's nice to see how much I've achieved in a week's work. So it's been a useful tool in analysing the way you're working.' (Practising product designer).

> 'Yes, it's been very useful', but, 'I was surprised to see that I didn't indicate [in the self-report] more instances of personal preference for using the computer.' (Practising architect).

> 'It [the self-report] was easy to use … I became aware of that I use computer less than I thought I did. Also how much time was spent on model-making when I could be doing something else. Because you use computers it makes model-making seem even slower.' (Product design student).

> 'It has made me a bit more aware of my conceptualisation, which is a good thing because it is good to distinguish between conceptualisation and then actual production.' (General design student).

Cross-case analysis

The approach to interpreting uses of conceptual tools in the multiple case study was a mix of cross-case strategies, including 'multiple exemplars' ('elements of design ideation'), 'types' or 'families' ('patterns of usage'), or 'variable-oriented strategies' ('themes across cases') (Huberman and Miles 1994:436; see Chapter *Methodology*). In this, the representation of cases became an "untangling" process that resembled a "search narrative" where meaning was "teased out". But also of 'letting the case tell its own story', in which 'the case content evolves in the act of writing itself' (Stake 1994:239-240), because the narrative, as a series of events, is concerned with process encapsulated in questions like 'and then? or why?' (Lodge 1986). Therefore, the writing reflects how the criteria of representation ultimately are decided by the researcher (ibid.), or, how the analysis presented becomes a personal interpretation that does not rule out alternative interpretations (Davies and Talbot 1987). In this sense, validity becomes an issue of epistemological validity, that is, 'validity represents the always just out of reach, but answerable, claim that a text makes for its own authority' (Lather, in Denzin and Lincoln 1994:579).

In this way, the authority of the research, as text, is shared between the researcher and the participants, as co-researchers. The cross-case analysis, therefore, in trying to preserve the uniqueness of each case whilst comparing them, is mediated through a narrative of both language and pictures, which is intended to illuminate ways of situated design ideation leading to an informed discussion about uses of conceptual tools. This sense-making approach, then, aims at reducing the risk of 'ending with a smooth set of generalisations that may not apply to any single case' (Huberman and Miles 1994:431). Therefore the radical social science method, which holds that it is possible to generalise from the existence of any case ('tap into whomsoever, wheresoever and we get much the same things'), is rejected (Sacks 1984:22, in Silverman 2000:108-109).

Case narratives

Bearing in mind the risk of generalising from case study, the ten cases are described and presented in pairs by domain, to give some structure, cohesion and flow to the presentation. Therefore, the fashion student and the fashion practitioner are paired, and so on. Each case is given an introductory, at-a-glance *ideation profile*, which includes the educational or work setting, a brief description of the project and its duration (the number of conceptual sessions worked as recorded in the Self-protocol). It also highlights the most used conceptual tool (ratio between the most used conceptual tool and all conceptual tools used, as a decimal fraction of 1.0), and conceptual tool intensity (ratio between total number of conceptual tools used and number of conceptual sessions worked).

The case descriptions are based on the individual Self-reports and Interview protocols (for transcripts of the interviews, see *Appendix F3 and F4*). Together they make up for narratives aiming at illuminating, and therefore *making sense* of differences between the design student and practitioner in each domain, and between domains. Sometimes a word [within bracket] has been inserted in a quote to help the smooth reading and understanding of a particular sentence. The interdisciplinary analysis and interpretation appear thereafter, extracted from recorded data, which have been tabulated and inserted into charts using dedicated software. This was done to facilitate comparisons between the students and practitioners across domains in order to address the research questions.

Fashion Design

Y2 Fashion design student (Central Saint Martins College of Art and Design)
Project brief: 'To design a capsule collection of six outfits in which every garment must contain a print'.
Duration: Number of recorded conceptual sessions: 29
Most used conceptual tool/s (fraction of 1.0): Modelling (0.7)
Conceptual tool intensity: 1.2 (36/29)

Practising Fashion designer (2001 graduate; Central Saint Martins College of Art and Design), working for a major UK fashion retailer based in London's West End.
Project brief: 'To design a fashionable range of three pieces of luggage to incorporate printed canvas'.
Duration: Number of recorded conceptual sessions: 7
Most used conceptual tool/s (fraction of 1.0): Words (0.4)
Conceptual tool intensity: 1.0 (7/7)

Comparison

Although the two briefs had print as a common feature, the ideation processes varied greatly. For a start, the duration of each project was considerably different. Thus the student's project was run over two months (29 conceptual sessions), although it was carried out in parallel with another Y2 project, whereas the practitioner's project lasted only three-and-a-half days (7 conceptual sessions), which, however, was described as a 'longish' project in that particular fashion company. The tight deadline against which the practitioner had to produce concept drawings reflected the short lead-times and design cycles operating in the fashion-wear and accessories industry.

The individual ideation processes of the student and the practitioner were very different. The student got started in the computing mode [C] by placing disused pieces of machinery ("found objects") directly onto the glass top of a photocopier (a digital means) thereby producing intriguing patterns on copy paper. These were then developed through freehand sketching [S]. This was a playful and imaginative activity that lasted about a week after which the student spent the remaining time almost entirely engaged in experimentation with materials in ways that was described as sketch modelling [M] using print screen tools, light box and darkroom photography. By scanning found items, the student created patterns that could not have been created by a digital process alone (software). Moreover, these images gave his idea an analogue feel, which seemed to owe as much to serendipity as to the creative use of technology. However, in his "discovery by chance" ("Aha!") he was prepared in the sense he knew how to work digital technology.

The student recorded three "Aha!" moments or "sudden insights" (see Chapter *Pilot*). The first happened in the computing [C] mode, when experimentation with photocopying turned out symmetrical images without cutting with paper ("a cut-through"): 'I didn't do that. I just pulled it off. It just worked'. The second moment appeared while sketch modelling [M], when the student found a lot of material left over and decided to cut a shirt: 'It was just an idea I thought of'. The third "Aha!" moment occurred through sketching [S] the day before the project critique when the student found material was still 'lying on the bedroom floor':

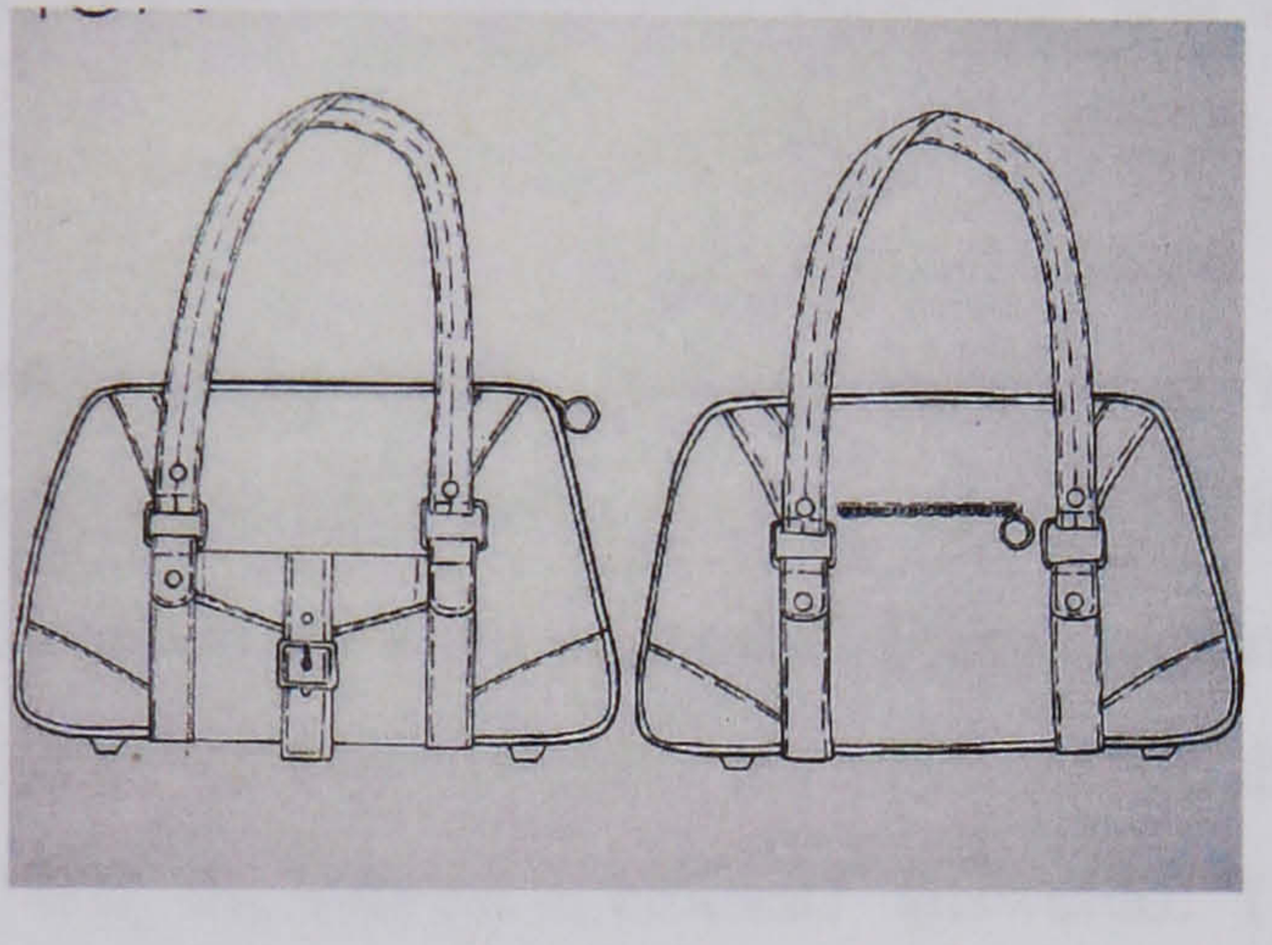
> 'Because you are constantly working finishing things off, you start generating more ideas. That's why I decided to suddenly make some trousers' ... 'I did about 45 [sketch] designs and then suddenly thought trousers can't be too hard to make. So let's just make the trousers. So I came here [to College] and made some trousers' (Illustration F:1).

Ill.F:1 FA Y2: '"Aha!" .. I made some trousers'.

In contrast to what may be described as an eclectic design process by the design school student, the practitioner's approach was less experimental. The first day was taken up by looking at existing luggage ranges in the shops, 'to see what the market currently had luggage-wise', and by using a large range of fashion magazines to collect what is know in the trade as "tear sheets" (magazine cuttings). The second day was spent searching the Internet [W], 'to see what was out there', and keeping appointments with print studios to view collections. On one such visit the practitioner had an "Aha!" moment [W] when a print was discovered.

'I found a print that made me think "Yeah! That's right". That's exactly what I need. And then as soon as I had that, it was easy. It was almost like designing a product around the print I bought and felt suited [the brief]'.

After the "Aha!" moment, which could be seen as an "extrovert" ideation event (recorded in the "We" communication mode) the practitioner returned to her studio desk where she quickly produced ideas doing "thumbnail" sketching [S] on A4 design sheets with a pen. The best idea was then turned into a measured, freehand drawing called the "spec", around which the design idea pivoted: 'Spec is everything here' (Illustration F:2)



Ill. F:2 FA Pr: 'Spec is everything here'

The spec was then, together with the bought print, scanned into the computer. The reason for scanning was to get the right scale because 'I was using a print so I wanted to get my idea what the print would look like on the finished product'. Colour swatches were also produced on the computer 'to present them in a clear, technical way', and sent to the manufacturer to make a prototype 'in the correct fabric and everything'. Thus the practitioner's designing did not entail any sketch modelling. In fact, the practitioner said she did not really miss sketch-modelling [M], although 'when someone makes a pattern from my sketches, then they can call me and I see it in person'. Thus the absence of sketch-modelling [M] contrasted sharply with the fashion student, who saw modelling as a 'core' conceptual activity: 'I love making, as much as I love printing'.

However, in general terms, both the student and the practitioner considered sketching [S] a 'core' conceptual activity. For the student the benefit of sketching was that 'it is quick, you just jot down ideas', whereas the drawback was that 'it is not as neat as some people would think. Especially if it is a quick process it is not going to be standard'. This was a reference to the difference between 'slick' digital images and 'raw' freehand sketches. The lack of sketching standards usable to industry was also reflected in the practitioner's usage of the computer to give the sketches 'more of a professional finish … so everything was right and clear so there were no mistakes'. This underlined not only the ambiguous, non-standard character of sketching (thumbnail) in contrast to measured drawing (spec), but also how professional practice demanded a higher level of 'finish' than design schools even at the conceptual stage.

The practitioner shared the student's view of sketching as a fast medium:

> 'I find sketching much, much quicker than the computer. ... I find it the quickest way to see how I want something to look, or could look. If I had to draw everything on the computer it would take me days'.

The practitioner, however, saw no drawbacks with sketching. 'For me sketching is really the only way I can design'.

The student considered words [W] a 'useful', rather than 'core' or 'marginal' conceptual tool. Moreover, the student preferred to sum up his work 'in a page' (written words) rather than talk about it: 'I don't really talk about my work in general. I think pictures can tell you more than words do'. The student's reluctance to talk about his work echoed the fashion designer Brian Kirby, who, when asked 'Why the interest in clothes?' answered: 'I realised you could be vocal without speaking' (Kirby 2003). In so doing, the student also projected what might be the truly specific feature of dance, or dancers: 'They do not necessarily need words in order to make themselves understood. They have movement' (Cramer 2003:82). Indeed, fashion as movement!

The practitioner also regarded words [W] a 'useful' tool. However, unlike the student, who worked most of the time in solitude at home, the practitioner was immersed in a busy commercial environment in which words [W] played an important role.

> 'In terms of speaking with my colleagues, conferring on ideas, it can be helpful if I'm stuck, or unsure of something, bouncing ideas off each other'. Or, when criticised, 'Sometimes [words] can make you unsure of yourself'.

The student considered sketch-modelling [M] a 'core' activity, both generally and specifically in the case study project:

> 'The benefits are that you can see it. You can't design something without modelling it. You can design something and leave it, or you can model something and see it for real. And there is much satisfaction for making'.

In contrast, the practitioner generally thought of sketch modelling only as a 'marginal' conceptual activity, and, in fact, did not use the modelling tool in the case study project. In this she was influenced by the way the design process was organised (division of labour) in the company she worked for. That is, she did not physically model garments herself, as she would have done in college, although she did meet with pattern makers. However, the practitioner shared the student's view of the visual, tangible benefits of modelling. 'There are benefits [with modelling] in that you can instantly see if it needs altering or changes'.

The student used the photocopier as a conceptual tool, which was recorded as computing [C] in the protocol.

> 'Benefits [with photocopying] are the same as with sketching: Quick. But you can also get some really nice results and effects. And it can look a lot slicker as well'.

The "slick look" of photocopies also meant they were used for presentations. In contrast, the practitioner seemed less enthusiastic about computing [C] as a conceptual tool

> 'because it takes quite a while to use the computer, because I'm Okay but not fantastic on it. But I'm learning to like it more'.

On the question of, 'Have your use of conceptual tools changed over time', the student said: 'No, it's the same. I don't think it ever will'. In contrast, the practitioner said she had changed since starting working in the fashion industry:

> 'The importance of sketching has changed. "Spec" sketching wasn't so important at college. "Spec" is everything here, getting it right and to scale. And although I don't like using the computer, I never used the computer at college at all. But we didn't really have any training on it so I think that's where the fear of computers comes from'.

These two contrasting views reflected differences both in personal attitudes and experiences but also how the creative environments in design schools and industry can differ.

The practitioner's lack of computer training on the degree programme was in stark contrast to that of the participant student, who was introduced to computers in his first year. This represented a rapid change in computer training on the fashion course because there was only a two-year gap between the Y2 student and the practitioner, who graduated from the same course in 2001. In fact, the use of computers among the Y2 fashion students was so widespread in 2003 that the case study project brief explicitly asked the students 'to refrain from the use of computer generated images'. However, the student said the stipulation in the brief did not make any difference to his conceptual approach. Thus the student's "creative licence" was much greater compared with the commercial constraints experienced by the practitioner.

On the question of the future impact of digital technology on conceptualisation the student, again, held very strong views of computers. This also reflected how the student throughout the project worked very much on his own, which, according to the protocol guidelines, was categorised as "Inner-personal communication", or "I-mode":

> 'It [digital technology] doesn't pose a threat to me at all. I know how computers work. So now I'm getting rid of computers'.

The practitioner's approach to computing reflected the business environment:

> 'In this company there's not a great deal of emphasis on computers. ... everyone freehand sketches. We use [the computer] for Internet access, and research and things like that, but actually design-wise we don't use it that much'.

In the Y1 case study it was suggested that uses of conceptual tools may represent a form of "investment", a strategy that is based not only on designer skills and experiences but involves a calculated "set-up cost" taking into account variables such as assessment criteria and other external rewards. From the fashion practitioners' perspective, the business environment might be such a variable (see also Chapter *Introduction*).

To summarise: Modelling [M] was the major conceptual tool used by the student (0.7), but words [W], and particularly spoken words, played a minor role as the student was working essentially on his own. Computing [C] was in the form of photocopying, which got the project started, together with sketching [S]. The practitioner, in contrast, used words [W] as the most frequent conceptual tool (0.4), which exemplified how design is a collaborative, or social activity: 'In industry, designers work a substantial part of their time with others' (Dwarakanath and Blessing 1994:95). However, the practitioner did not use sketch-modelling [M] at all, as she was constrained by cost and time pressure in the business. In comparing the two, the student, rather that the practitioner, displayed qualities sometimes associated with fashion design, for example, 'nebulous, spontaneous, chaotic and imaginative' (Lawson 1990:1). However, the case study shows that such statements highlight the risk of generalising design practice in terms that reflect assumptions, or stereotyping, rather than empirical evidence. This further suggests that:

> 'Much more knowledge about designing "in the real world" is needed before design researchers can advise on "how designing work is done"' (Dorner 1999:413).

Architecture

Y2 Architect student (The Bartlett)

Project brief: 'To design an arrivals building for visitors on a National Trust site'.
Duration: Number of recorded conceptual sessions: 17
Most used conceptual tool/s (fraction of 1.0): Modelling (0.5)
Conceptual tool intensity: 1.0 (17/17)

Practising architect, working for an award-winning London based practice
(2001 Diploma, The Bartlett; ARB/RIBA 2003)
Project brief: 'To design the interior of a flagship fashion store in London's Oxford Street (2,000 square metres)'
Duration: Number of recorded conceptual sessions: 85
Most used conceptual tool/s (fraction of 1.0): Computing (0.4)
Conceptual tool intensity: 1.6 (135/85)

Comparison:

There was a considerable difference in the length of the two projects. The student spent three-and-a-half weeks (17 conceptual session) on a conceptual studio project, that is 'There was nothing that was totally resolved', although the student had to produce final drawings at the end of the academic year. The practitioner recorded two months of conceptualisation (85 sessions) at the start of a nine-month long commercial project 'working continuously with project managers and quantitative surveyors'. This was the longest individual project of all ten cases.

The student's way into what was largely a self-directed project was through words [W]), by first visiting the model workshop of the architecture firm Fosters and Partners, and by talking to tutors and peers about the brief.

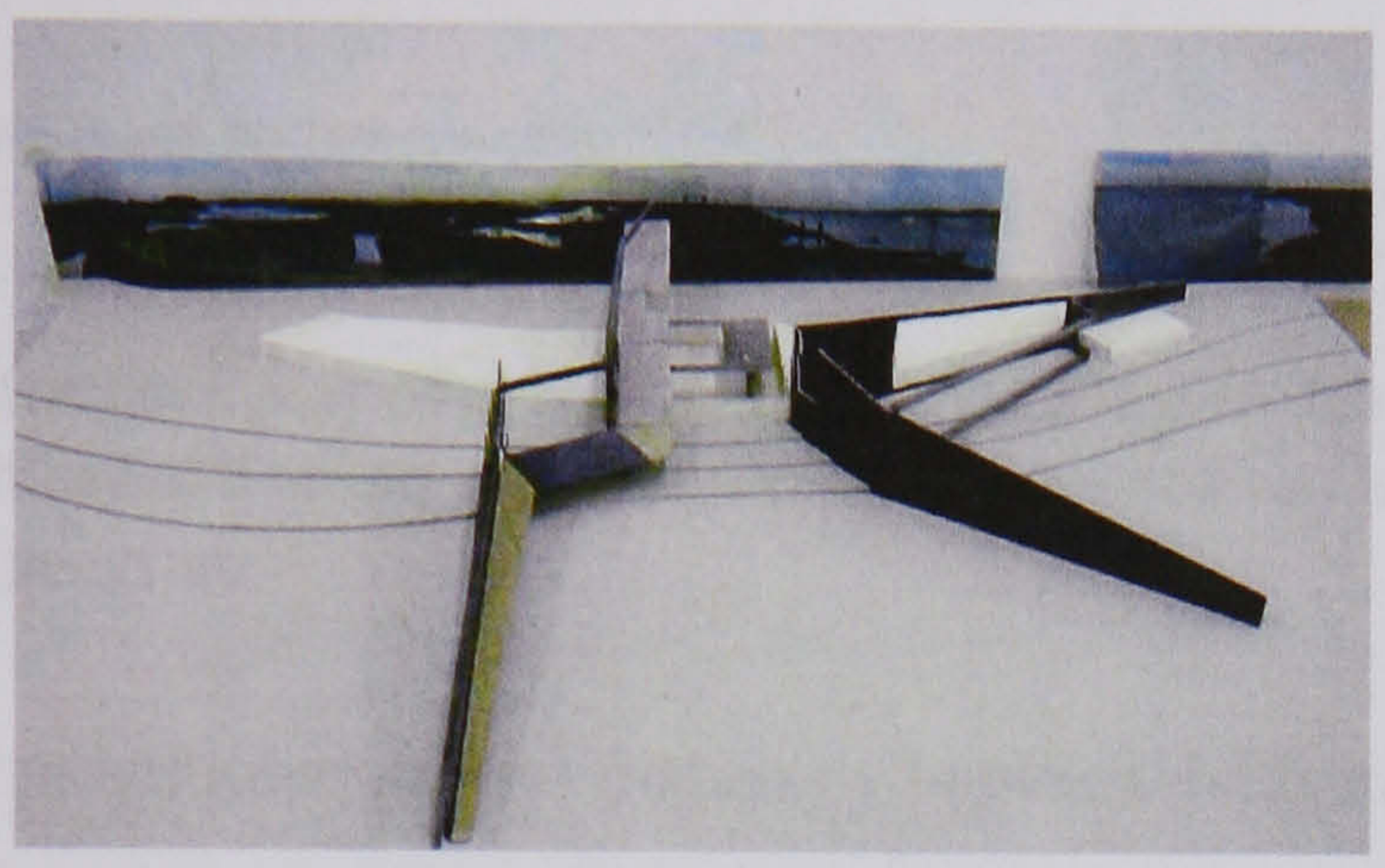
> 'The spoken words, tutorials, were really sparse ... so the rest of the time you're on your own, unless you spent five minutes talking to a friend ... so most of the time is working on your own with these [conceptual] tools'.

Then there was sketching [S], which was loose ('scribbles'), before sketch modelling [M] and computing [C] took over.

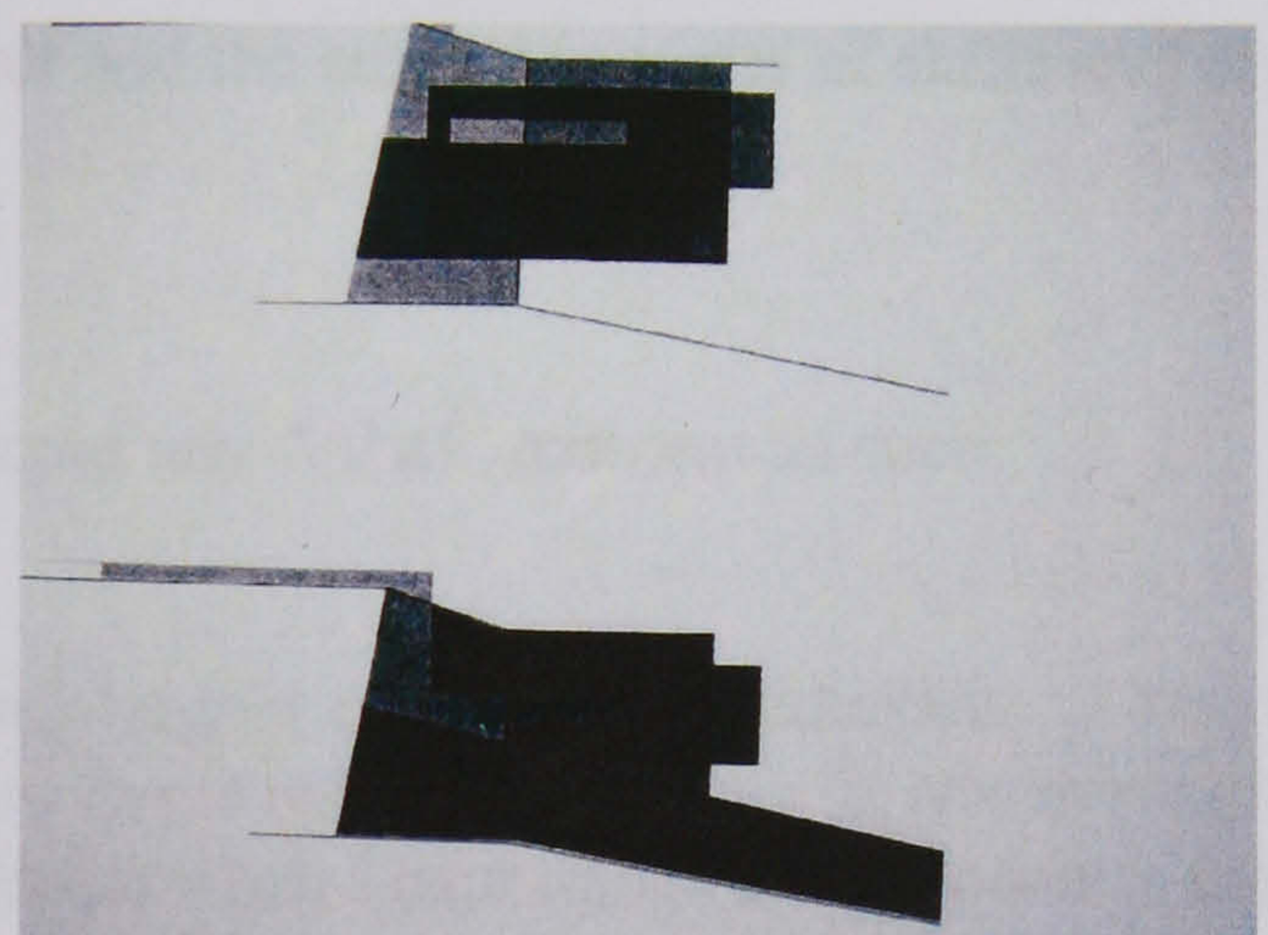
But modelling [M] was the student's prime and most used conceptual tool (0.5) (Illustration F:3).

> 'I prefer to model it out rather than to sketch to start conceptualising the idea'. 'They [tutors in Y2] encourage you to design through making, the act of making, so really

there's a mix of computing and modelling'. 'Once you got the form [generated from grey card modelling], and the tutor is happy, then you can take one step further putting the model into an AutoCAD drawing' (Illustration F:4).



Ill. F:3 AR Y2: 'Modelling was the prime conceptual tool'



Ill. F:4 AR Y2: 'Putting the model in an AutoCAD drawing'

To get started on a project the practitioner said he largely followed a pattern:

> 'You have a meeting, you discuss or go and see something, and that's where I really get the ideas'. But 'I do tend to start with sketches [S], those doodles you do when you go to a lecture, or see an art show, or whatever, when you sit on the train, the kind of little sketches that get you going'.

But also words [W]:

> 'Meetings have been very important [for getting ideas going], informally around desks and kind of looking over drawings together, within the office and with the client'.

At the concept sign-up meeting, seven weeks into the project, the point at which the client contractually agreed to go ahead, sketch models were also used: 'Everything we had, we had on the table'. The use of email, recorded as words [W], was also important:

> 'In many cases, the email dialogue that follows is equally valuable, if not more important than the meetings'... 'Beyond this it was certainly the computer which was used as really a core tool'.

But there were two parts to computing:

> 'There's the core part of computing which is actually getting drawing done' ... 'But lots of the conceptualisation was done in three-dimensional model space using the Rhino software program'.

Significantly, the practitioner moved frequently between different conceptual tools throughout the initial stages of the project: 'I work best when I move between different mediums'. In contrast, the student engaged with conceptual tools in a serial rather than parallel fashion, that is, no more than one conceptual tool at a time in each session worked, which suggest differences between the practitioner and the student in terms of skills and experience but also the design environment.

The student did not record any "Aha!" moment as such:

> 'But I think they largely came after the tutorials ... You are made to reflect on the progress you've made in the tutorials'... 'It was more gradual as I put the models together. Although when I experience such moments they tend to come when I'm not involved in the work, when you have more distance from your work ... for instance, when I'm on the bike cycling and suddenly these things come together because you are relaxed enough to let it happen'.

In contrast the practitioner recorded a "breakthrough moment" two weeks into the project when evaluating a new modelling software program.

> 'I'd been playing around with the 3D- modelling program. And it had an extra little icon on the tool bar with which you could do something special to objects [modifying the objects by rounding the corners]. And just using that became really a key part of the design, which now, months later [at the time of the interview], is still there. And just seeing that threw up new ideas ... I knew in the back of my mind what I wanted to do but it was the ease with which the program let me do it, compared to how difficult it was in the other program. That was really a kind of "Oh, well let's do it this way then"'.

But the "Aha!" moment had a forerunner. At the very beginning of the project, the design team visited Tate Britain where a mobile bar was temporarily put up for show:

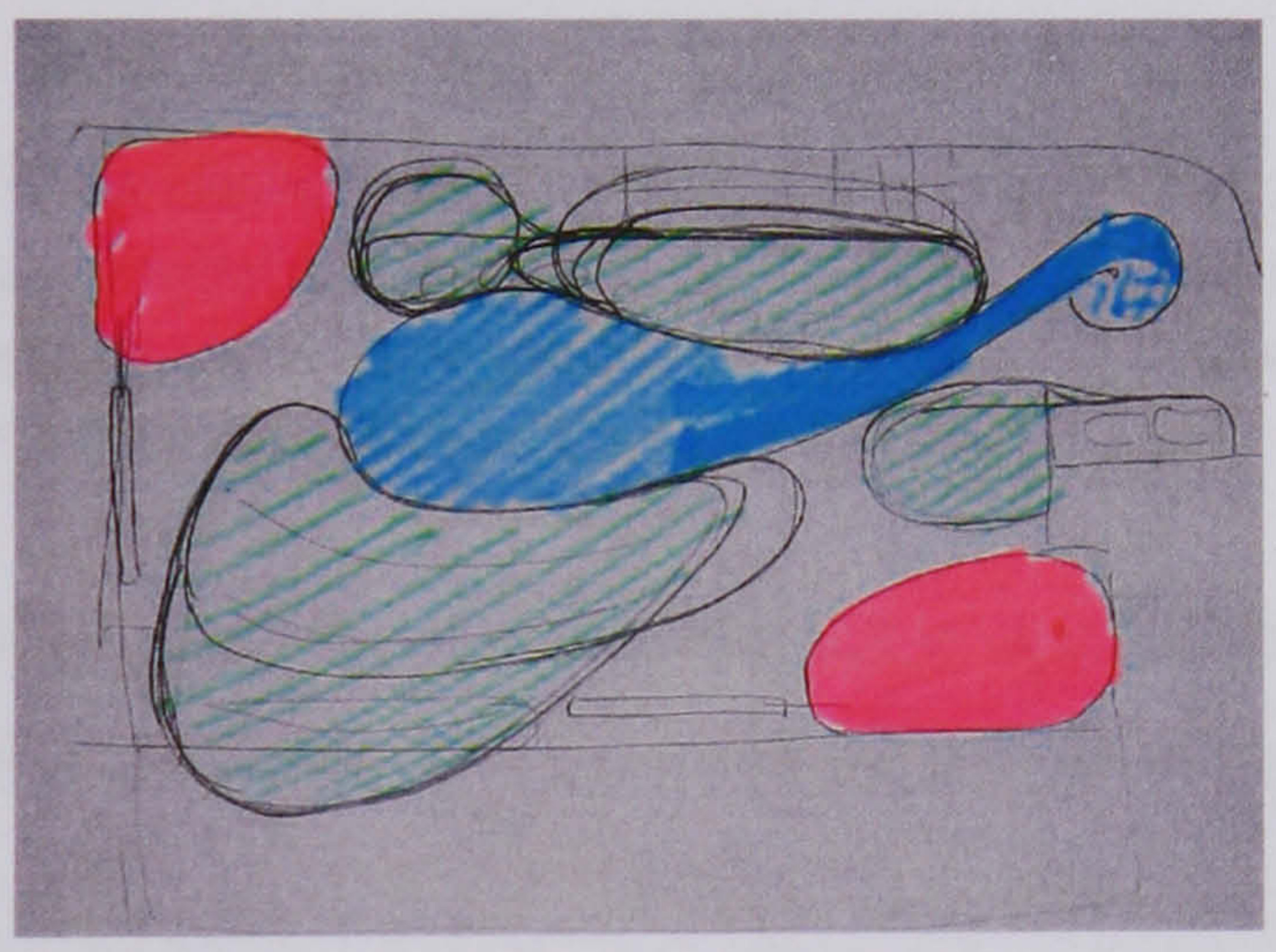
'The bar was rapidly sketched [from memory back in the studio] and taken into the computer. And that is funnily what actually led to the new 3D modelling program'.

Both the student and the practitioner saw sketching [S] in general as a "useful" rather than a "core" activity. The student found the benefits of sketching [S] in 'the quickness of generating ideas'. But also:

'The drawbacks are if you are not so talented regarding drawing. It then can be limiting. I think it's something you're naturally gifted with. If I had the talent for sketching then sketching would be more important to me than modelling because model-making is a lot slower'.

The practitioner always started with sketching [S]:

'Sketching is just quick. It's not permanent, it's the easiest thing to kind of throw away. It's quick on demand. I would say there are no drawbacks, apart from sketching is not precise' (Illustration F:5).



Ill. F:5 AR Pr: Floor plan: 'Sketching is just quick'.

The student considered verbalisation [W] a 'core' conceptual activity:

'The benefits are you allow the ideas to flourish ... the drawbacks are we are just talking about it. We are not actually seeing it because designing is largely about visual so there needs to be a visual subject matter'.

The practitioner rated words [W] a 'useful' conceptual tool.

'A key communication tool has to be the benefit. The drawback is that it's not a drawing. But words, spoken especially, sometimes are very quick and informal, the one-minute comment at someone's desk'.

The student thought sketch-modelling [M] was a 'useful' conceptual tool. A visit to an architectural model workshop emphasised its usefulness:

> 'I think people can understand a model a lot easier. They [the architects] said that most of the customers, if there is a model and a drawing presented, they go straight to the model to get the idea of what they are going to buy. The drawback is the time it takes to make. And that's another advantage with sketching because for model-making you'd have to do it in a workshop at a desk but for a sketch you can use any old bit of paper to work out an idea'.

The practitioner also rated sketch modelling [M] a 'useful' conceptual activity although he did not like it very much:

> 'Probably to do with patience. But the benefits are that whenever you've got a physical object like a model everybody gets involved so quickly in it. The model gives you something very concrete that everybody can look at, and everybody can look back to when they had little play cards. They can understand the scale idea'.

The student thought computing [C] was 'useful' but,

> 'I don't use if for conceptualising. But it's being pushed a lot in this [course] unit. You photograph the model and manipulate the photos [in PhotoShop™] then you sketch on top of it. You may put it [the photograph] into a CAD package too. But CAD is very limiting for conceptualisation. It's more engineering'.

Although the practitioner considered computing [C] a 'core' conceptual tool, and it was his most used single tool (0.4), he was also aware of the pitfalls of going too early to the computer.

> 'I think sometimes it [computing] can be quite dangerous at the early stage of conceptualisation because you can end up finding yourself stuck in a corner where you always have to produce photo-realistic renderings on the computer at a stage when you are not ready to do that'.

The benefits with computing are 'flexibility and speed', and also at the ideation stage.

> 'To be able to do a really quick 3D sketch model [on screen] and send it to an engineer at the most early stage and say, are we going down the wrong road here, or, with time, do you think we can make this work?'

A drawback with computing [C], was client expectation of computer imagery: 'We stop them [clients] from continuously demanding more images by charging for them extra'. Another is the stability of the computer system: 'If something crashes, if the server goes down, to me that's really, really a sever drawback'.

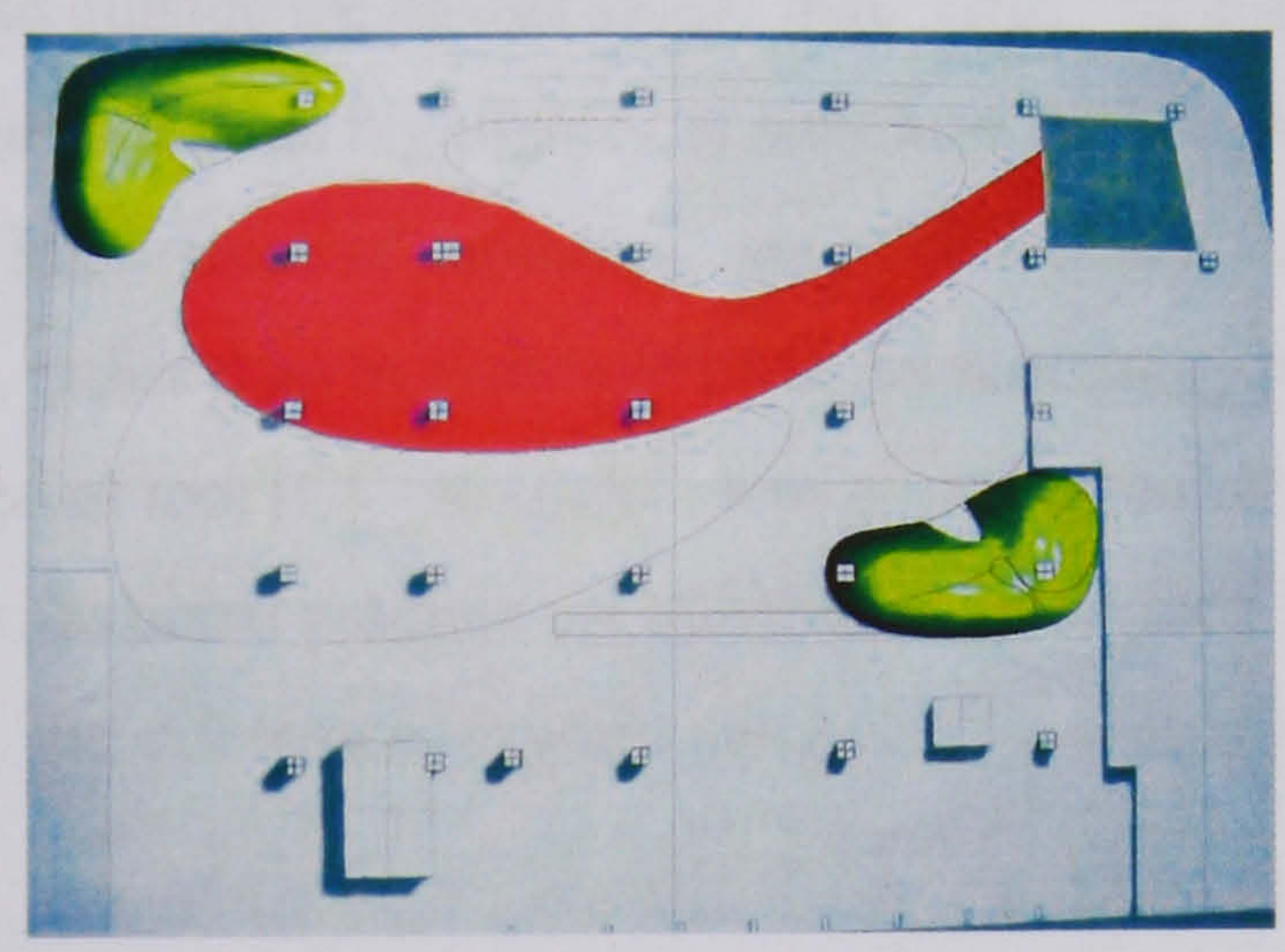
On the question whether the use of conceptual tools had change over time, the student found that computers were more widely used in the second that the first year of study.

> 'That's to do with the nature of the course ... although the head of Y2 tutors is very much against computers. He actually marks you down if you overuse the computer. He wants to see hand-drawn stuff. I tried to bring in more sketching to the project, but I didn't. But that's what I'm always saying. Because I rely too heavily on model making'.

This may suggest that the students had formal drawing classes: 'No, we've had a tutor coming in giving us an hour of a lecture, but that's it'.

The practitioner first thought there had been no change since his college days. However, when looking at the Self-protocol recordings transferred into charts during the interview (reflection-on-action), he found that

> 'Now there are more words [W] and more going backwards and forwards between sketching [S] and computing [C]' (Illustration F:6).



Ill. F:6 AR Pr: Floor plan: from analogue to digital sketching (Cf. Ill. F:5).

The practitioner explained this shift in conceptualisation over time as being influenced by 'the client and office environment'. 'For my Diploma project I was working mainly on my own, and from home'.

As to the impact of digital technology on conceptualisation the student thought the conceptual phase was being cut short because of computers: But 'Whether it's a good or bad thing I don't know'. Did students then feel under pressure to use the computers more and more?

> 'No, I think if you'd asked the average student here they'd say that they generated ideas either through modelling or sketching, apart from searching the Web'.

The practitioner took both a pragmatic and optimistic view of the future of digital technology:

> 'I think there's a very positive outlook for using digital technology as well as sketching. I'm very happy with it. If I'm given a conceptualisation task, it's natural for me to go backwards and forwards between sketching and computing. They compliment each other. With more technology, say 3D printers, I think people will take to more modelling with plasticine'.

There was an extensive use of physical modelling in this firm of architects. This may have had something to do with the fact that the senior partner and founder of the firm, at the age of 65, did not use the computer.

> 'No matter how much we've done virtual modelling and drawing, at the end of the day he [the senior partner] always wants to have the model made'.

To summarise, significantly both the student and the practitioner got started by events outside their immediate studio environment, that is, by visits to a model-making studio and art gallery respectively. It was also outside the design studio that "Aha!" moments occurred. In this, words [W] was the conceptual tool. This highlights not only how design ideation can take place anywhere but also the importance of capturing uses of conceptual tools as close to 'real design situations' as possible, rather than in experiments under laboratory conditions. Regarding computing as a conceptual tool [C], the student was more sceptical than the practitioner, which may suggest that in professional practice the benefits of computing were more apparent than in design schools, that is, the difference between designing for a degree and designing for a commercial client.

Graphic Design

Y2 Graphic design student (Central Saint Martins College of Art and Design)
Project brief: 'To design an interaction experience that communicates a sense of space'.
Duration: Number of recorded conceptual sessions: 19
Most used conceptual tool/s (fraction of 1.0): Computing (0.5)
Conceptual tool intensity: 1.1 (22/19)

Practising graphic designer, sole practitioner, (2001 graduate; Central Saint Martins College of Art and Design)
Project brief: 'To design a web site for a UK fashion retail company introducing a new brand'.
Duration: Number of recorded conceptual sessions: 45

Most used conceptual tool/s (fraction of 1.0): Computing (0.5)
Conceptual tool intensity: 1.8 (84/45)

Comparison

Although both projects lasted about the same length of time, or eight weeks, the most striking difference at-a-glance between the two was the number of recorded conceptual sessions (19 versus 45), and conceptual tool intensity. That is, the student used on average 1.1 tool per conceptual session compared with 1.8 for the practitioner. This reflected differences not only in the briefs and individual design approaches but also the design environment and the constraints under which the student and the practitioner worked. Thus the student was influenced by a brief he largely disliked (the project was 'just a block') to the extent that the lack of 'inspiration' made him work only intermittently on the assignment so much so that he was being "told off" by the personal tutor. In contrast, the practitioner was under constant commercial pressure to meet deadlines and deliver results throughout the project:

> 'It's this thing of money. The client writes the brief. There are preconceptions on their side and it's not easy to deal with'.

Another striking feature was that none of them used modelling [M] as a conceptual tool, but then graphics are normally not associated with 3-dimensional design. However, this might be a preconception because the ideation workshops in the Y1 case study showed that modelling [M] can occur in graphics (see Chapter *Findings Y1 Students*).

The student got started in the word mode [W], in a group briefing followed by a personal tutorial. Thereafter, in the third session worked, the student found 'some old unused images on the computer, which fit well aesthetically with [the] project'. However, the finding on the computer was 'accidental, was cleaning up files – wasn't intending to work'. In the interview, I suggested that this might be a serendipitous moment ("Aha!"), although the student had not recorded it as such.

In the fourth session the student used sketching [S] for the first time, and then in conjunction with words [W]. The use of words [W] and sketching [S] in the early phases of conceptualisation was in contrast to how the student generally regarded sketching a 'core' conceptual activity whereas both words [W] and computing [C] were considered 'marginal' activities. Towards the end of the project the student used almost exclusively computing [C], with a little sketching [S].

The conceptual process was described thus (Figure F:16):

> 'I used sketching to generate my ideas as quickly as possible and to make plans for what I was going to do with the computer. I used computing to try to make the conceptual visual, to try to make ideas into a sort of visual thing to respond to and maybe have more ideas, and to see what the aesthetics would look like. I used words because I had a "crit" every single week'.

In the tutorials, the tutor did sketching, not the student: 'It was useful because it is obviously difficult to convey [ideas] verbally, so a sketch helps'.

The extensive use of computing [C] towards the end of the project was driven by the 'assessment criteria'. As a result, computing was recorded as the most used single tool (0.5):

> 'Part of the criteria was that we would start experimenting on the computer. We had to be on the computer, we had to be on this program [Director]'.

Yet the student recorded sketching [S], rather than computing [C], as essential (Figure F:17).

> 'Sketching was much faster. Also we were learning [Director] from the start so it was quite clumsy, so you were not quite sure how to make it happen. So it was pretty slow from that point of view'.

Also, as the student noted in a freehand sketch: 'The computer can only think of space in co-ordinates'. In this the student highlighted the difference, and the personal conflict, between sketching on paper and on screen.

The practitioner's way into the project was driven by the client's need.

> 'I've been using sketching and wording and diagrams in order to see what is asked of me, what this brief is about. How many things needed to be included, what pictures are important, and ideas for layouts'.

The practitioner started with sketching [S], together with written and spoken words [W], including the annotated sketch, which he rated as 'core' conceptual tools in general.

> 'A kind of conversing with the client ... showing with drawing what it might look like, what we could do. I think they get involved'. Moreover, 'I like to use sketches and wording because I get something out of my brain, some ideas, and put it on paper and reflect on it, taking it backwards and forwards'.

The practitioner started using computing [C] in the third session, and together with sketching [S] and words [W]. Computing [C] was considered a 'core' conceptual activity, and also the most used single tool (0.5) in the project. 'I do it with computing as well, placing an image on the left, then on the right, to see how they interact'.

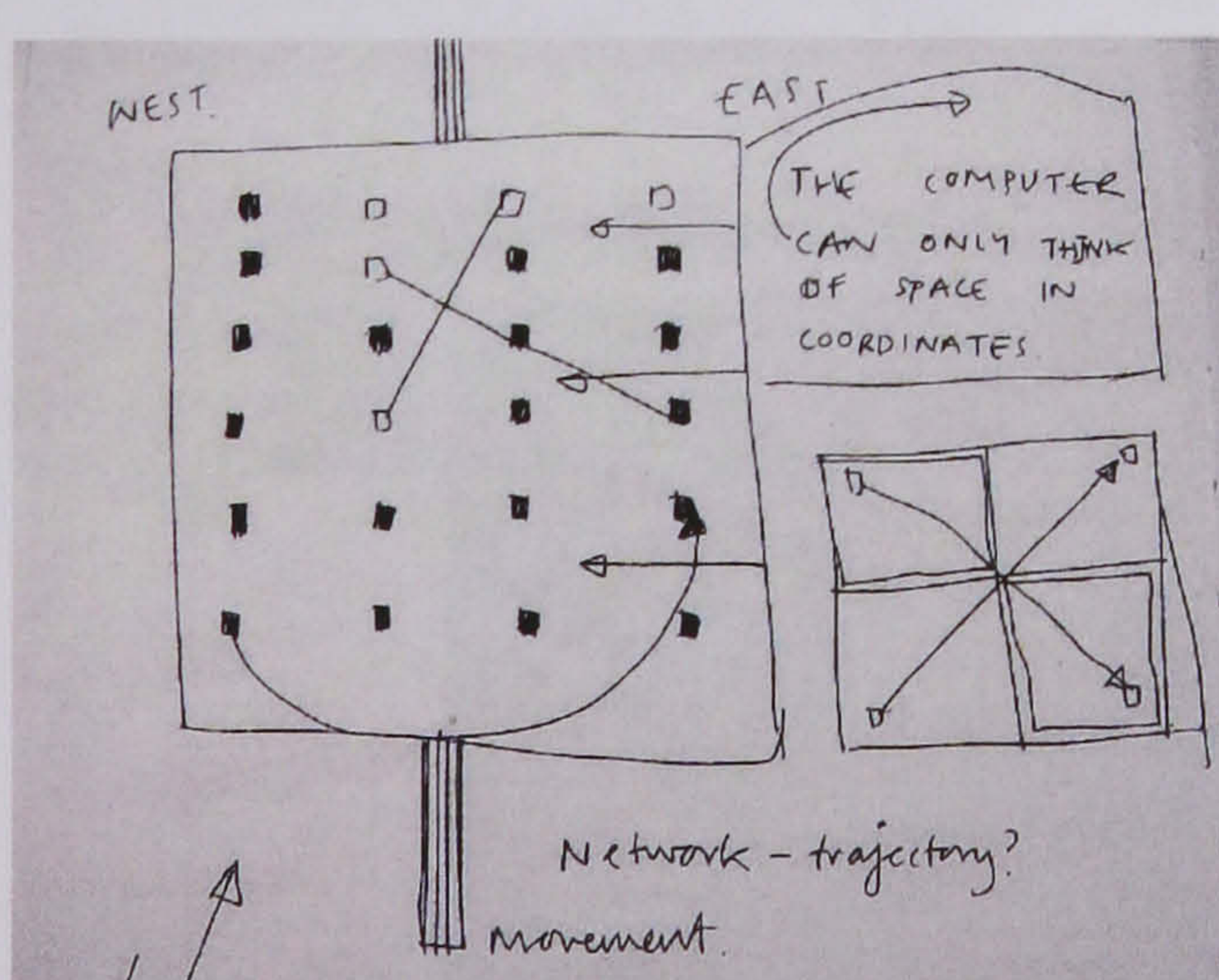
The student recorded what he called a 'slight "Aha!" moment' quite late in the project when, lacking inspiration, he returned to sketching [S]. This occurred after an interim with the tutor that produced 'a page of visual thinking':

> 'I'd been struggling with what my conception of space was and what to do. Just taking down what I thought about'.

The practitioner identified an "Aha!" moment when, using a combination of sketching [S], words [W] and computing [C], 'it sort of came together'. However, this serendipitous moment built on the work that had gone beforehand: 'What I can say is that from the first day I had some ideas, sparks'.

The student generally rated sketching [S] as a 'core' activity. '[Sketching is] very quick, it happens at idea speed … It's very much noting ideas, drawing them out' (Illustration F:7). However, the student also emphasised the aesthetic aspect of sketches suggesting that the lack of drawing skills, in a formal sense, may limit the ability to visualise thoughts and ideas.

> 'If your sketches are not aesthetically pleasing they may hold you back conceptually what you are trying to do. For me, whatever I'm creating, it has to be appealing. Conceptually obviously that's important but it can be quite frustrating if your sketches are just scribbles'.



Ill. F:7 GR Y2: 'Sketching happens at idea speed'.

The practitioner also considered sketching [S] as a 'core' conceptual tool in general.

'Strength of sketching is visual thinking. I don't know of any drawbacks of sketching. I think sketching is quicker than computer, [but] it depends if you want something final or just ideas'.

The student considered spoken and written words [W] a 'marginal' conceptual tool. In this he highlighted the "translation problem" in the interplay between the visual and the verbal (Tomes et al.1998, see also Chapter *Findings Y1 Students*).

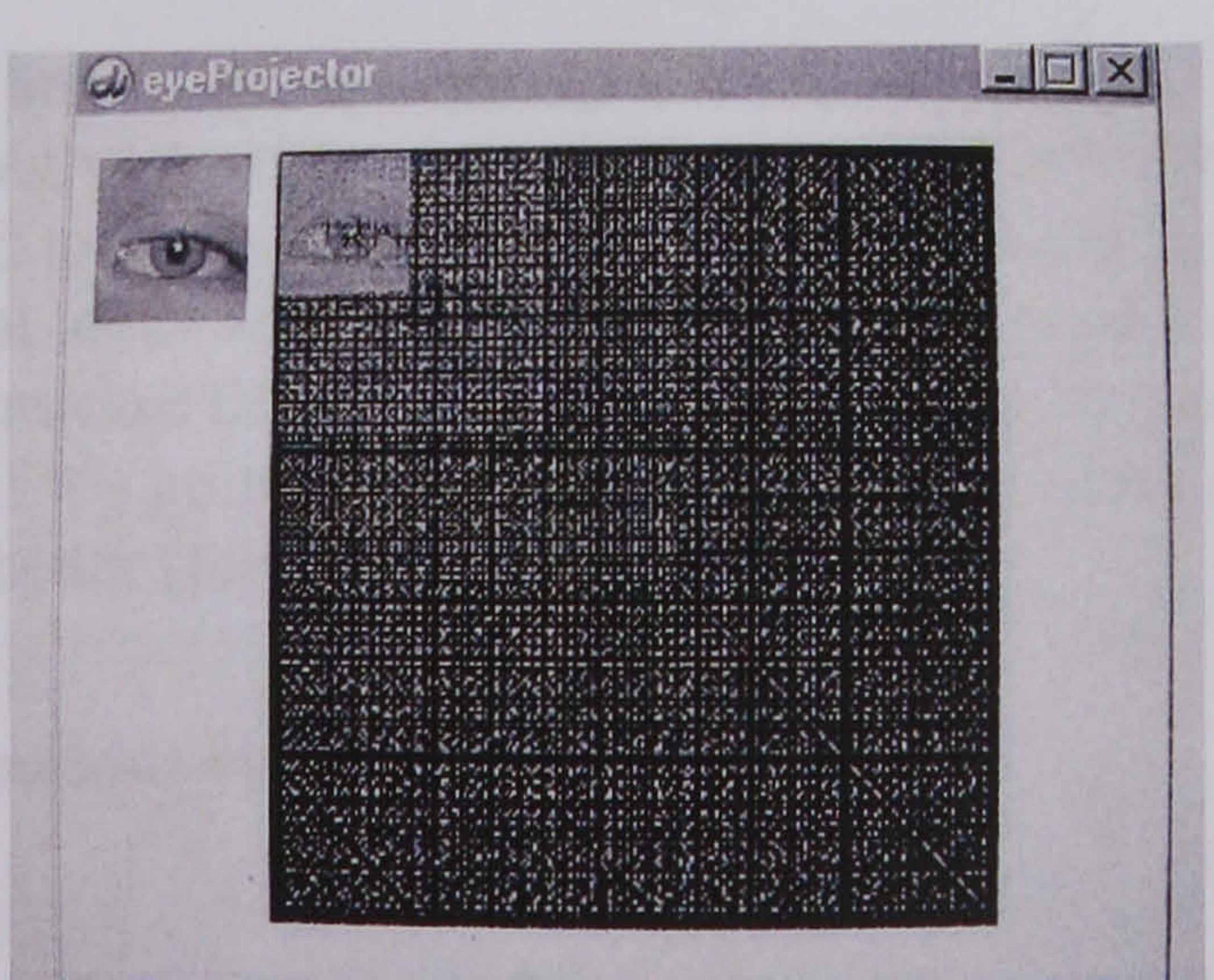
'The ambiguity of words means that in translation it could be any idea and you can't understand it. To do something visual is very useful. But there are little things you can explain with words'.

Although the practitioner described words [W] as a 'core' conceptual activity, he too was aware of the "translation problem" in the conceptual process.

'Words are sometimes difficult because it's hard to convince people, or understand what they are thinking. I like to use diagrams or using sketching and wording at the same time. It gives me an idea how to place things together. To be more clear about an idea and then I reflect on it and interrelate it'.

The student held a rather sceptical view of computing [C] for ideation, and described it generally as a 'marginal' conceptual tool:

'It [Computing] can be like a time-based sketch but I think there are more drawbacks with computing for ideation compared with old-fashion sketching. I think it is too slow and also the tools themselves really dictate what you can and can't do with them. So if you were to use PhotoShop™ or something like that you only have the functions and features that predefine what you can manipulate or draw with. So it's better to use a pencil if it's for conception' (Illustration F:8).



Ill. F:8 GR Y2: 'Computing can be like a time-based sketch'

The student's concern with the risk of being driven by the computer, rather than driving it, was further elaborated:

> 'With the computer you often go down a route of what the computer can do, not necessarily how you arrived at it yourself. But there are things that computer does very well, as long as you have an idea what you want to do. For me computing is good for finishing pieces, but for ideas it is not for me personally that good. But it depends on what kind of program you are using. For example, with Director™ you can actually use a programming language inside so it is more conceptualising than drag-and-click PhotoShop™'.

To the practitioner computing [C] was a 'core' conceptual activity although

> 'It's not as free as sketching and wording. But it helps me to see and produce something and take it back and work on it again. But then time matters ... the computer helps you to do web design. You can't do without it'.

Asked whether the use of conceptual tools had changed over time, the student replied: 'It's been sketching the whole time, apart from assessment criteria which demand something else'.

In contrast, the practitioner felt that sketching has suffered:

> 'I do less sketching because lack of time, and lack of freedom with the client. There's a difference when you do something for a client and when you do it for yourself. At college I could do any tool, sketching, painting, or whatever. But after college, I've been more interested in computer, doing graphics'.

On the question of future impact of digital technology on conceptualisation, the student said it depended on who used the computer.

> 'Some programs are designed to produce finished products, very smooth and clean, not necessarily bad but very slick which is what some people would like. I know people who got practised to use computers and they would use it as a sort of cut-and-paste and make quick visual ideas what things would look like together using it as a typographical means and a lot quicker than drawing out the lettering by hand. But it depends what the end is all for ... if it's going to be viewed on screen, I think conceptually they [computers] are better [for web design]'.

The practitioner took a cautious view of digital technology:

> 'You have to watch out so that technology doesn't take over'... 'It [the computer] seems easier but it is actually more complicated. The digital medium can give some already established scripture. And that doesn't allow you to create from scratch. That's why sketching and wording are very essential in the process'.

To summarise, the main difference between the student and the practitioner was how their design processes were strongly influenced by their respective design environment, in similar ways to the fashion student and the fashion practitioner. Thus the student's dislike for his project impacted negatively on the conceptualisation process, in contrast to the practitioner who had to be very focused on the commercial design brief throughout. In terms of ideation, they differed most over computing as a conceptual tool. Thus the student expressed fears of losing his creative freedom to the computer, whereas the practitioner regretted that his sketching had suffered as a result of computing, by necessity, taking over in professional practice. As graphic designers, they were both aware of the translation problem between the verbal and the visual emphasising how both can be difficult or ambiguous in conveying meaning.

Product Design

Y2 Product design student; (Central Saint Martins College of Art and Design).
Project brief (self-initiated): 'The further adaptation and use of plugs and plug sockets'.
Duration: Number of recorded conceptual sessions: 16
Most used conceptual tool/s (fraction of 1.0): Modelling (0.4)
Conceptual tool intensity: 1.4 (23/16)

Practising Product designer, working for an award-winning London multidisciplinary design practice; (2001 graduate; Leeds University).
Project brief: 'An audit of an existing retail record store with view of future record selling business'.
Duration: Number of recorded conceptual sessions: 10
Most used conceptual tool/s (fraction of 1.0): Words/Computing (0.5/0.5)
Conceptual tool intensity: 1.7 (17/10)

Both projects were relatively short, two weeks for the student (16 conceptual sessions), one week for the practitioner (10 conceptual sessions), which reflected the essential conceptual character of the projects, that is, both focused on "thinking", rather than "making design" (development, detailing and prototyping).

Moreover, the student's project was influenced by the fact it was self-directed, that is, the student wrote his own brief although the course tutor had specified criteria for presentation. In writing his own brief, the student had in fact started the design process in the words [W] mode, which included brainstorming, library search and interviews. However, it was only at the interview (reflection-on-action) that the student realised that writing the brief was actually part of the ideation process.

> 'I consider [the brief] to be my "Aha!" moment. The "Aha!" moment was the way I decided to write the brief ... when I kept reducing my brief ... because I found a hole in the market, a potential for the design'.

Before correcting himself, the student had recorded sketching [S] for getting started, which was followed four ideation sessions later by sketch modelling [M]. 'The prime tool for this project was sketching, and model-making'. Only in the later part of the conceptual phases did the students use computing [C]. '[Computing] for all presentations, and only in the final stages of the project, and because of the nature set by the staff [tutor]' (Figure F:20). Considering how the writing of the brief formulated the design problem (the "Aha!" moment), and therefore directed the design process, the student seemed to have overlooked the brief [W] as a conceptual tool until the interview.

The "thinking design" mode was emphasised by the practitioner in that he perceived a difference between conceptualisation and designing;

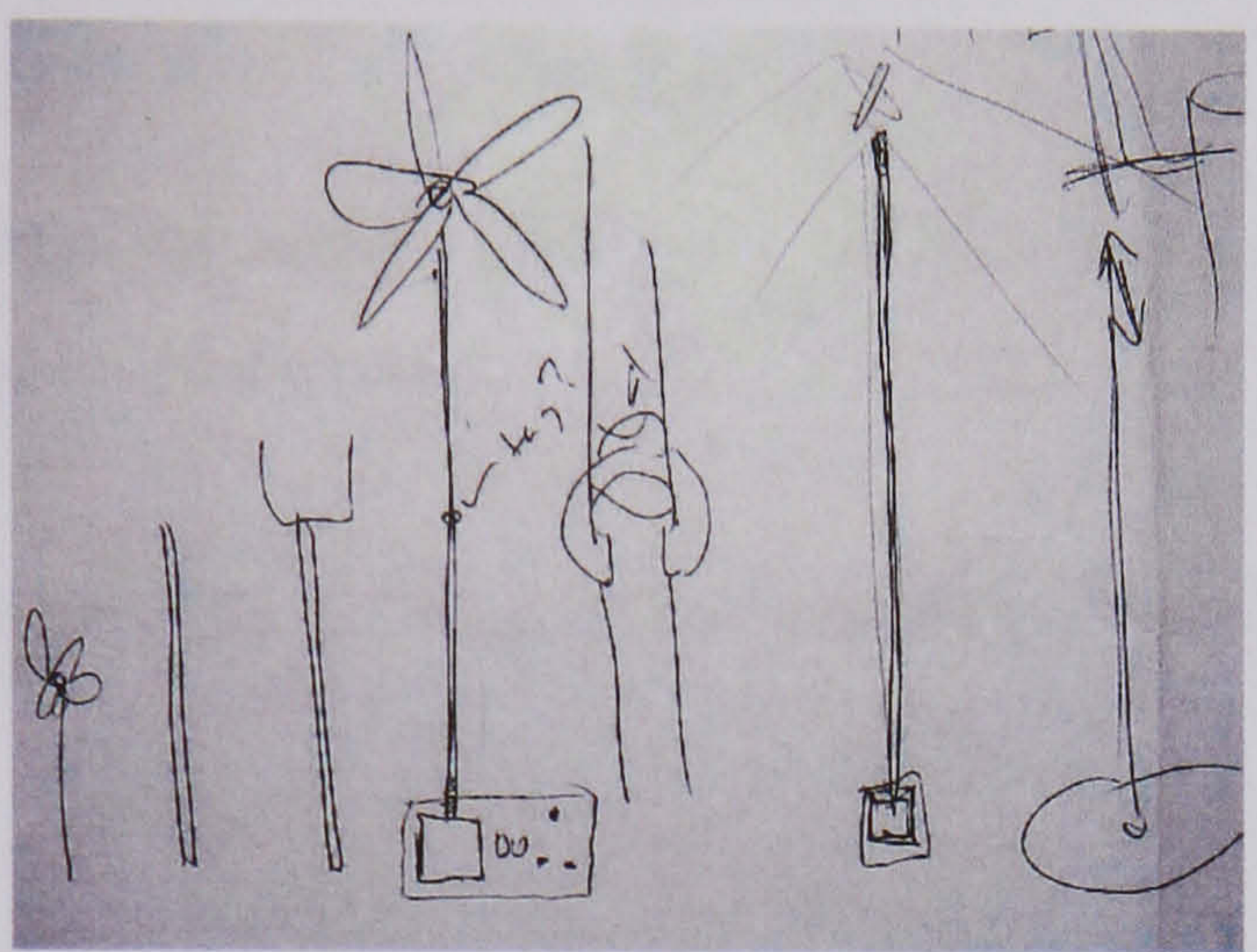
> 'Conceptualising is understanding what the client needs, what the customer needs. As a pitch we felt we didn't want to design something. We are trying to convince the client how our views and ideas would meet their future of the retail environment. We're still in this pitch, we haven't presented a concept, we just presented the way in which we would work and the way we would approach the project'.

In other words, conceptualisation was focusing on "process", rather than "product", with the aim of convincing the potential client that the firm was the right choice for the job.

The practitioner got started with words [W], which occurred in the initial team audit and brainstorming [morning] session (Square One). This meeting generated many ideas, which the participant regarded as "Aha!" moments for the work he did in the following afternoon: 'The words I wrote that afternoon [Square Two] were extremely influenced by what was said in that meeting'. In fact, words [W] were used in every recorded session throughout the project. The only other conceptual tool used was computing [C], which, together with words, made up the most important tool in equal parts (0.5/0.5) (Figure F:22). Computing was employed for image search ("Internet image banks"), to match the words, and for image manipulation using imaging software. Thus, in contrast to the student, the practitioner was well aware of the positive "power of words" as a conceptual tool. In fact, on seeing the firm's creative director after the interview, words were acknowledged to be a powerful conceptual tool in the company.

The student regarded both sketching [S] and words [W] as 'core' conceptual tools.

> 'The benefits of sketching are the speed and the ease of sketching. And also it is a pretty medium in itself ... The drawbacks are they depend on your skills' (Illustration F:9).



Ill. F:9 PR Y2: Sketches 'depend on your skills'.

Elaborating on the skill aspect, the student said they had 'no formal [drawing] tuition as such' and thought that sketching skills were being ignored by tutors: 'If [students] hand in a freehand sketch, it is frowned on, for not being done in PhotoShop™'. But the student also raised the social aspect of drawing:

> 'All "big" designers are using pencil and paper. You feel that if you want to be a "big deal" in design you are going to shoot yourself in the foot if you're using the computer all the time. So the social impact will want me to stay with paper and pencil'.

On the benefits and drawbacks with words [W]: 'They are very useful. You get an immediate response'. But also: 'At the conceptual stage I think you can be swayed, and that's not necessarily a good thing'. These concerns highlighted how uses of conceptual tools reflect socialisation, that is, how values and skills are acquired in the design school environment through tutor and peer group interaction.

The practitioner found words [W] a "core" activity and this was his preferred mode of conceptualising in the recorded project: 'I find it very easy to write down ideas' but also, 'weaknesses with words, it can be quite a drawn out process'. Similarly, about spoken words: 'When you not consciously think about putting things to paper it's quite nice, you are much freer'. Although sketching [S] was regarded as a "core" conceptual tool in general, it was not considered for this project: 'I haven't really thought about it [the project] enough to sketch'.

The student considered sketch modelling [M] a 'core' conceptual activity, and it was also his most used single tool (0.4):

> 'Modelling definitely helps in the realisation of concepts, it helps to have it in solid form. The drawbacks are that it takes time to create that concept … an irritating long time'.

The practitioner regarded modelling [M] as a 'useful' conceptual tool, but, similar to sketching [S], it was not used in the project.

The student saw computing [C] as a 'useful' activity but also felt it was restrictive as a conceptual tool.

> 'In the actual conceptualisation process it [the computer] wasn't particular useful. The drawbacks are it is too slow and you'd need a degree of skill to be able to use it in the beginning and I just found it stifles the creative process battling with the working knowledge of the machine as opposed to your idea'.

In contrast, computing [C] was a 'core' tool for the practitioner: 'At the end of the day, it's just a tool'. The benefits of computing for the recorded project was that 'it's very quick, very easy to source images', and also for manipulating "ready-made" images (Illustration F:10). In this, computing [C] was also 'used as a tool for communication … as a presentation tool'.

Ill. F:10 PR Pr: Manipulating "ready-made" images.

On the question whether the use of conceptual tools had changed over time, that is, between the first and second year, the student said that he did more model making 'because the School is pushing it'. But he also did more computing [C].

> 'That's not because of the School but because of the realisation for which computers are being used. Everyone individually is learning. One of the pressures is pushing computers'.

As to any changes between college days and professional practice, the practitioner said he felt 'restricted by business':

> 'Now I use the computer a lot more. My sketching has suffered, but then my approach to a project might have changed as well. My approach to concepts has matured. I think I'd would have jumped at conclusions at college'.

The constraints set by the business design environment were raised in unexpected ways. The practitioner, in explaining how the selection of images was dependent on what was in the computer database, thought he would have achieved 'a much better result' by taking his own photos, but did not because 'time restrictions and the ease of the computer and the quality of the images'. This prompted the question: 'What stopped you from taking your own photos? In college you'd be doing these things'. Answer:

> 'Absolutely. You are restricted to the four walls here. It's a routine I guess, [imposed by] the office environment. I didn't think about it at the time. On reflection, it would be a lovely way to do it. It's about confidence in your own abilities'.

Thus the practitioner, in reflection-on-action highlighted both external (business) and internal (self-imposed) constraints that may exist in the design environment and how they may effect the ideation process (see Chapter *Literature Review).*

On the question of future impact of digital technology on conceptualisation, the student replied:

> 'In terms of conceptualisation it [impact] is relatively small. I'm still more influenced by paper and pencil. But if the [graphics] tablet became as quick or as smooth as pencil and paper and was accessible, I'd use it tomorrow. Because it would be so more accessible in the computer ... I wouldn't have to scan it and manipulate in any other way. And it can be reproduced as many times I'd want'.

However, the student also expressed wider concerns about the growing use of computer graphics:

> 'It is too easy to reproduce, anyone can do it. And that's a difficulty because you don't need to be that skilful to make a computer piece look impressive especially to people who are unaware, who aren't in the industry all the time. And as a result people getting jobs are those who are particularly well trained in that computerised field. And people with real skills and talents are being left behind ... So people are competing unfairly'.

Here the student resented the neglect of traditional skill-based design in that he equated analogue tools with 'real skills and talents'.

The practitioner found the impact of digital technology a difficult issue,

> 'because anything that is digitally created on the computer has been programmed by someone else – it's decided by "Apple" [software]. In that respect it's disheartening to think that my limitations are the limitation by this tool. I think you have to accept it. You can achieve a lot with words and computing. I'm happy to run with digital technology but there's a part of me that enjoys drawing, and I think that'll never leave. That's something romantic about it as opposed to something on the computer. So there's life in the pen yet!'

To summarise, both the student and the practitioner were driven by words [W] but the student, unlike the practitioner, used sketching [S] and modelling [M] too. The practitioner was much more enthusiastic about computing than the student. This reflected how the practitioner was essentially writing a pitch document based on words and ready-made images for which no sketching and modelling were needed. That is, the practitioner's task seemed quite expedient; it was to meet a tight commercial deadline for a pitch presentation. In a way the student's task was similar in that he wrote his own brief. Thus both projects were essentially about communicating design concepts. But in this the student seemed troubled by the course requirement, which emphasised computing rather than sketching, which the student thought of as an essential skill for a professional career. Ironically, then, if the student had known his professional counterpart, he would have realised that traditional design skills are not always necessary when designing in the real world, and therefore he might have felt more confident and comfortable with his own design brief.

General Design

Y2 General design student (Goldsmiths College).
Project brief: '"The cycle project": To find design solutions for urban cycling'.
Duration: Number of recorded conceptual sessions: 23
Most used conceptual tool/s (fraction of 1.0): Words/Computing (0.4/0.4)
Conceptual tool intensity: 1.6 (37/23)

Practising general designer; practitioner in partnership (2002 graduate, Goldsmiths College)
Project brief: '"Digger Bowls": To design a system where a metal bowl can be created collectively within an exhibition space'.
Duration: Number of recorded conceptual sessions: 6

Most used conceptual tool/s (fraction of 1.0): Words (0.5)

Conceptual tool intensity: 1.8 (11/6)

Comparison

The two projects varied greatly in duration yet were essentially conceptually driven with a high ratio of conceptual tool intensity. Thus the student's project was tutor led and lasted five weeks (23 sessions), whereas the practitioner ran her own self-directed project spread over three weeks (6 sessions). The student's written brief was to 'produce three concept solutions' for urban cycling, whereas the practitioner worked from a mental image of a personal fascination with mechanical diggers. Conceptually, then, both student and practitioner got started (Square One) with spoken and written words including Internet search. These activities were recorded as words [W]. The student's use of the Internet for search was described as:

> 'I did research into developments already made [because] there are Web sites for encouraging people to cycle. I looked into a few books'.

The practitioner explained the start of the project on the Internet thus:

> 'It was Internet research ... instead of asking someone, you ask the Web - the Internet is an enormous source of information'.

Both the student and the practitioner underlined the importance of verbalising concepts using spoken and written words [W]. The student:

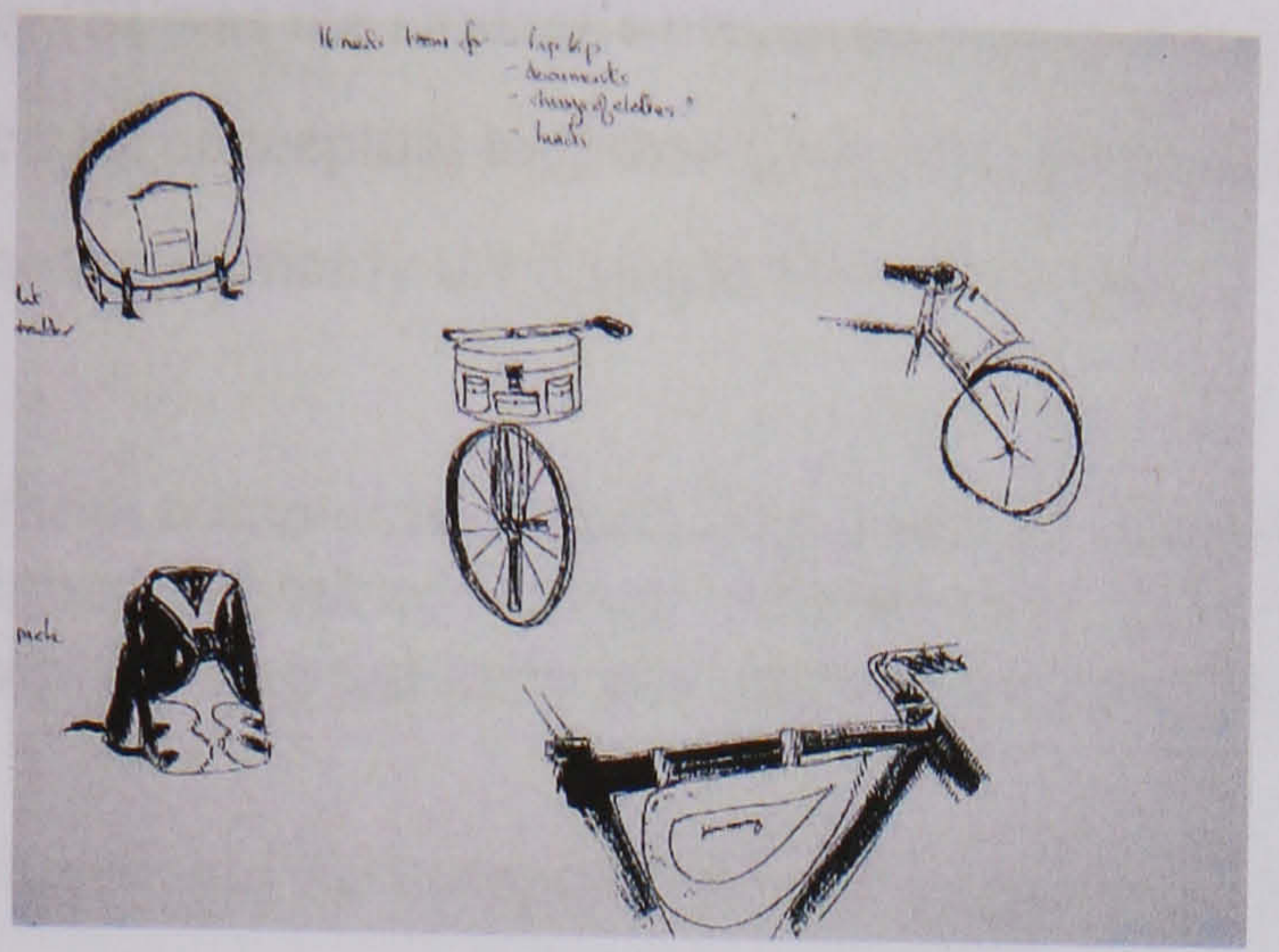
> 'I couldn't do without [words] for all the research I did, also talking to people, to get ideas of them, and talk about my ideas'.

Talking was also essential to the practitioner, and constituted the most used single tool (0.5):

> 'I talked to people all the time, not necessarily designers, just everyone. It [talking] is the thing that comes to me throughout the design process. It's very important on development of any idea'.

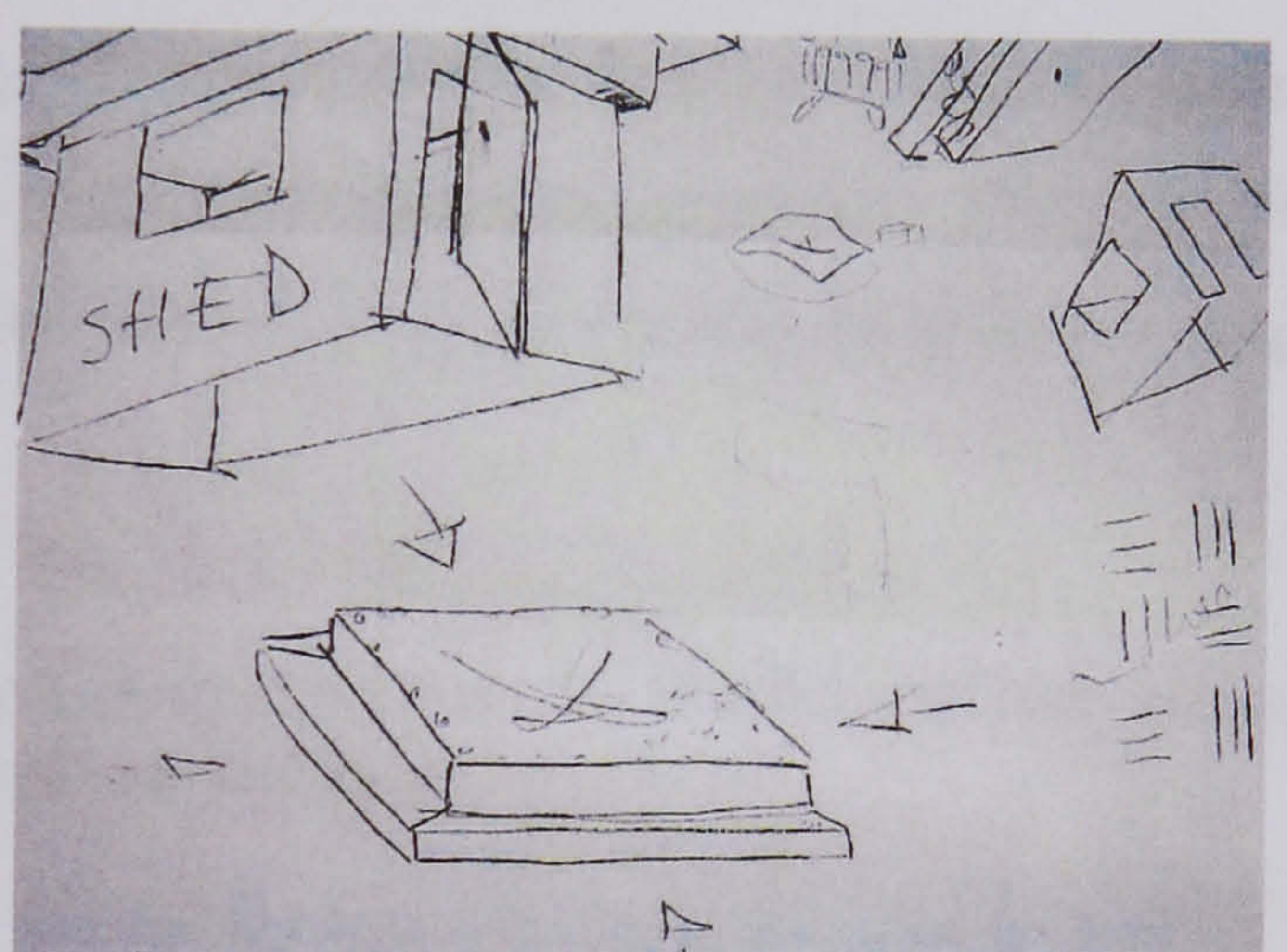
Both used freehand sketching [S]. The student:

> 'Sketching [is] trying to understand the way bikes look because the design solutions I decided on were to do with encouraging children to cycle so there are graphic type images that would be attractive to young people. So I sketched that out' (Illustration F:11).



Ill. F:11 DE Y2: 'Sketching is just putting on paper what is in your head'

The practitioner: ' Whilst I was talking I used sketching [S], a way to illustrate the words' (Illustration F:12).



Ill. F:12 DE Pr: 'Whilst I was talking I used sketching'

Computing [C] was also used to help visualise ideas. The student:

> 'I found I couldn't use the computer to draw well so I was looking for doing some Flash™ animation [software application] … I used PhotoShop™ [software] to just import pictures, photographs of people cycling. And then I used Illustrator™ [software] to make drawings over the top so to try to understand how images of bikes look when you put them into a kind of cartoon look'.

The practitioner:

> 'I was just sketching on the computer and how I could visualise it … just playing with Illustrator™ software application creating shapes and trying to make it'.

But although sketching [S] was the student's preferred tool at the conceptual stage, she found computing [C] an essential conceptual tool throughout the project. In fact, computing [C] and words [W] were the most commonly used single tools (0.4/0.4).

> 'I can't do without computers or sketching. I sort of conceptualised all the time as the projects developed. I think conceptual tools are used up to the end, until I present it. If you stop conceptualising too early you might stunt ideas that could be developed'.

In contrast, the practitioner said the computer did not help to generate ideas: 'The idea was already there. It was how to communicate the idea'. But was the computer then just a presentation tool? 'No, it was about finding a way of communicating the idea that was difficult to communicate'. It seems that computing played a hybrid role, part ideation, part communication/presentation reflecting how ideas have to be externalised, or the symbiotic relationship between designer and tool (see Chapter *Pilot*, and Chapter *Literature review*).

As for sketch modelling [M], the student recorded a couple of events but these were quite tentative: 'I decided it was going to be mainly graphics'. The practitioner didn't do any sketch modelling but said she intended to produce a prototype at a later stage, with the external help of a metal workshop:

> 'I went to see how metal sheet can be shaped, and also asking the people working there how my idea could be working'.

This approach reflected the post-modern role of the designer as a "conceptualiser", rather than "designer-maker". Or, rhetorically, "Get your ideas right, then get help with their execution!"

As to landmark events, or "Aha!" moments, the student related those to 'when listening to people' [W]. Three such moments were recorded. First, in a lecture [W], where the design process was described in future terms as 'working backwards'. Second, in a group discussion [W], where inspiration came from 'just seeing other peoples' solutions or ideas how to cycle'. Third, in a single tutorial [W], 'that gave me a bit more structure to my ideas and I thought, oh yes, I could this way and do that'.

The practitioner's "Aha!" moment happened at a dinner party talking to people [W]

> 'Right at the beginning, even before "Square One". It triggered the whole project. The first idea came from the fact that I love [mechanical] diggers… how can I bring it into the design process. And I thought: That!'

Significantly, all the “Aha!” moments occurred in the word [W] mode.

Looking at strengths and weaknesses of conceptual tools, the student expressed the benefit of sketching [S] as

> 'just putting on paper what is in your head, in an image, a picture. The drawback is if you don't have much drawing skills, if you can't draw something out of your head, which is something I can't do'.

Words [W] were seen as an 'infinite' tool but also 'You can't read everything!' The strength of sketch modelling [M] was to 'help get a better understanding of things in three dimensions, the drawback was it depended on 'skills and materials available'. Computing [C] was considered beneficial because,

> 'you can cut corners in terms of it might take you a long time to sketch, with the computer it is more doing the donkey-work. But sometimes it makes the process quicker, just to change, look at an image and then be able to change it in some way without it taking an hour or so to draw it'.

The practitioner saw the benefit of sketching [S] as 'a tool to visualise, because what is otherwise just air, unless it goes to the paper'. The strength of words [W] was expressed as:

> 'When you tell someone else what you are thinking they will have a question about it. And these questions are what you start to work with that is not just talking to yourself'.

Modelling [M], although not used in the project, was generally regarded as a 'core' activity.

> 'You just can't form an idea into something without going through an intermediate stage of modelling. The realm of ideas and realm of objects are too far apart. The model is between them'.

Computing [C] was seen as 'another tool of visualising, a tool of research'. The practitioner saw no drawbacks with any of the conceptual tools. This reflected how the practitioner recognised ideation in terms of cognition:

> 'The computer doesn't give me any ideas, but neither does drawing, or anything else … They are not originators of ideas … They are tools for communicating'.

Moreover, the practitioner questioned the notion that conceptual tools might help in communicating a solution to a design problem:

'Design problem, in my opinion, is a very outdated view of generating design motivation. I mean, no one needs a bowl shaped by a digger. No one needs more chairs. We are in some sense eroticised by the creation of new ideas'.

Here, it seems, the practitioner was arguing from a post-modern perspective of approaching design, that is, of 'putting ideas on top of objects (see Chapter *Methodology*).

On the question whether uses of conceptual tools had changed over time, the student thought not. 'But I'm trying to change it because I need to do a lot more sketching'. The practitioner found that 'You work a lot more compared with college. At college I could have done a lot more on my own, using the tools more'.

On the question of the impact of digital technology on conceptualisation, the student thought

'it can open a lot of doors to information you might not have been able to access before. And I think it can cut a lot of corners'.

The practitioner:

'It is easy to communicate with, to produce work, to reproduce, to copy'. But 'It's not going to be more important but more present'.

To summarise, the Internet figured prominently in both projects in the search for or development of ideas, which highlighted how both the student and the practitioner got started through words [W], both written and spoken. In fact, both participants were extensively 'talking design', in which their projects became a form of critical discourse. In getting started (Square One), computing, together with words [C+W], was also used to visualise ideas. Both also did sketching [S]. In contrast, sketch modelling was not used by either of them although the practitioner regarded it a 'core' activity, but only 'marginal' by the student.

Tool intensity by case and domain

Y2 FA	Pr FA	Y2 AR	Pr AR	Y2 GR	Pr GR	Y2 PR	Pr PR	Y2 DE	Pr DE
1.2	1.0	1.0	1.6	1.1	1.8	1.4	1.7	1.6	1.8

Table F:1 Conceptual tool intensity

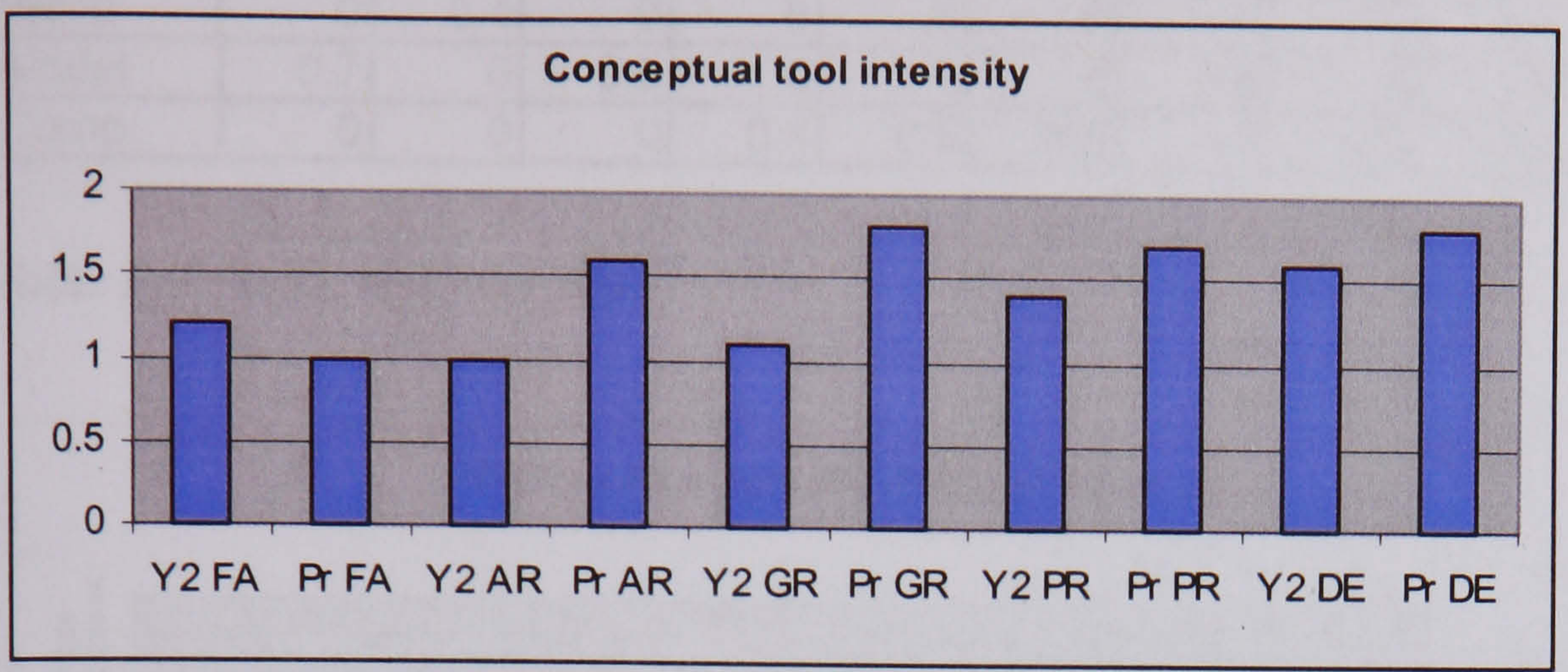


Fig. F:1 Conceptual tool intensity

Table F:1 and the corresponding Figure F:1 show how the average number of all conceptual tools recorded was higher among practitioners than students, with the exception of the fashion domain. The higher tool ratio was particularly noticeable in architecture and graphics where the practitioners used on average 1.6 and 1.8 conceptual tools per session compared with 1.0 and 1.1 respectively for the architecture and the graphic students. The difference was less pronounced in the product and general design domains. These patterns suggest differences in working practices in which the practitioners were more experienced in using tools in a parallel mode, rather than serial mode, as appeared to be the case with the fashion, architecture and graphic students. That is, the practitioner would more often go backwards and forwards between different tools, and often in the same session, whereas the student tended to stick to one tool at a time.

Most used single tool

Table F:2 and figure F:2 give an overview at-a-glance, in which the table and figure highlight the most used single tool, as a ratio of all tools used, in each of the ten cases (in two cases, the first position is shared between two tools). Thus, for instance, the single most used tool by the fashion student (Y2 FA) was modelling [M], at the ratio 0.7 (for easy reading, the remaining tools, and whether used or not are marked zero in the table). Overall, then, the most striking feature is the diversity of tools, and that sketching [S] was not recorded as the most used single tool in any of the cases (for a full result, see below *Relative conceptual tool usage*).

	Y2 FA	Pr FA	Y2 AR	Pr AR	Y2 GR	Pr GR	Y2 PR	Pr PR	Y2 DE	Pr DE
Sketch	0	0	0	0	0	0	0	0	0	0
Word	0	0.4	0	0	0	0	0	0.5	0.4	0.5
Model	0.7	0	0.5	0	0	0	0.4	0	0	0
Comp	0	0	0	0.4	0.5	0.5	0	0.5	0.4	0

Table F:2 Single tool overview

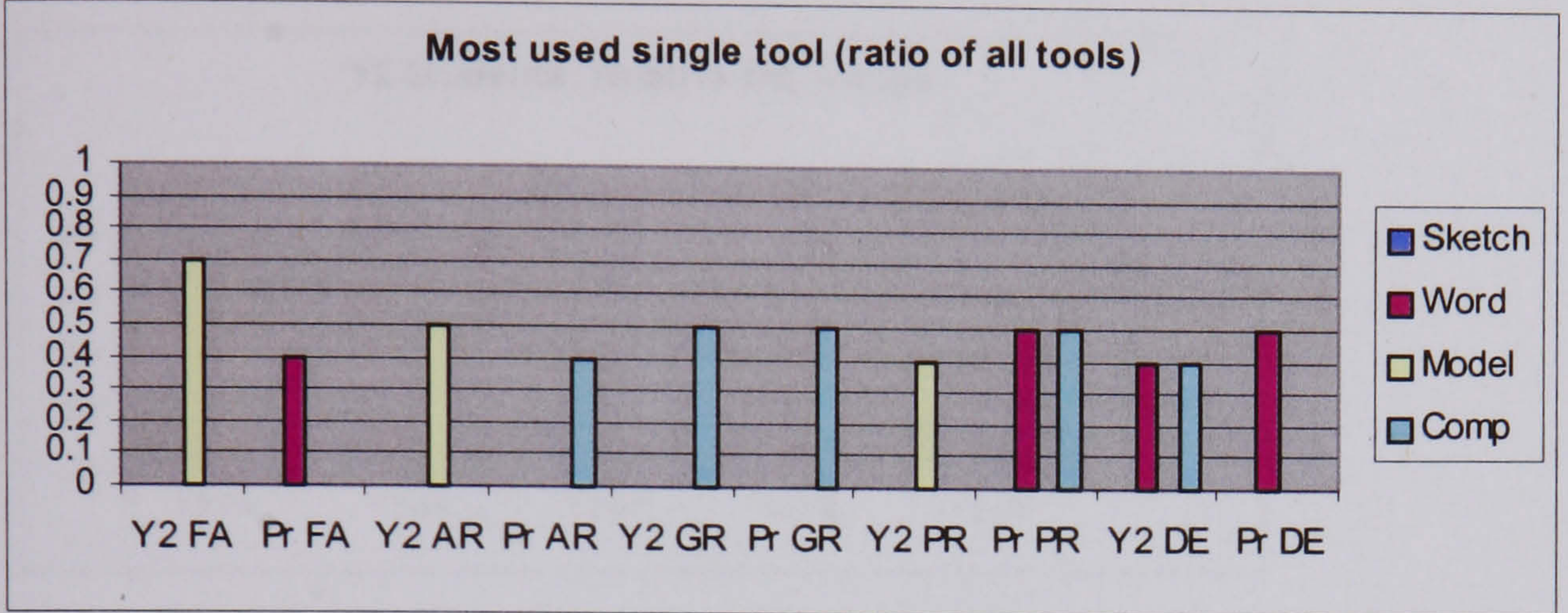


Fig. F:2 Single tool overview

Relative tool usage

To compare uses of conceptual tools across the cases, single tool usage was calculated as a ratio of total tool usage for each project. Thus the resultant ratios, as a decimal fraction of 1.0, represent the relative use of individual conceptual tools. For example, in Table F:3 Y2 AR, the ratio 0.1 means that the second-year architect student used sketching [S] as a conceptual tool in around 10 per cent of the recorded sessions, whereas spoken and written words [W] were used in about 20 per cent of the sessions (0.2). Or put differently, the student used words [W] twice as often as sketching [S]. In Table F:4 Pr AR, the corresponding figures for the practising architect were 0.2 and 0.3. Figures F:3 and F:4 show the corresponding charts.

Essential tools were calculated in the same way (Tables F:5 and F:6). According to the self-report guidelines, a tool was essential when the participant thought he or she could not do without it. All figures were translated into subsequent charts using a dedicated software program (Figures F:5 and F:6).

	Y2 FA	Y2 AR	Y2 GR	Y2 PR	Y2 DE
Sketch	0.1	0.1	0.2	0.2	0.2
Word	0.0	0.2	0.3	0.3	0.4
Model	0.7	0.5	0.0	0.4	0.0
Comp	0.2	0.2	0.5	0.1	0.4

Table F:3 Students' relative tool usage

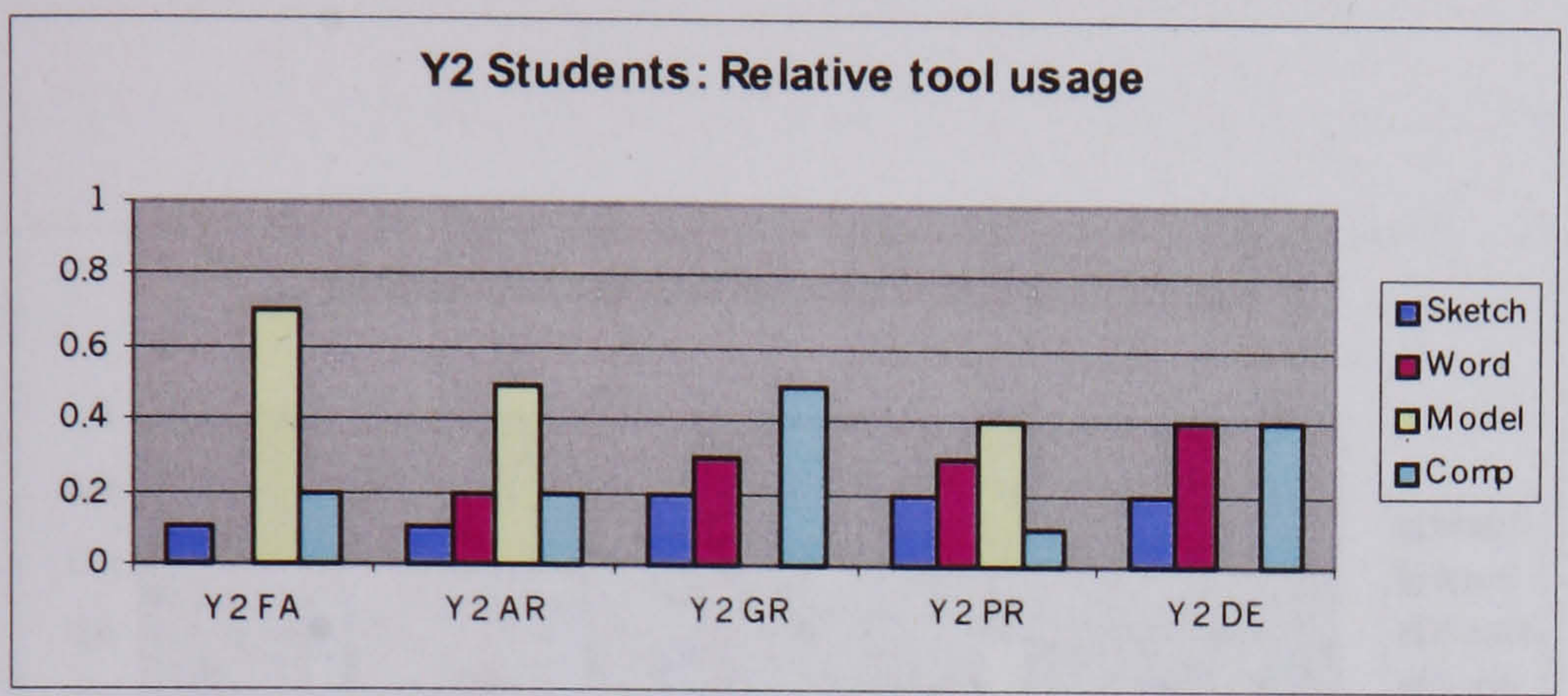


Fig. F:3 Students' relative tool usage

	Pr FA	Pr AR	Pr GR	Pr PR	Pr DE
Sketch	0.3	0.2	0.1	0.0	0.2
Word	0.4	0.3	0.4	0.5	0.5
Model	0.0	0.1	0.0	0.0	0.0
Comp	0.3	0.4	0.5	0.5	0.3

Table F:4 Practitioners' relative tool usage

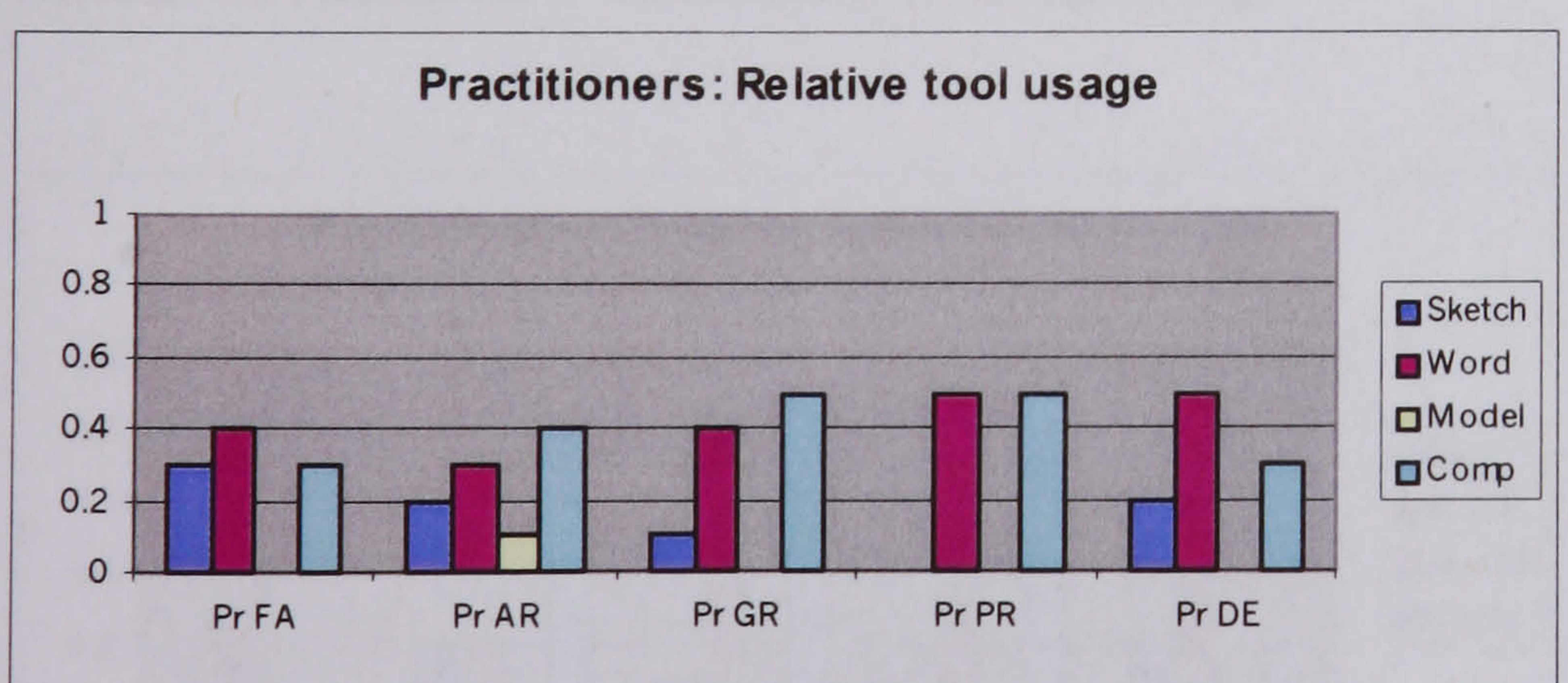


Fig. F:4 Practitioners' relative tool usage

	Y2 FA	Y2 AR	Y2 GR	Y2 PR	Y2 DE
Sketch	0.3	0.0	0.4	0.2	0.3
Word	0.0	0.5	0.6	0.3	0.3
Model	0.2	0.0	0.0	0.4	0.0
Comp	0.5	0.5	0.0	0.1	0.4

Table F:5 Students' relative essential tool usage

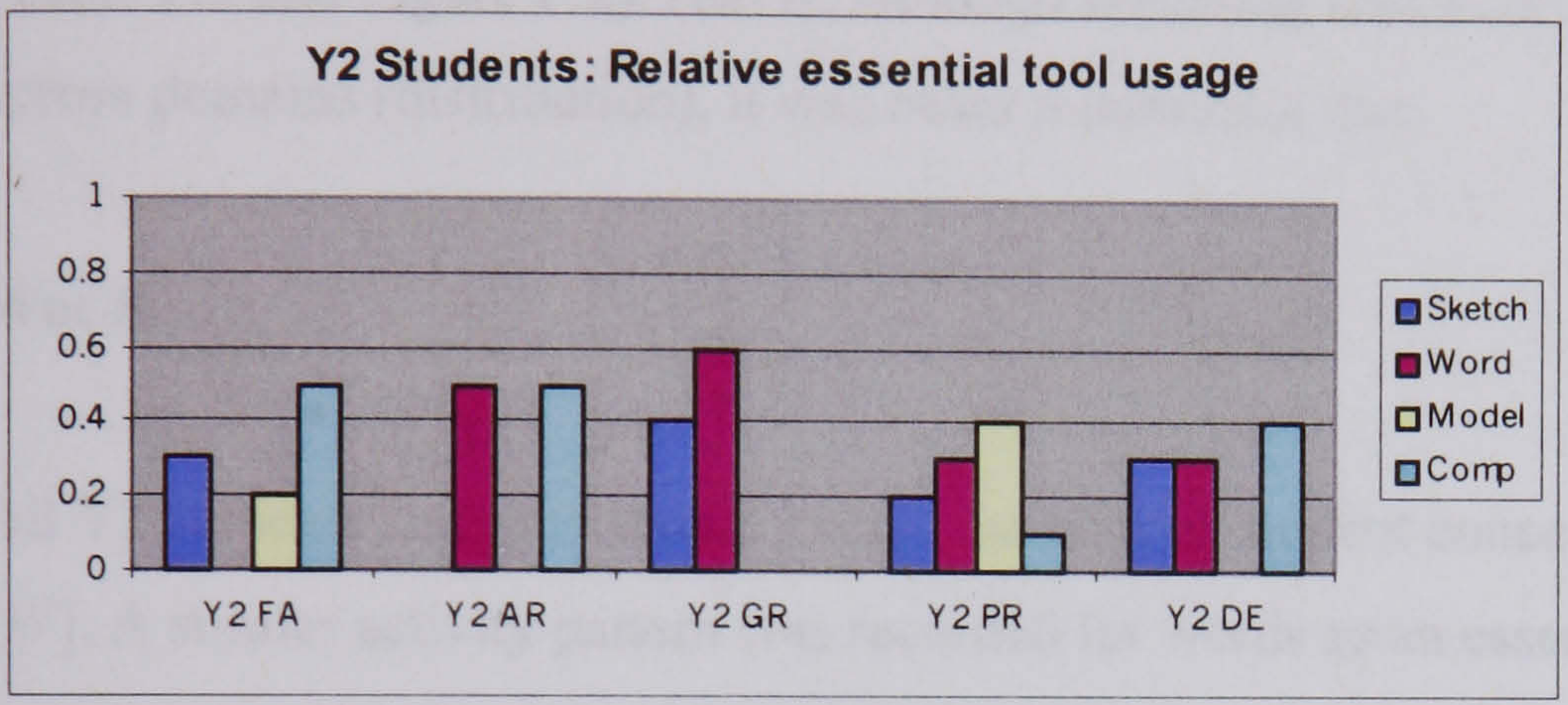


Fig. F:5 Students' relative essential tool usage

	Pr FA	Pr AR	Pr GR	Pr PR	Pr DE
Sketch	0.0	0.2	0.1	0.0	0.2
Word	1.0	0.2	0.4	0.5	0.6
Model	0.0	0.0	0.0	0.0	0.0
Comp	0.0	0.6	0.5	0.5	0.2

Table F:6 Practitioners' relative essential tool usage

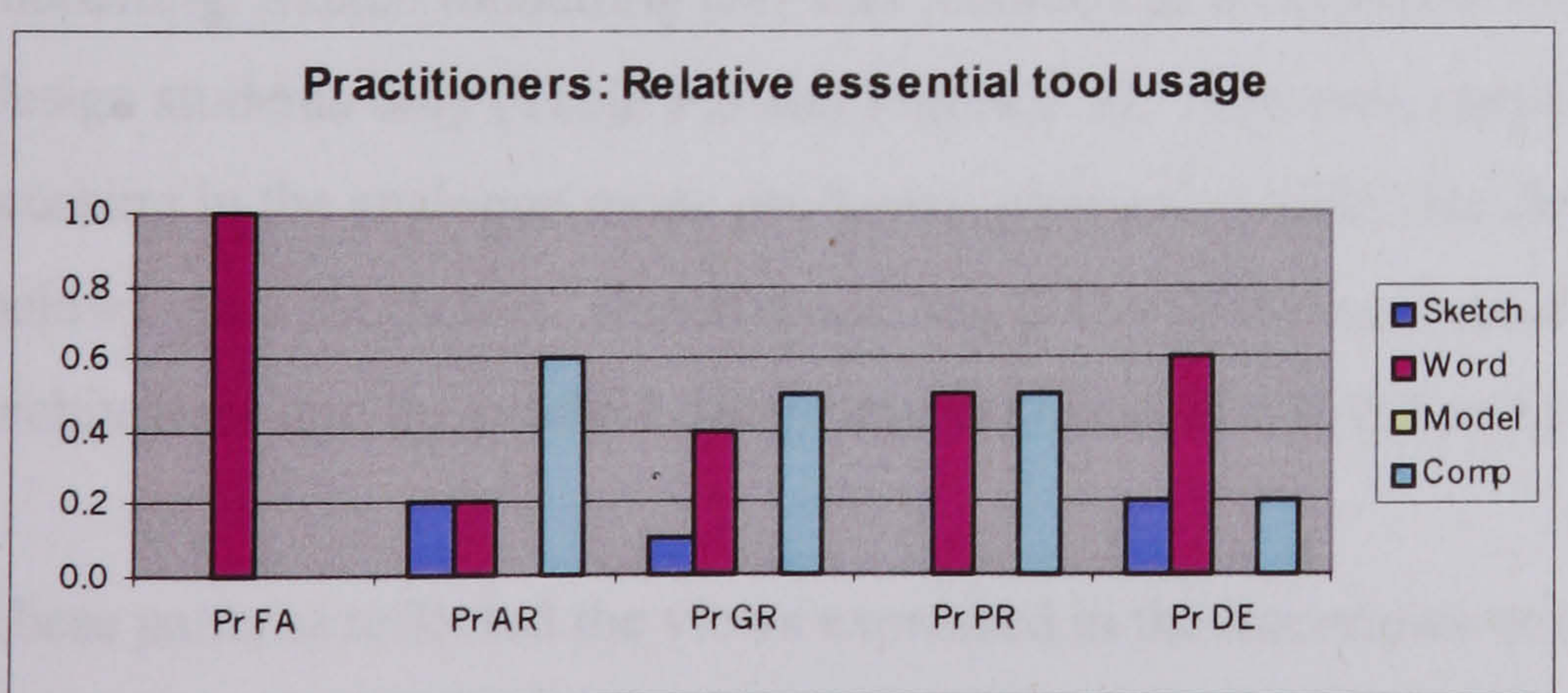


Fig. F:6 Practitioners' relative essential tool usage

Sketching

All Y2 students and practitioners except the product practitioner used sketching [S] as a conceptual tool. Sketching was recorded as an essential tool by all except the fashion and the architecture students, and the fashion and the product practitioners. However, sketching [S], measured as a ratio between a single conceptual tool and all conceptual tools used (as a decimal fraction of 1.0), was not recorded as the most used single conceptual tool in any of the projects. (Table F:2 and Figure F:2).That is, although sketching was widely used as a conceptual tool across domains (distribution), it was never a dominant one.

Words

All Y2 students and practitioner except the fashion student conceptualised in the verbal mode [W]. A similar activity pattern was recorded for words as an essential tool, except the fashion practitioner, who singled out words (for an interpretation see below). As a ratio of all tools, words [W] were used as the single most used conceptual tools by the fashion practitioner (0.4), and the general design practitioner (0.5), and, shared equally with computing [C] by the product practitioner and the general design student (both 0.5). (Table F:2 and Figure F:2).

Modelling

Three Y2 students did sketch modelling [M], with the exception of the graphic student and the general design student. In contrast, only the architect among the practitioners used sketch modelling. Sketch modelling [M] was recorded as an essential tool by the fashion and product design students only (Table F:5 and Figure F:5). However, sketch modelling here meant working in the analogue mode producing physical models (for digital modelling, see Computing below). As a single tool, sketch modelling [M] was the most used tool by the fashion, the architecture and the product design student (ratio of 0.7, 0.5 and 0.4 respectively).

These patterns reflected the views expressed in the interviews in which sketch modelling was regarded as a slow and time consuming conceptual medium, which may suggest that sketch modelling is the conceptual tool most under pressure in commercial practice where time and cost are important constraining factors.

Computing

Computing [C] was recorded as a conceptual tool by all participants. As such it was regarded as an essential tool by all except the graphic student and the fashion practitioner. As a single tool, computing was the most used tool by both the graphic student and the practitioner (a ratio of 0.5), by the architect (0.4), and by the product design practitioner and the general design student, who both recorded computing on par with words (a ratio of 0.5). (Table F:2 and Figure F:2).

Thus computing emerged as a widely used conceptual tool. However, in most cases computing meant 2-D image manipulation using painting packages (bit map), such as PhotoShop™, rather than drawing packages, CAD (vector), although the graphic student and the general design students as well as the general design practitioner used 2-D vector programs, such as Illustrator™. However, only the architect used 3-D modelling software (vector) in the ideation process. This might suggest that computing was for most participants essentially a visualisation tool for representing, enhancing, developing and communicating, rather than generating ideas.

However, this seems an oversimplification of how conceptual tools were being used in the projects because digital image manipulation (bit map) stimulated ideation as exemplified by the fashion student and the product design practitioner, who both used extensively digital images (see individual cases above). Therefore, computing played a role as a conceptual tool, not just as an expression of surface but also reflecting the deep structure of ideation (language).

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Getting started: Square One

At the very beginning of each interview, the participant was asked to rate conceptual tools in general and according to whether they were 'Core', 'Useful' or 'Marginal'. The individual rating was then compared with the participant's actual usage of conceptual tool(s), both at the very start of the project ("Square One"), and throughout the project, as recorded by the participant in the self-report.

The findings are presented in Table F:7. Figures in bracket represent the ratios of relative usage of essential tools. The tool ratings ('Core', 'Useful', and 'Marginal'), then, would be read against the ratios for essential tools. For instance, the Y2 architecture student (Y2 AR), who began the project in a verbal mode [W], described words [W] as a 'core' conceptual tool, and used words [W] as an essential tool in half (0.5) the sessions worked. Computing [C] made up the other half of essential tools used although it was described as 'useful', rather than 'core'. This suggests that the student used computing [C] more than he would have liked or, 'it's [the computer] being pushed a lot in this unit' (see case particulars above).

PART.	START	CORE	USEFUL	MARGINAL
Y2 FA	C	S (0.3) M (0.2)	W (0.0) C (0.5)	
Pr. FA	W	S (0.0)	W (1.0) C (0.0)	M (0.0)
Y2 AR	W	W (0.5)	S (0.0) M (0.0) C (0.5)	
Pr. AR	S+W	C (0.6)	S (0.2) W (0.2) M (0.0)	
Y2 GR	W	S (0.4)		W (0.6) C (0.0)
Pr. GR	S+W	S (0.1) W (0.4) C (0.5)		
Y2 PR	S	S (0.5) W (0.1) M (0.4)	C (0.0)	
Pr. PR	W	S (0.0) W (0.5) C (0.5)	M (0.0)	
Y2 DE	W+C	W (0.3) C (0.4)		S (0.3) M (0.0)
Pr. DE	W+C	S (0.2) W (0.6) M (0.0) C (0.2)		

Table F:7 Getting started

The commonly held view that sketching initiates the design process (see Chapter *Methodology*) was challenged by the findings. Thus when looking at how the participants *actually* began their projects (Square One), it emerged that only one participant, the product design student, Y2 PR, got started with sketching [S] as a single conceptual tool. In fact, even in this case the participant effectively got started with words [W] because the interview revealed that writing the project brief was actually what sparked off the ideation process (see above *Y2 product design student*). Nevertheless, in Square One, eight participants used either words [W] on their own (four participants) or combined with sketching [S+W] or computing [W+C]. Only one participant, the fashion student, started the project solely in the computing mode [C]. But although verbalisation [W] played a major role in getting started, it did not exclude sketching. However, the findings suggest that sketching first thing is an assumption that does not necessarily correspond with how designers *actually* initiate the design process. Perhaps the way the participants got started was "blurred", rather than "clear-cut", or how the front end of the design cycle might be described as "bleeding-edge" rather than "cutting-edge" (see Chapter *Literature review*).

However, as mentioned (see Chapter *Methodology*), there is a strong assumption that designers get started with sketching. For example: 'When designers first tackle a design problem they usually do so by sketching' (Plimmer and Apperley 2002:9). In fact, so common is this view that when designers "deviate" from the "sketch norm" it may register as a surprise. For example, in a two-hour industrial design experiment it was found "surprising" that the subject's 'first actual sketch appears *only* [my italics] 45 minutes into the exercise' (Goldschmidt 1996:70). The behaviour was expressed by the subject as: 'there's no sense in starting from scratch if you can start at square two instead of square one or square zero' (ibid.). This suggests that conceptual tools cannot be prescriptive, that is, there is no "right tool at the right time" (see also Chapter *Introduction* and Chapter *Literature review*).

Tool assumptions

Table F:7 also revealed discrepancies between what participants considered to be a 'core' conceptual tool when designing in general, and what they recorded as an 'essential tool' in the protocols, that is, a difference between "theory" and "practice" as to what the designer thought he or she could not do without. For example, the practising fashion designer regarded sketching [S] in general as a 'core activity' yet did not record it as an 'essential tool' in the protocol, which might have been expected. In fact, the only 'essential tool' recorded by the practising fashion designer was words [W], although she considered words 'useful', rather than 'core'. The practising graphic designer also regarded sketching [S] as 'core' but recorded very few sketch events as 'essential'. However, the practising graphic designer also described words [W] and computing [C] as 'core' activities although with these two tools there was a much better correspondence between 'core' and 'essential tools', or a ratio of 0.4 and 0.5 respectively. Another mismatch was how the graphic student saw words [W] as a 'marginal' conceptual tool yet often recorded it as an 'essential tool' in the protocol, or a relative figure of 0.6. Overall, the participants regarded most conceptual tools as either 'core' or 'useful', with very few of 'marginal' importance.

The discrepancies between what participants thought about conceptual tools in general, and what tools they actually used in the projects suggest a difference between an "ideal" state of tool usage, or *ethos,* and the actual tool usage, or *techne.* For example, participants might ideally have regarded sketching [S] a 'core' conceptual tool yet in practice, in the actual design situation, they may not have recorded it as an essential tool, or not used it at all. However, the discrepancies also suggest that participants may have shared common assumptions about conceptual tools, and notably sketching, of which they were unaware only to come to light through the protocol analysis. That is, assumptions were revealed in the interview situation (reflection-on-action), rather than in the self-recording situation (reflection-in-action).

Therefore assumptions about uses of conceptual tools might have influenced the way participants projected themselves in the interview situation. Moreover, there was a risk that they told the interviewer what they thought the interviewer would like to hear in order to create a more favourable impression (Oppenheim 1966). Therefore, participants' responses might have reflected a presumptive view of sketching, as in "how can you be a designer without a sketchbook", rather than the actual picture of how they used sketching. Significantly, however, the participants showed no embarrassment when the discrepancies were revealed, rather they found such "unmasking of assumptions" a positive outcome of the protocol analysis. In this, the self-analysis protocol became a useful means of "deconstructing" values and beliefs underlying design decisions thereby raising self-awareness about ideation processes.

However, the exposed assumptions also questioned data validity, that is, 'whether the findings are 'really about what they appear to be about' (Robson 1993:66). Still, by combining the two protocols, a reliability check was carried out (triangulation), that is, the recorded data were checked against interview statements. This highlights the risk with interviewing on its own, and notably when researching aspects of creativity, such as design ideation, and how it might produce a partial or distorted picture of what actually happened (see Chapter *Methodology*).

Tools and Self-image

The social aspect of designing and how it may relate to conceptual tools was highlighted in the interview with the Y2 product design student:

> 'There's also this social aspect of design, and all "big" designers are using pencil and paper: "I scribbled with a bit of charcoal on the toilet wall" kind of thing. You feel that if you want to be a big deal in design you are going to shoot yourself in the foot if you are using the computer all the way'.

Thus the student raised the question of disciplinary identity, or the social dimension of design through the role of sketching in that he compared himself to 'big designers'. Big designers, then, were a "reference group", which reflected the social identity of designers in general and the student's professional aspiration to become a product designer in particular. In other words, the student in his second year already identified with the profession to which he aspired. In this he gave voice to an aspect of social psychology that deals with "social identity" or "social comparison", or how 'people evaluate themselves in relation to others' or, 'our beliefs about the groups to which we belong' (in Bernstein and Nash 1999:496). However, eager as the student was to become a product designer, he also expressed concerns about sketching skills being ignored by tutors and, by implication, how poor sketching skills might lower his chances of joining the profession. Thus, at a curriculum level, the student also identified the problem of course expectations and the teaching and learning of skills in design schools.

Moreover, the status of designers, like other professionals or trades people, is reflected in the tools, or devices, they employ or display. In this

> 'the device can stand in (it is metonymic) for the trade or profession of the designer. So the aspiring architect seeks to acquire and display a drafting pen, and develop skill in using it. The practitioner wears the device into narratives that define areas of expertise' Or, 'implicated in the narrative construction of the self is the design device, be it pencil, drafting pen, compass, chisel, CAD system or electronic drawing board' (Coyne et al. 2002: 279-280).

This suggests that the impact of digital technology on conceptual tools may have wider professional and social repercussions. That is, whether digital tools, such as digital tablets, are understood as an extension of or substitution for analogue tools, such as pencil and paper, may influence not only approaches to ideation and self understanding but also institute new hierarchical orders among designers, both professionally and socially.

Moreover, the narrative of the self through design devices implies authorship and therefore may recall Platos' distinction (in the *Republic* Book 3) between two ways of representing action in verbal discourse, that is, the author' voice, *diegesis*, and the characters' voices, *mimesis*. This distinction is sometimes referred to as "telling" and "showing" (in Lodge 1986). Arguably, then, the designer, in combining telling and showing, in verbal (words) and non-verbal (images and artefacts) ideation, reflects the *persona* behind the design. Or, put differently, the autobiographical element of designing reveals the designer's thoughts, feelings and behaviour. This aspect of designing also came to light in the ideation workshops (see Chapter *Findings Y1 Students*).

From a phenomenological perspective of personality, as developed in Carl Roger's 'Self Theory', uses of conceptual tools may be regarded as a part of the designer's 'self-experience', or 'self-concept, which is the way one thinks of oneself' (in Bernstein and Nash 1999:424). This suggests that the designer's self definition is mediated through conceptual tools. That is, the designer's self-concept is defined not only by what tools he or she uses precisely but also how the tools displayed reflect the self-image, or self-actualisation of the designer. The projection of self seems particular relevant in a digital design culture where the latest technology is necessary but also may obscure designer identity, which highlights how conceptual tools are *surface* structures whereas conceptualisation, as context and language, signifies *deep* structure.

Therefore, at the ideation stage, visualisation skills are not enough. That is, in a digital design culture, the computer discloses the need for both verbal and non-verbal skills.

Moreover, telling and showing through a combination of verbal and non-verbal means suggest similarities between the designer's and the artist's self-portraiture ("autobiography") in which the self-image of the artist may be achieved through a synthesis of word and image. Such a synthesis may be expressed as,

> 'a quintessential statement of art as autobiography, of the artist's dual role as creator and created, of his authorship, and his presence in his own work' (Schneider Adams 1996:130).

This suggests that the participant designers, in their dual roles of creator and created, in telling and showing using conceptual tools, and notably sketching [S] and words [W], effectively may have portrayed their self-image (see also Chapter *Findings Y1 Students*).

What is then interesting is how the portrayed self-image relates to ideation through computing [C]. First, only the architect and the practising graphic designer saw computing [C] as a 'core' conceptual activity yet no participant entirely dismissed computing [C] for not being a conceptual tool. However, the positive attitude to the digital medium might reflect the image the participants wanted to project of themselves. That is, as the stated research objective was to look for the impact of digital technology on conceptual tools, participants wanted to portray themselves largely in favour of computing, rather than against. That is, all participants, although at times critical of digital technology, reflected how the computer was an indispensable tool in everyday design practice (see also Chapter *Introduction*).

Strengths and weaknesses of tools

In addition to tools being described as 'core', 'useful', or 'marginal', the participants were asked to identify tools according to their perceived *strengths* and *weaknesses*. From the response emerged a number of key words associated with each tool category (Figure F:7). The number in bracket represents how many participants used that particular word, or similar words to that effect, to describe the strength or weakness of the tools used.

TOOL	STRENGTHS	WEAKNESSES
SKETCH	Quick (8)	Skill (5)
WORD	Ideas (3)	Non-visual (3)
MODEL	3-D (3)	Slow (4)
COMP	Changing (4)	Slow (3)

Fig. F:7 Strengths and weaknesses of tools

Although sketching [S] was not used as a dominant single conceptual tool in any of the cases, it was a tool described by eight participants as "Quick". This suggests that sketching was an easily identifiable tool associated with speed (see Chapter *Literature review*). Words [W], too, were described as a quick way of generating ideas but countered by their weakness for being "Non-visual". That is, verbalisation [W], as natural language, was often used for describing ideas although words did not always manage to capture the full intent of the designer. A benefit with sketch modelling [M] was how it could express form in three-dimensions, yet, negatively, it was also seen as a time consuming activity for which a dedicated workspace was often needed (worktop, cutting map, tools and materials), unlike sketching, which could be done almost anywhere (sketchpad). The strength of computing [C] was seen in its capacity for facilitating frequent changes to a design, but it was also considered slow for conceptualising operating through menus and tool bar, in contrast to just scribble down an idea on a piece of paper, or simply talking.

Sketching as skill

Half of the participants said that the weakness of sketching was due to the skill factor, that is, drawing skills were implied in sketching. Significantly, this was a view held only by the students and therefore raised the issue of skill-based teaching and learning in design schools. This may suggest that the participant students felt conceptually constrained from lack of drawing skills. Moreover, it contradicts the commonly held view that sketching is a natural visual language, for instance, 'sketching is effortless and natural; we learn to sketch as very young children' (Plimmer and Apperley 2002:9). Instead, the findings suggest, *first*, that for sketching to be effortless, it need not only to be initiated but has to be practised too (skill), a widely held view among practitioners too (see Chapter *Introduction*). *Second*, that the way children do sketching may be natural but it is different from the designer sketch. Therefore, sketching for design may not be *generic* to design but a specific skill with its own characteristics (Goldschmidt 2003). This may further have implications for CAD as a sketching tool as well as for teaching and learning design (see Chapter *Literature review*, and Chapter *Findings Y1*).

But despite the participant students' strongly held views on sketching as a skill based activity, freehand drawing was not formally taught in the design schools from which the participant students were drawn (except my own one-off drawing classes at Goldsmiths, see Chapter *Findings Y1*). This suggests that the amount of sketching done by the students did not only reflect lack of drawing skills but was also influenced by the learning objectives. Arguably, then, if design schools did not provide opportunities for enhancing or encouraging such skills, students might consider the effort, or "set-up costs" for doing sketching too high (for "set-up cost", see Chapter *Findings Y1 Students*; for "least effort", see Chapter *Literature Review*).

The lack of sketching skills might have further implications for teaching and learning design in design schools. For example, and in pursuing a reductionist argument *in extremis*, the set-up cost might imply that students who have not gained sketching skills would fall back on conceptualisation skills other than sketching [S], that is, words [W], sketch modelling [M] and computing [C]. However, if sketch modelling [M] and computing [C] were not among the students' competencies either, the effective conceptual tool left would be words [W]. That is, design ideation would become essentially a verbal activity, or talking and writing about design. In this, design may become dislodged from the practice of design in a way similar to the relationship between, say literary criticism and production of literature.

In this scenario, teaching and learning design would turn cultural studies where tutors and their students engage in a form of critique similar to that long practised in art. Thus art and design as a theoretical pursuit would be in symbiosis where the conceptual tool would be critical thinking [W]. But it would not be a practice-based activity in the design school tradition, rather an education in the liberal arts. In turning the argument for sketching upside down, we may then portrait the "conceptual designer" whose strength lies in verbal skills [W], rather than sketching [S], modelling [M] or computing [C]. But in so doing, we may also have to ask not just what is sketching for, but what is design education for?

However, among the practitioners, in contrast to the students, sketching skills seemed less of an issue. Yet, compared with the students the practitioners did not do more sketching [S] In fact, only the fashion practitioner did relatively more sketching than the students, and one practitioner, the product designer, did no sketching at all (Figure F:4). This suggests that what mattered to the practitioners was not so much the use of any particular conceptual tool but how they could best produce a satisfactory solution to the task in hand. That is, a rather pragmatic approach to designing in which uses of conceptual tools were influenced by the commercial design environment of team culture, client demands and user expectations. Such working practices also reflected how the practitioners tended to employ conceptual tools in a parallel, rather than in a serial fashion, that is, using more than one tool at the time. However, this is not to say that sketching was unimportant to the practitioners, rather that sketching was not necessarily the preferred or primary conceptual tool for the task in hand. This, again, was in contrast to generalised views about sketching, including the participants', which reflect a common observation of differences between what we say we do and what we actually do.

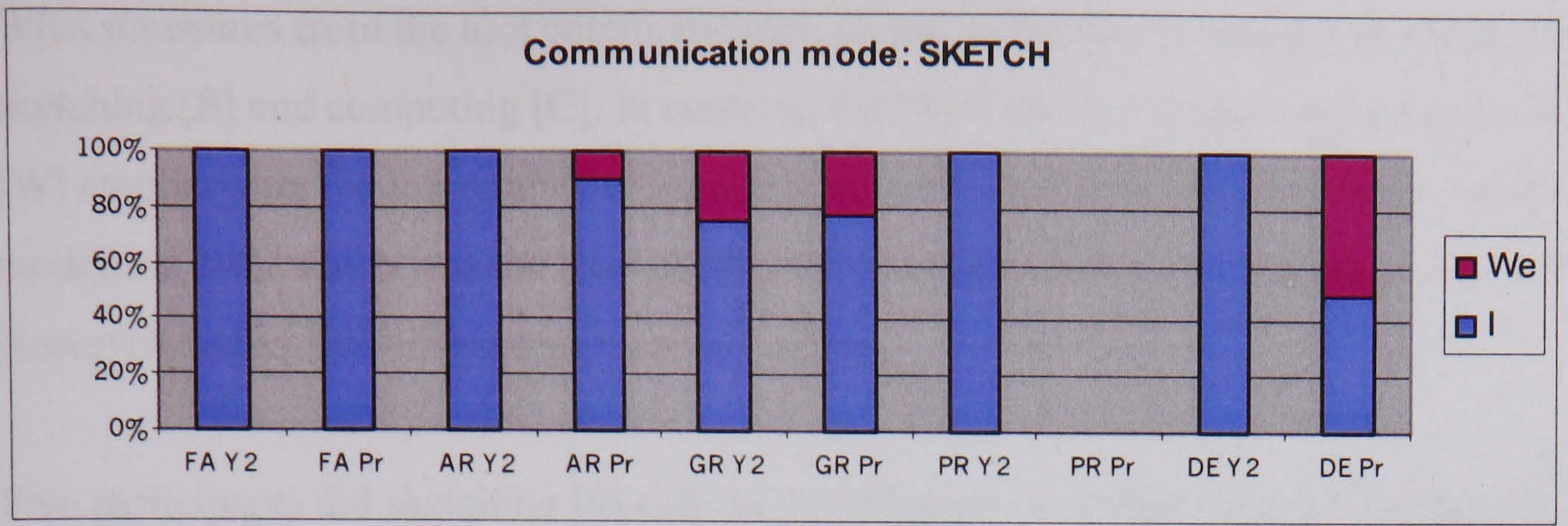
> 'Sketching is the preferred preliminary capture process for designers because it provides a quick and easy way to externalise design ideas' (Plimmer and Apperley 2002:9)

The case findings also reflected how professional practice is largely based on collaboration, with team, client, user and a multitude of non-design professionals, unlike the relative isolation in which students are typically working. Yet, the relative isolation from designing in the real world, that is, designing for financial gain, may have encouraged risk-taking and playfulness which may be given less space in commercial design environments, as exemplified by the graphic and the product design practitioners. However, design schools are addressing the issues of collaborative and inclusive design. For example, both the fashion and the product design students took part in projects set by industry during their second year providing them with 'live' projects and professional feedback.

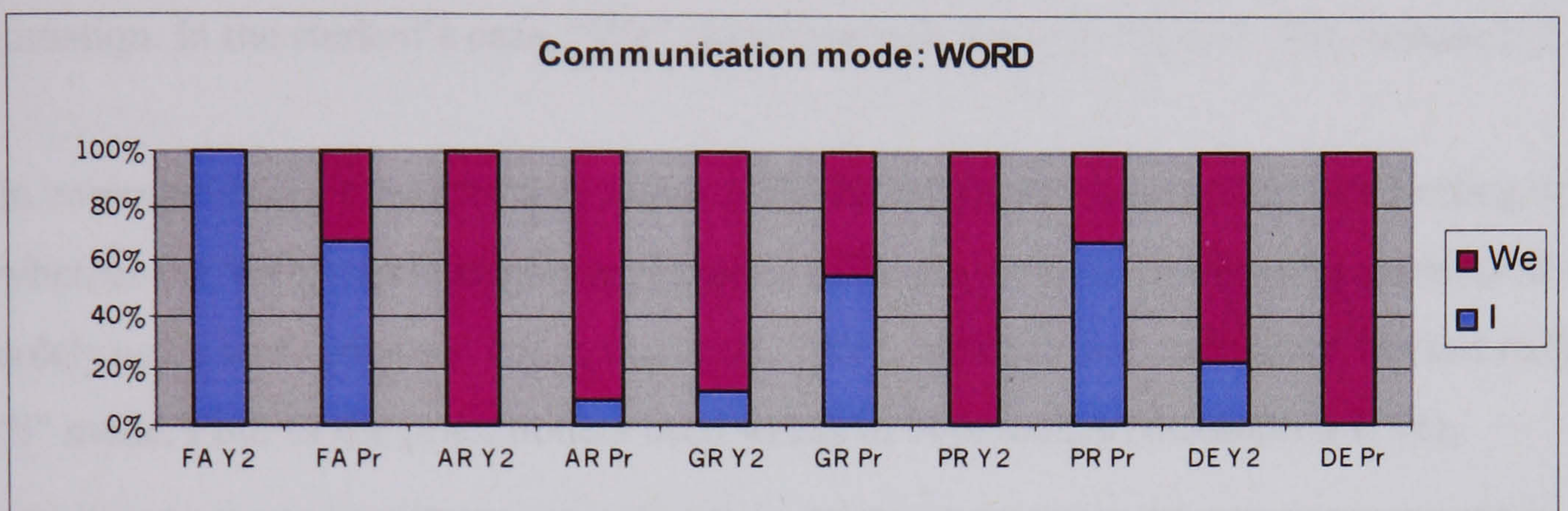
Tool communication

The participants traced the mode of communication when conceptualising, that is, working on their own was recorded as "I" (Inner-personal communication), and working with others as "We" (Inter-personal communication). For example, if participants did sketching on their own, it would be recorded as "I", but, if done with others, say another student, team member or client, it would be recorded as "We".

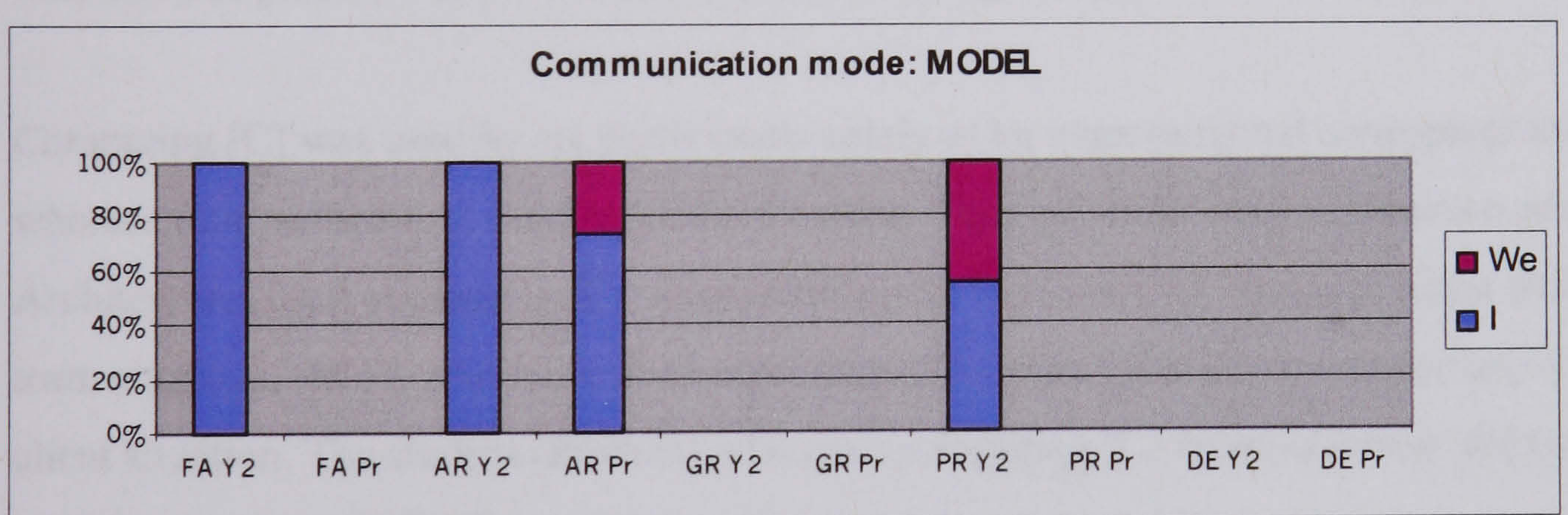
The charts below show the communication modes, "I" or "We", expressed in percentages, for each conceptual tools, [S], [W], [M], and [C], as used by each participant (Illustrations F:13, F:14, F:15 and F:16). For instance, sketching by the general design practitioner occurred in either "I" mode or "We" mode in roughly equal amounts, or 50 per cent, whereas the general design student did sketching solely in the "I" mode (Illustration F:13). When there is no bar in the chart for a particular tool, then that tool was not used by the participant.



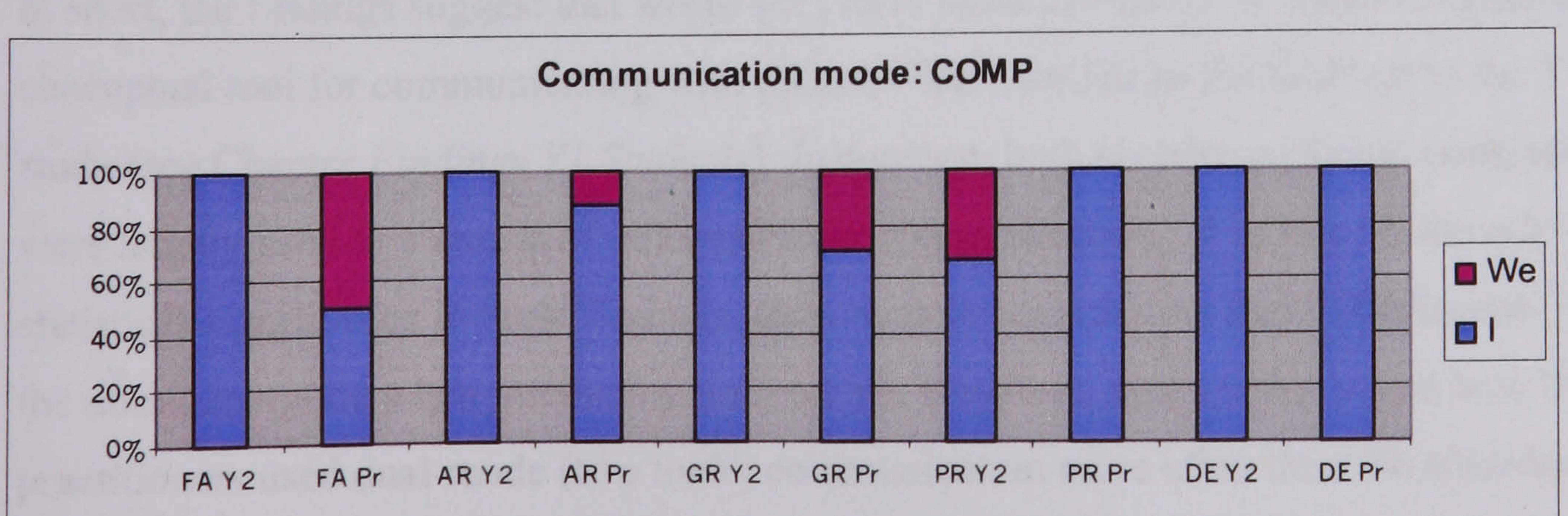
Ill..F:13 Communication mode: Sketch



Ill. F:14 Communication mode: Word



Ill. F:15 Communication mode: Modelling



Ill. F:16 Communication mode: Computing

What transpires from the tool communication charts is that the "I" mode was prevalent in sketching [S] and computing [C]. In contrast, the "We" mode was the most prominent for words [W] emphasising the importance of language in communicating ideas to others. Sketch modelling [M], which was the least used conceptual tool, took place mainly in the "I" mode. However, individual differences were noticeable.

Five participants did sketching [S] only in the "I" mode. Four participants did sketching [S] in both modes ["I + We"]. One participant did no sketching at all. Of the four, three were practitioners who used sketching to describe or explain their concepts when in a team or client situation. In the student's case, "We" sketching took place in tutorials (Illustration F:13).

In communicating concepts with words [W], the "I" mode meant essentially writing down ideas, whereas the "We" mode largely represented talking to others. Three participants used words solely as an inter-personal conceptual tool, "We", whereas one participant worked only in the "I" mode. Four of the practitioners used words in both modes (Illustration F:14).

Sketch modelling [M] was used partly as an inter-personal tool, "We", by two participants, that is, the architect when collaborating with team and clients, and the product design student in tutorials. Six participants did not use sketch modelling at all (Illustration F:15).

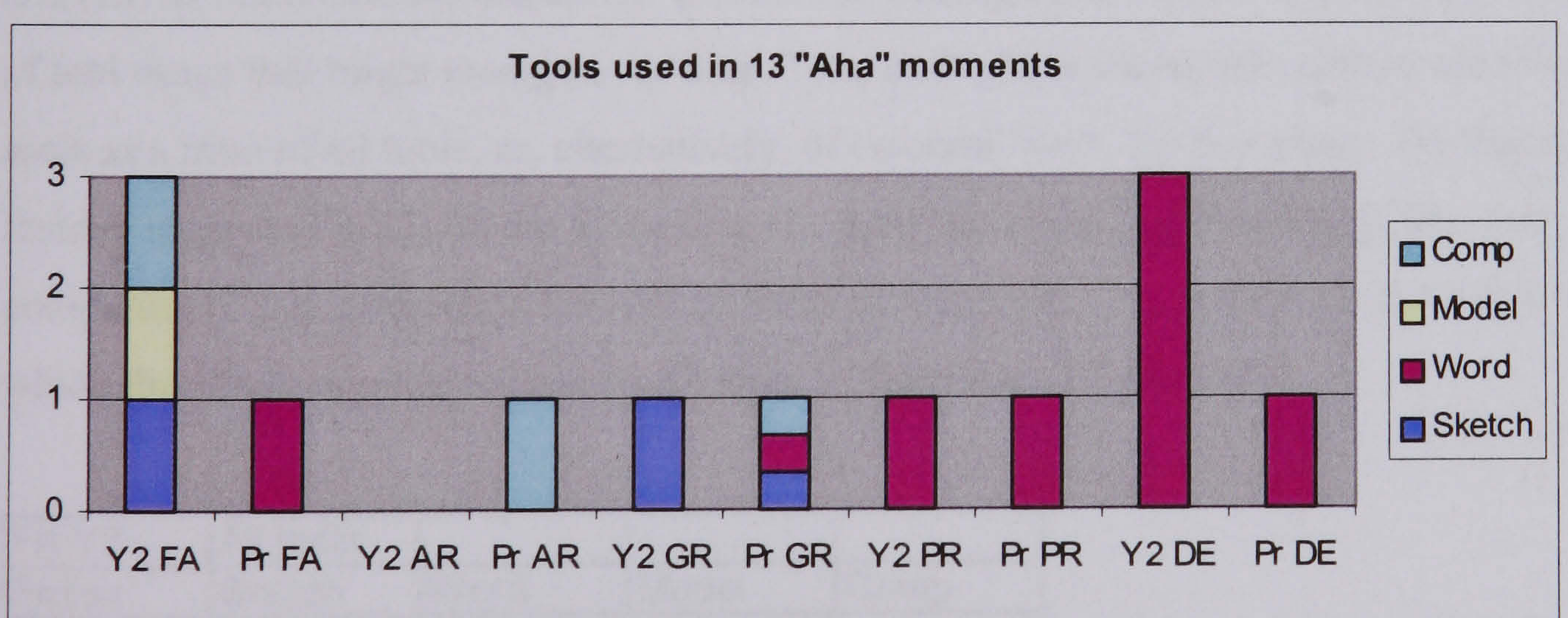
Computing [C] was used by six participants solely as an inner-personal conceptual tool, "I", whereas four participants used it in mixed modes. Thus two practitioners (Fashion and Architecture) used computing [C] when working on their own, "I", but also when working in a team situation, "We", whereas a third participant (Graphics) also used computing [C] in the client situation. The student (Product) who used computing [C] collaboratively did so with other students (Illustration F:16).

In short, the findings suggest that words [W] were underestimated, or taken for granted as a conceptual tool for communicating with others, "We", similar to the findings in the Y1 student study (see Chapter *Findings Y1 Students*). In contrast, both sketching [S] and computing [C] were largely used as a means of inner-personal communication, "I" mode. Although there is no statistical significance in these findings, they suggest nevertheless that verbalisation [W], was the dominant mode when interacting with others. However, noteworthy is also how the practitioners used dual-mode (two tools) communication more often than the students. This suggest that the commercial design environment demands more intense and sustained levels of collaboration and interaction between teams and clients compared with the more ad-hoc interaction between student and tutor in design schools, for instance, "tutor walk-about" or "sign-ups" for students.

Moreover, the practitioners' dual-mode communication mode suggests that they used conceptual tools in a parallel fashion, in contrast to students who employed one conceptual tool at a time, or in serial fashion. Interestingly, the computer works in a serial mode, that is, task follows task in a linear sequence. Therefore one might speculate that students' serial application of conceptual tools would encourage greater use of computers. However, there was no evidence of this, which suggests that conceptual tool usage cannot be easily predicted.

"Aha!" moments

All participants but the architecture student recorded at least one event of creative insights, or "Aha!", as described in the individual cases. Each event was then matched with the conceptual tool(s) used. The chart reveals that of a total of 13 "Aha!" moments recorded (left scale), 15 tools (S, W, M and C) were used and identified (Illustration F:17). Accordingly, eight "Aha!" moments happened in the word mode [W], three occurred during sketching [S], and computing [C], and one moment while modelling [M]. Of the ten participants, only the graphic practitioner was engaged with more than one conceptual tool when the "Aha!" moment occurred. And only the fashion and the general design students recorded more than one "Aha!" moment, or three each.



Ill. F:17 "Aha!" moments

The findings illuminate how over half of the events (8) occurred during verbalisation [W], which suggests that natural language was particularly helpful in capturing, translating and reforming ideas of a serendipitous nature. However, computing [C], captured as many "Aha!" moments as sketching [S], or three each. This suggests that ideas, as creative sparks, can ignite, or be ignited anytime and anywhere in the design process, not just in the early phases, and can be captured and externalised with any conceptual tool. Yet, we might speculate that the use of words [W] in product [PR] and general design [DE], and both by students and practitioners, reflected the particular emphasis on ideation (process), rather than on artefact (product) in those four projects. But then the fashion designer expressed her "Aha!" moment in words [W] too, although she was very much engaged with the materiality of design (fashion accessories). Still, what seems to have mattered in all these cases was a high level of verbalisation going on in the design environment, and through "talking design". However, this may not be that surprising because everyday designing is grounded in language, which suggest that reliance on words reflect the social context of designing, that is, how ideas may spark ("Aha!") in conversation with others, or one-self, and whether in or outside college or the professional studio.

The findings also highlight the importance of externalising ideas, and capturing them, lest we lose or forget the ideas, hence the usefulness of keeping track of ideas through self-reporting. Moreover, the relative few "Aha!" events when sketching [S] underline how freehand sketching, although traditionally seen as the prime tool associated with conceptualisation, is only one of many ways of generating and capturing design ideas (see also Chapter *Literature review*).

Time trace

Each case was nominally divided into three phases, the beginning (I), the middle (II), and the end (III) to illuminate the sequential distribution of single conceptual tool and therefore patterns of tool usage that might emerge over time. Thus each phase shows the relative use of single tools as a ratio of all tools, or, alternatively, of essential tools, for that phase. For instance, the fashion student (FAY2), in the first phase (I), used sketching [S], modelling [M}, and computing [C], in proportion 2:4:4 of all tools of that phase (fractions 0.2 + 0.4 + 0.4 = 1.0 in which the whole number represents all tools in the phase). (Table F:8).

FA Y2	All tools			
Phase	Sketch	Word	Model	Comp
I	0.2	0.0	0.4	0.4
II	0.0	0.0	1.0	0.0
III	0.1	0.0	0.7	0.2

Table F:8 Fashion student: Time trace all tools

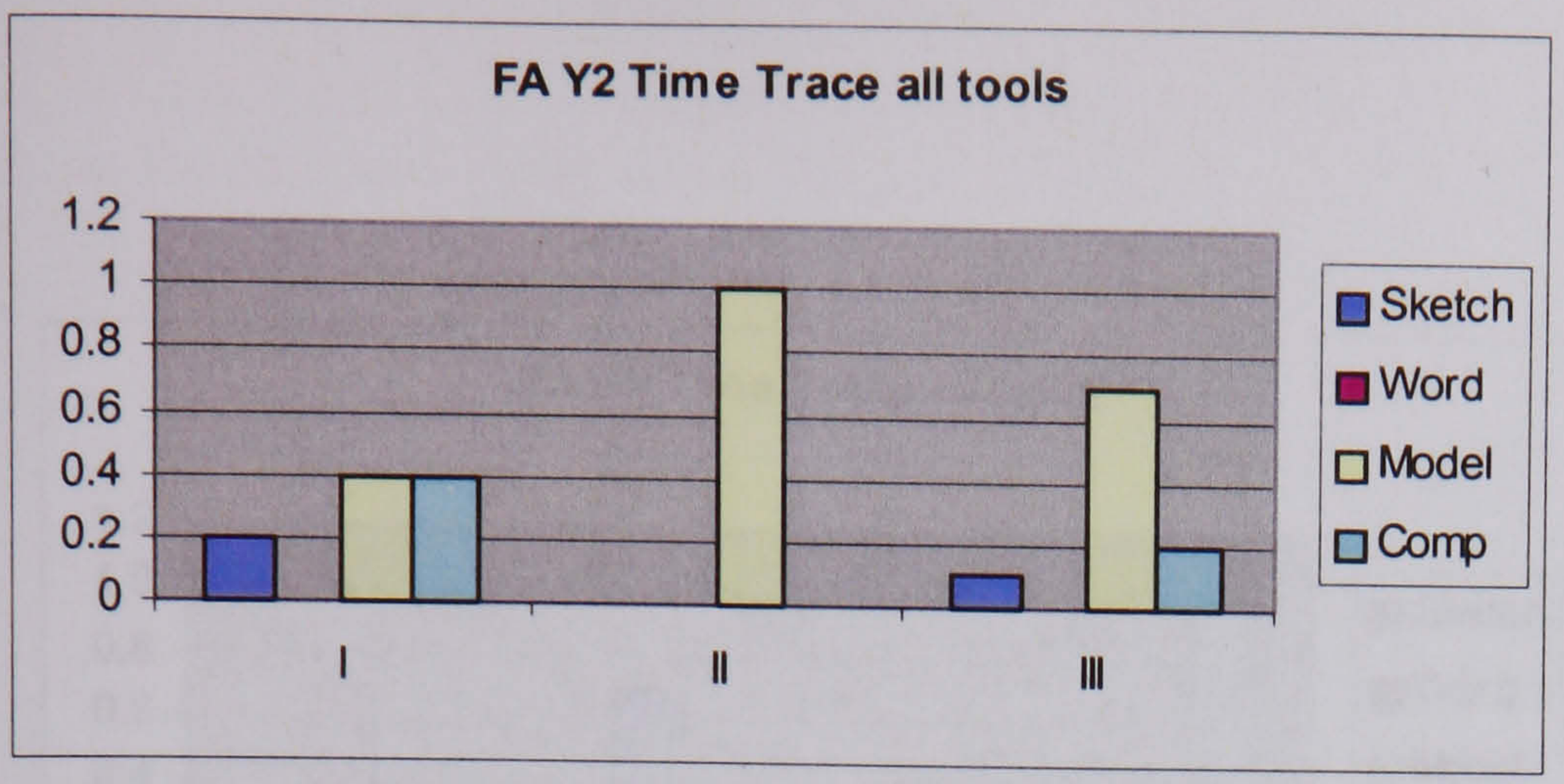


Fig. F:8 Fashion student: Time trace all tools

FA Y2	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.3	0.0	0.1	0.6
II	0.0	0.0	0.0	0.0
III	0.3	0.0	0.3	0.3

Table F:9 Fashion student: Time trace essential tools

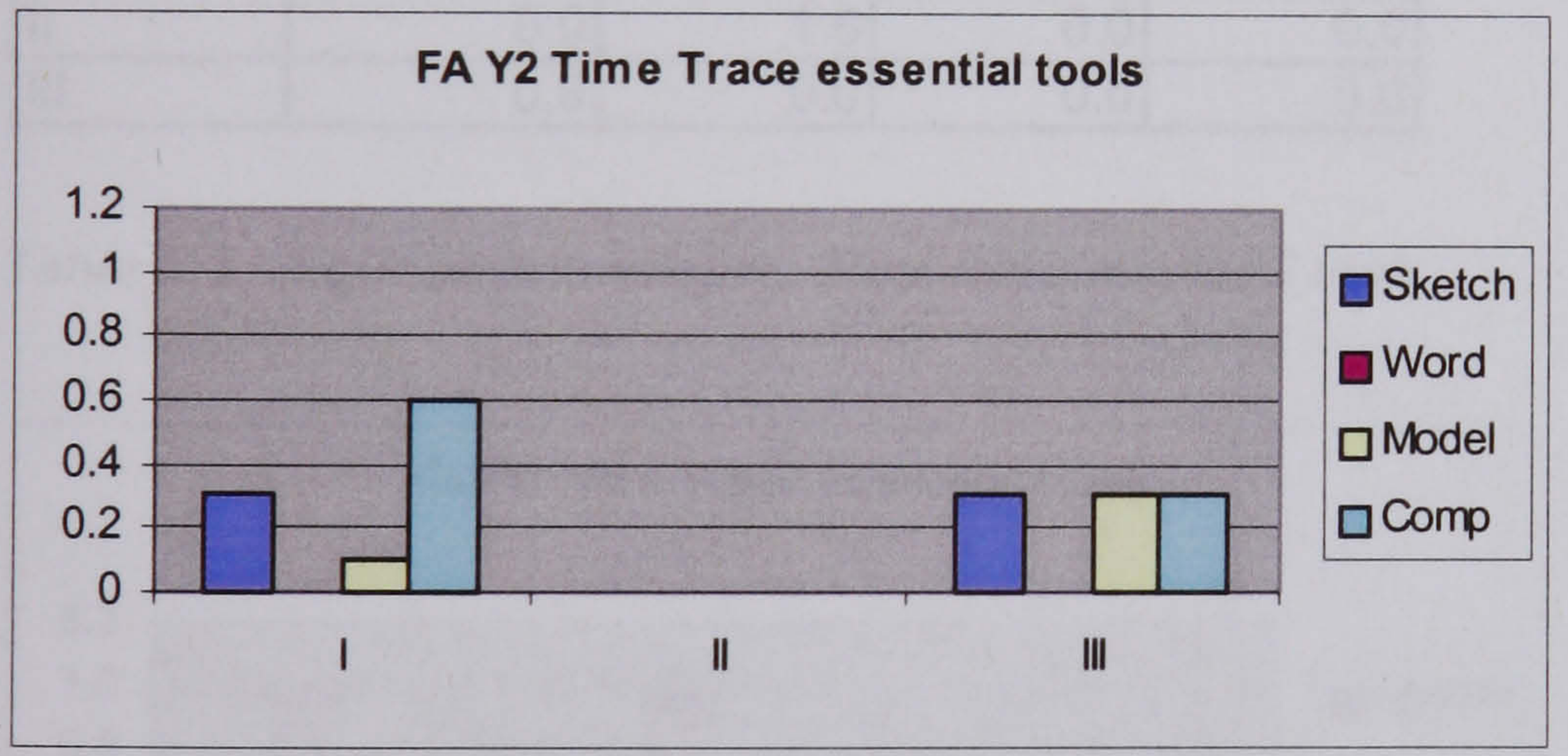


Fig. F:9 Fashion student: Time trace essential tools

FA Pract.	All tools			
Phase	Sketch	Word	Model	Comp
I	0.0	0.7	0.0	0.3
II	0.7	0.3	0.0	0.0
III	0.0	0.0	0.0	1.0

Table F:10 Fashion practitioner: Time trace all tools

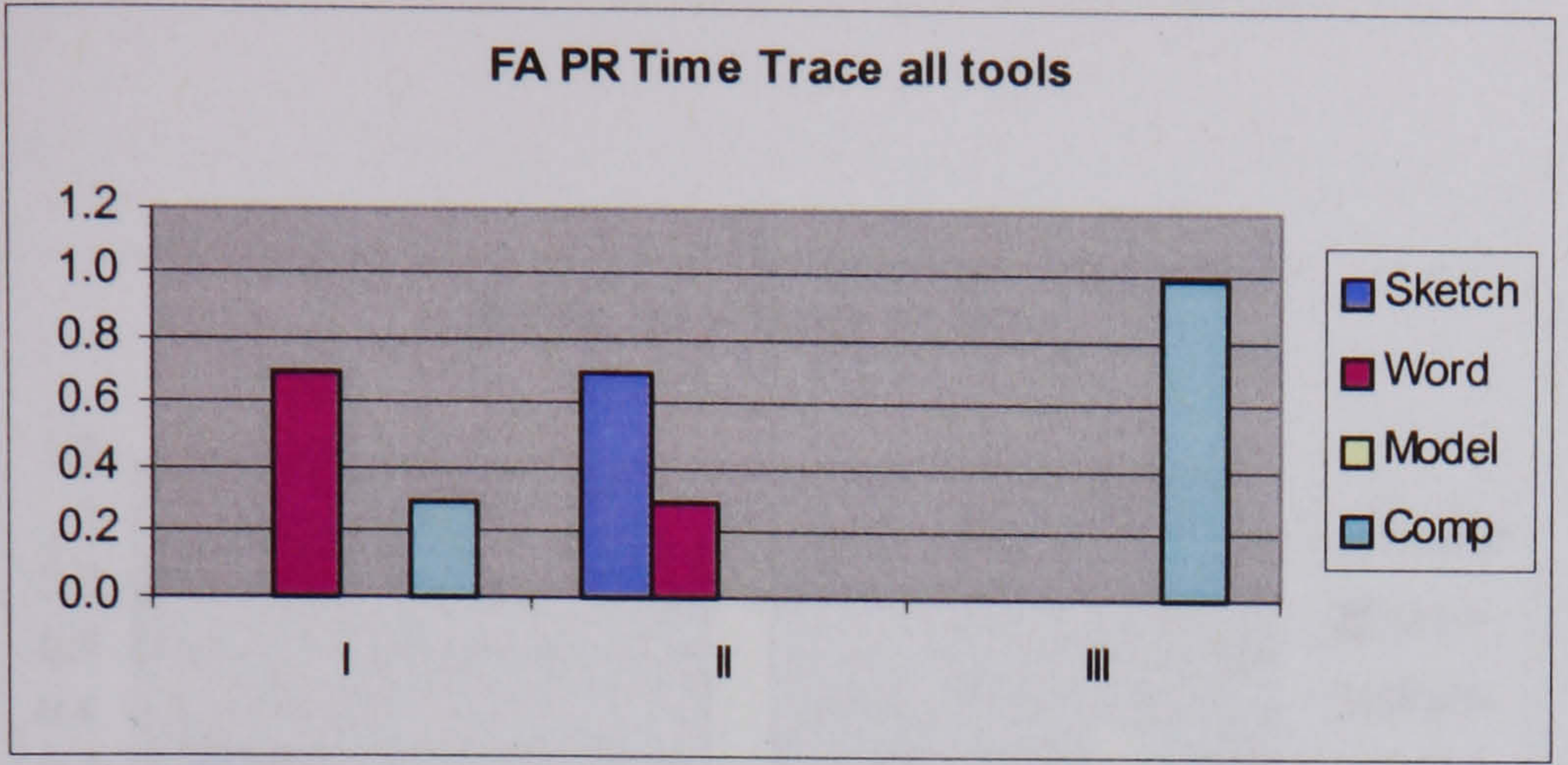


Fig. F:10 Fashion practitioner: Time trace all tools

FA Pract.	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.0	1.0	0.0	0.0
II	0.0	1.0	0.0	0.0
III	0.0	0.0	0.0	0.0

Table F:11 Fashion practitioner: Time trace essential tools

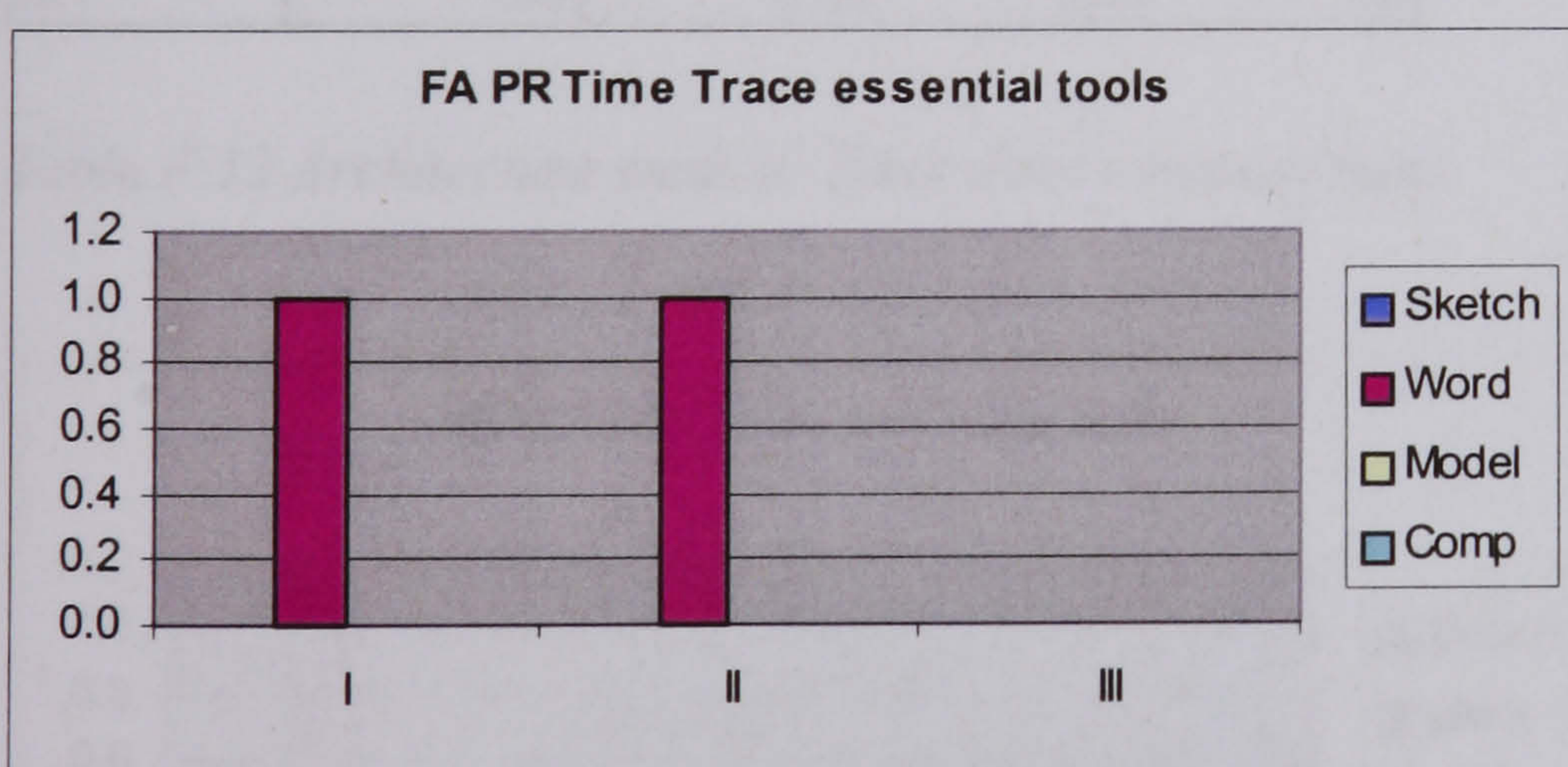


Fig. F:11 Fashion practitioner: Time trace essential tools

AR Y2	All tools			
Phase	Sketch	Word	Model	Comp
I	0.3	0.3	0.0	0.3
II	0.0	0.0	1.0	0.0
III	0.0	0.2	0.4	0.4

Table F:12 Architecture student: Time trace all tools

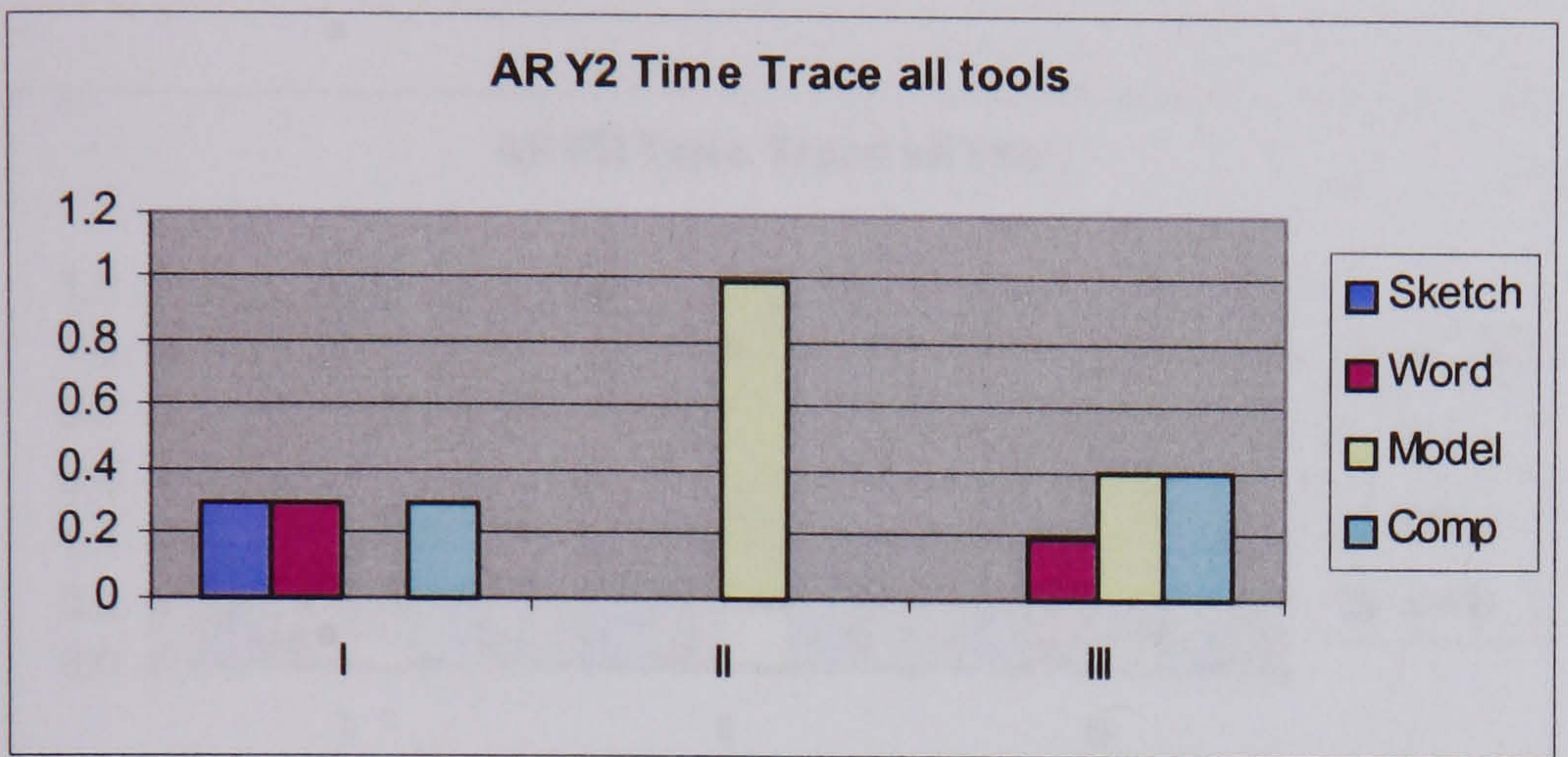


Fig. F:12 Architecture student: Time trace all tools

AR Y2	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.0	1.0	0.0	0.0
II	0.0	0.0	0.0	0.0
III	0.0	0.0	0.0	1.0

Table F:13 Architecture student: Time trace essential tools

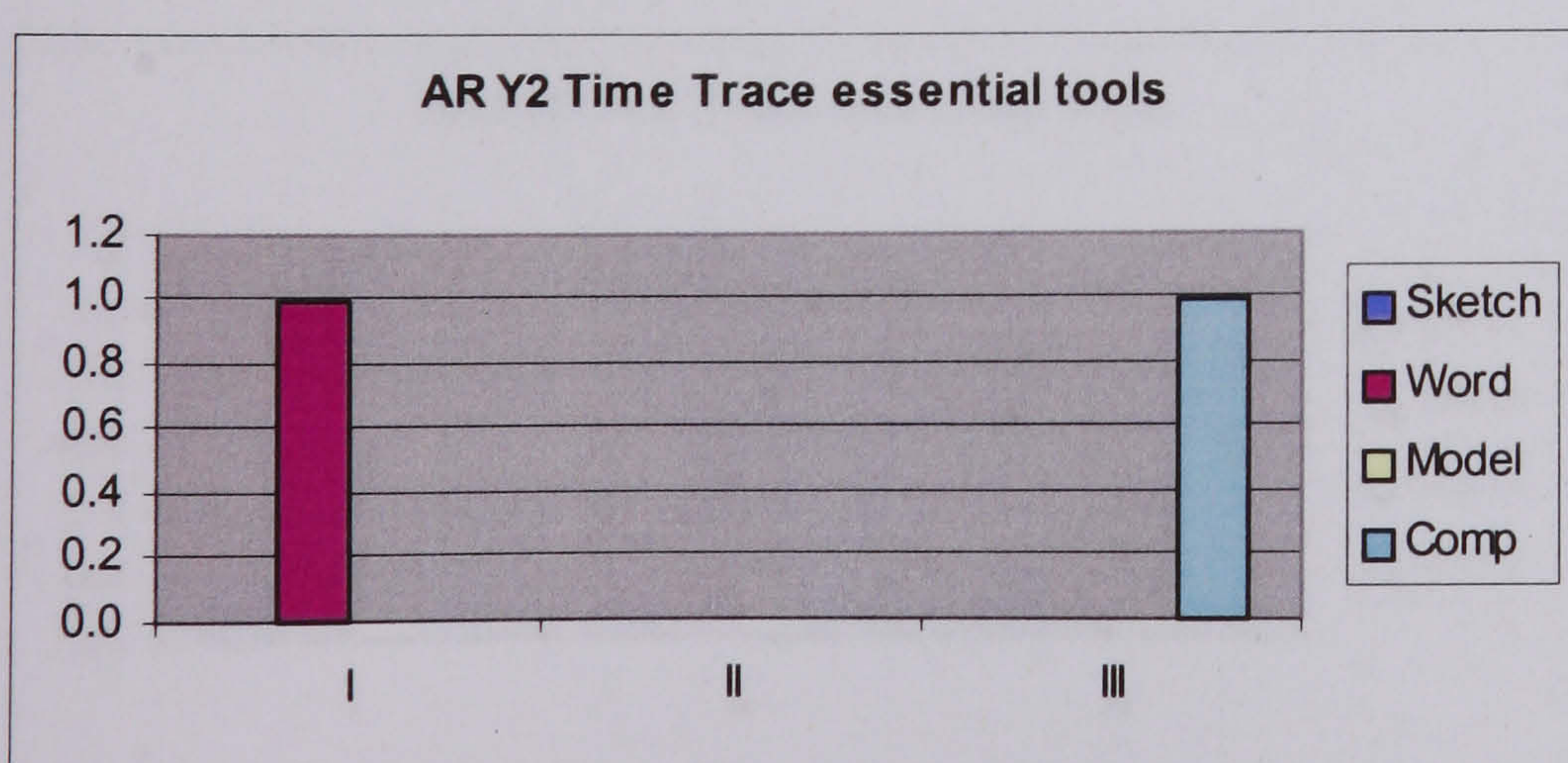


Fig. F:13 Architecture student: Time trace essential tools

AR PR	All tools			
Phase	Sketch	Word	Model	Comp
I	0.2	0.3	0.1	0.4
II	0.3	0.2	0.2	0.3
III	0.2	0.3	0.1	0.4

Table F:14 Architect: Time trace all tools

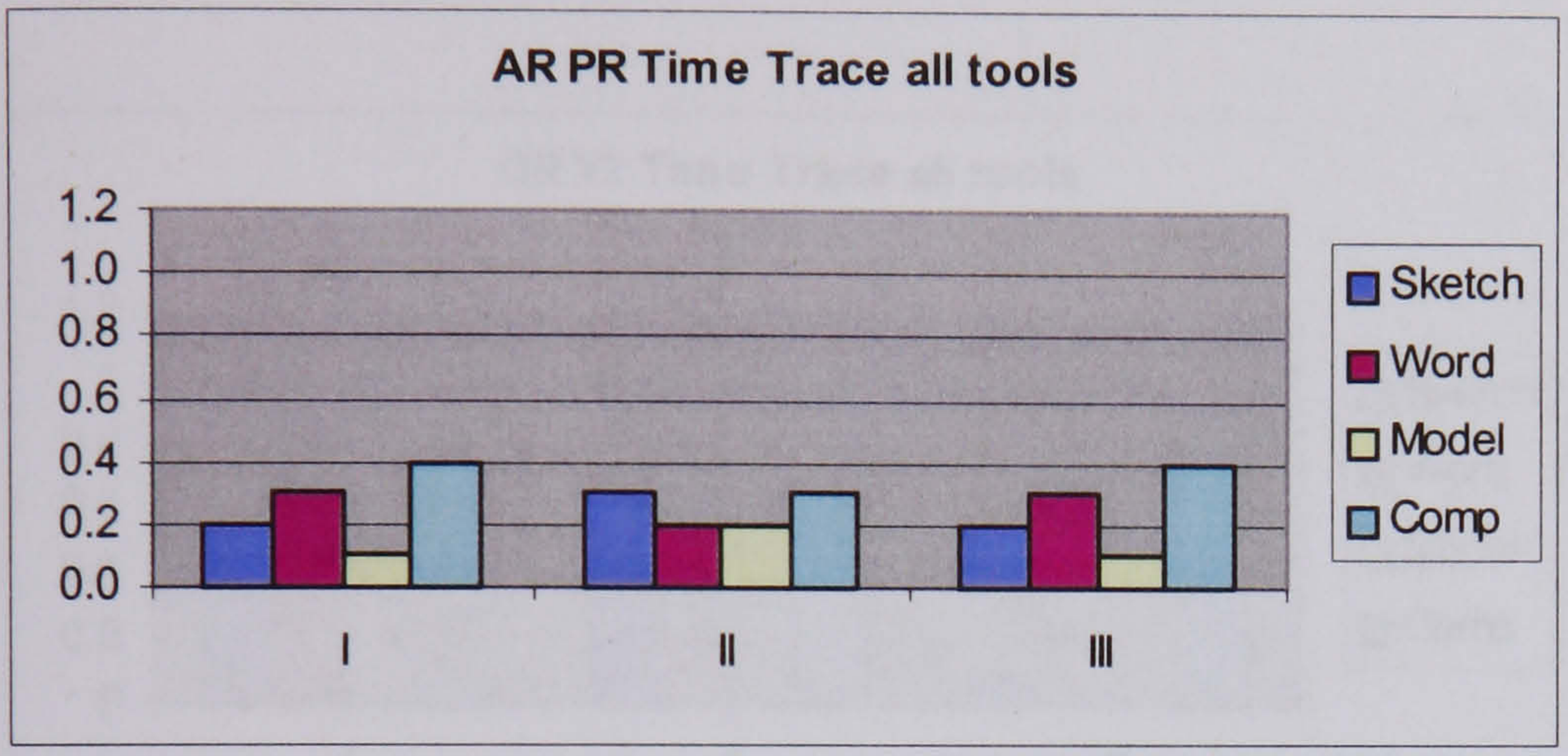


Fig. F:14 Architect: Time trace all tools

AR PR	Ess. tools			
Phase	Sketch	Word	Model	Comp
I	0.2	0.3	0.1	0.4
II	0.3	0.2	0.2	0.3
III	0.2	0.3	0.1	0.4

Table F:15 Architect: Time trace essential tools

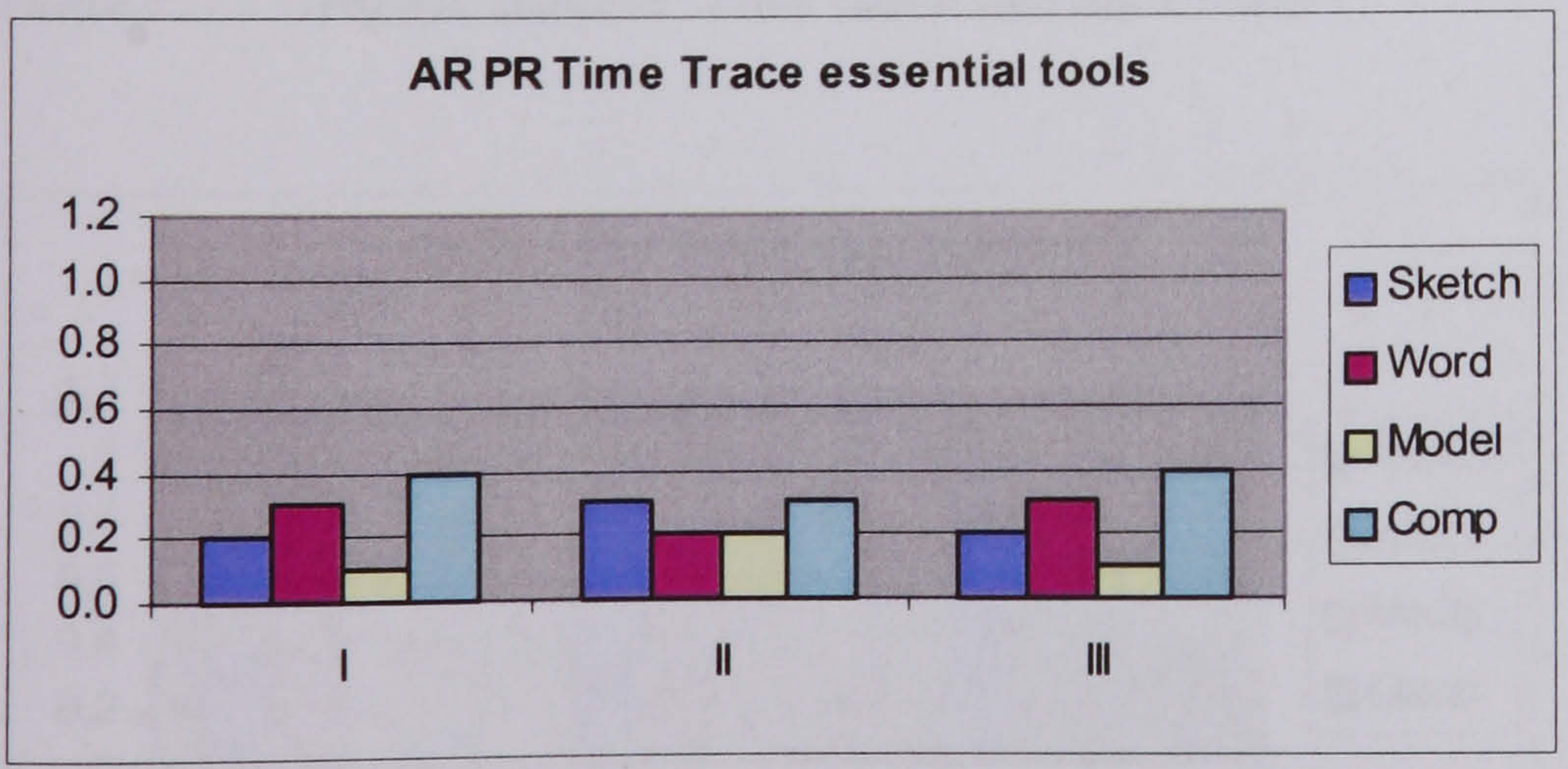


Fig. F:15 Architect: Time trace essential tools

GR Y2	All tools			
Phase	Sketch	Word	Model	Comp
I	0.4	0.5	0.0	0.1
II	0.4	0.2	0.0	0.4
III	0.1	0.0	0.0	0.9

Table F:16 Graphic student: Time trace all tools

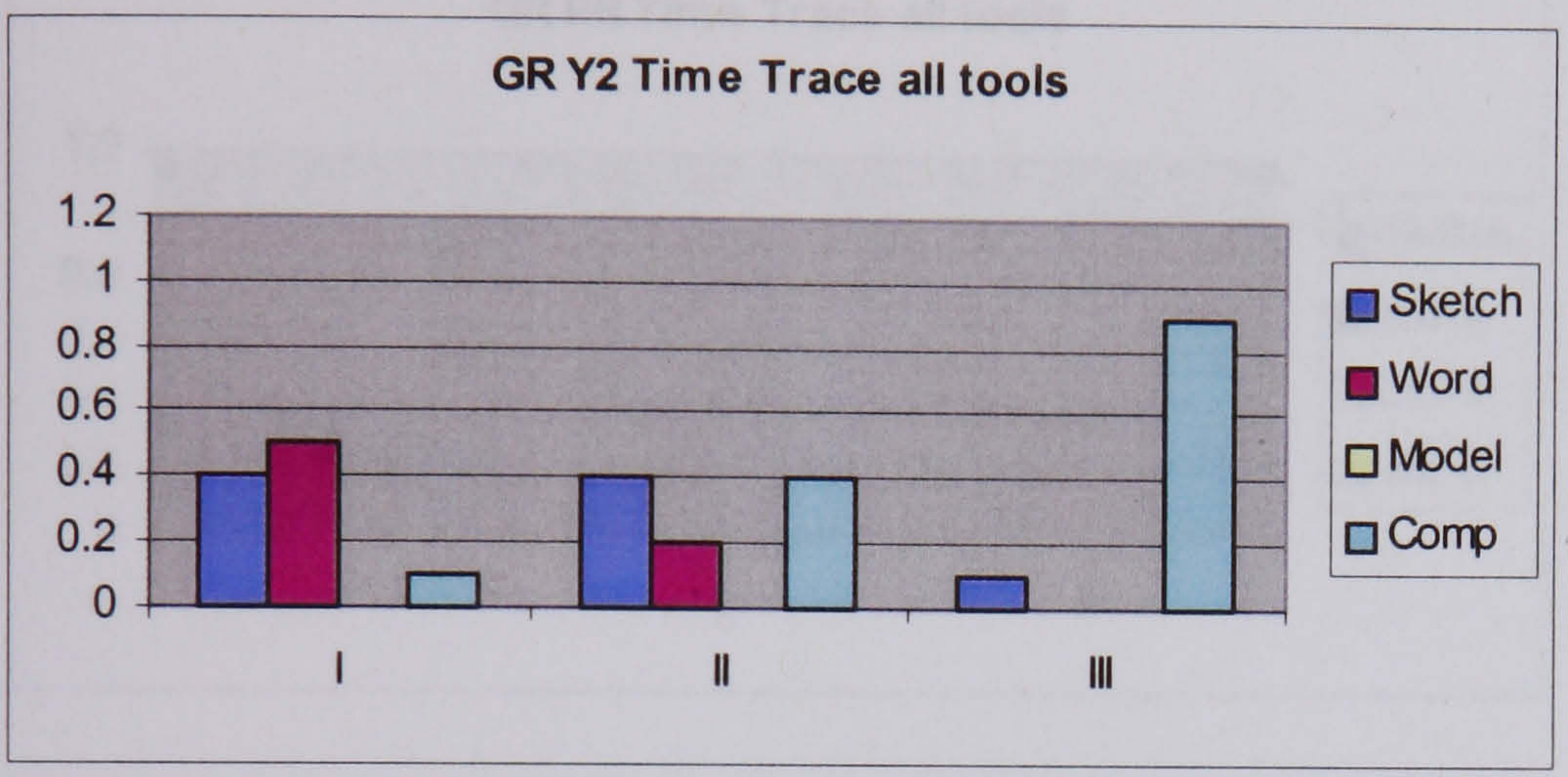


Fig. F:16 Graphic student: Time trace all tools

GR Y2	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.4	0.5	0.0	0.1
II	0.7	0.3	0.0	0.0
III	1	0.0	0.0	0.0

Table F:17 Graphic student: Time trace essential tools

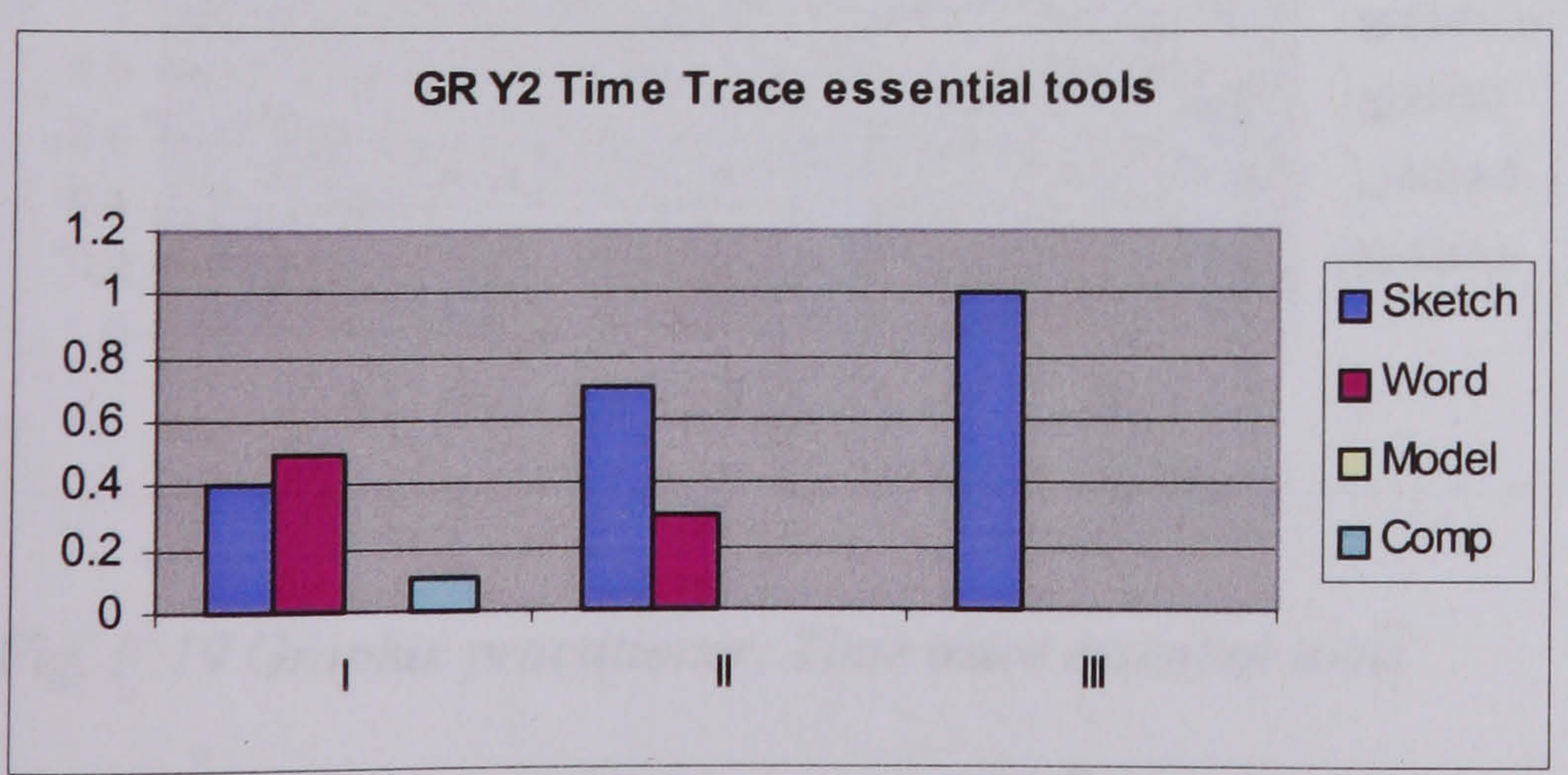


Fig. F:17 Graphic student: Time trace essential tools

GR PR	All tools			
Phase	Sketch	Word	Model	Comp
I	0.3	0.4	0.0	0.3
II	0.0	0.4	0.0	0.6
III	0.0	0.4	0.0	0.6

Table F:18 Graphic practitioner: Time trace all tools

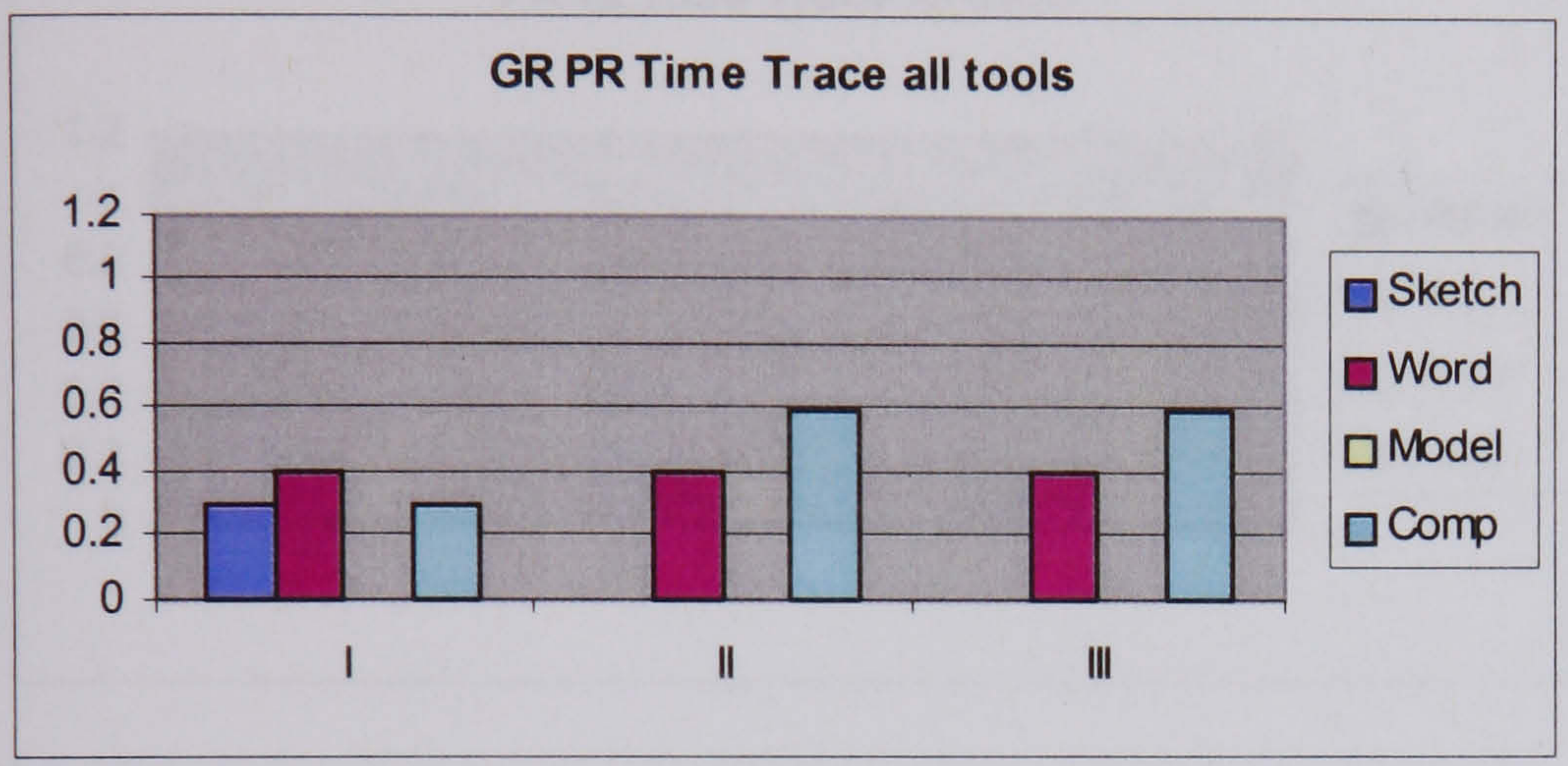


Fig. F:18 Graphic practitioner: Time trace all tools

GR PR	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.4	0.4	0.0	0.2
II	0.0	0.4	0.0	0.6
III	0.0	0.3	0.0	0.7

Table F:19 Graphic practitioner: Time trace essential tools

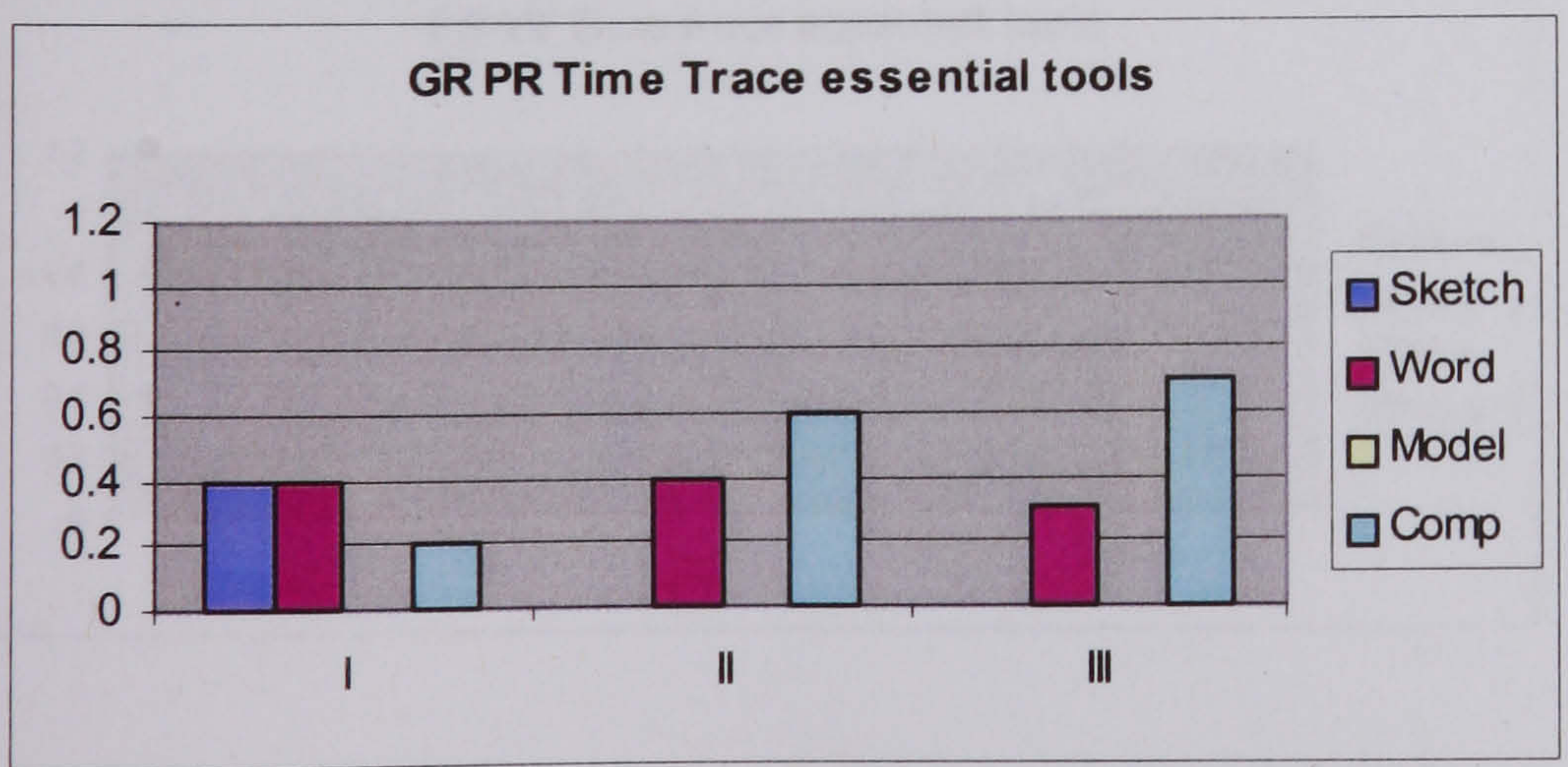


Fig. F:19 Graphic practitioner: Time trace essential tools

PR Y2	All tools			
Phase	Sketch	Word	Model	Comp
I	0.7	0.0	0.3	0.0
II	0.5	0.3	0.2	0.0
III	0.1	0.1	0.6	0.2

Table F:20 Product design student: Time trace all tools

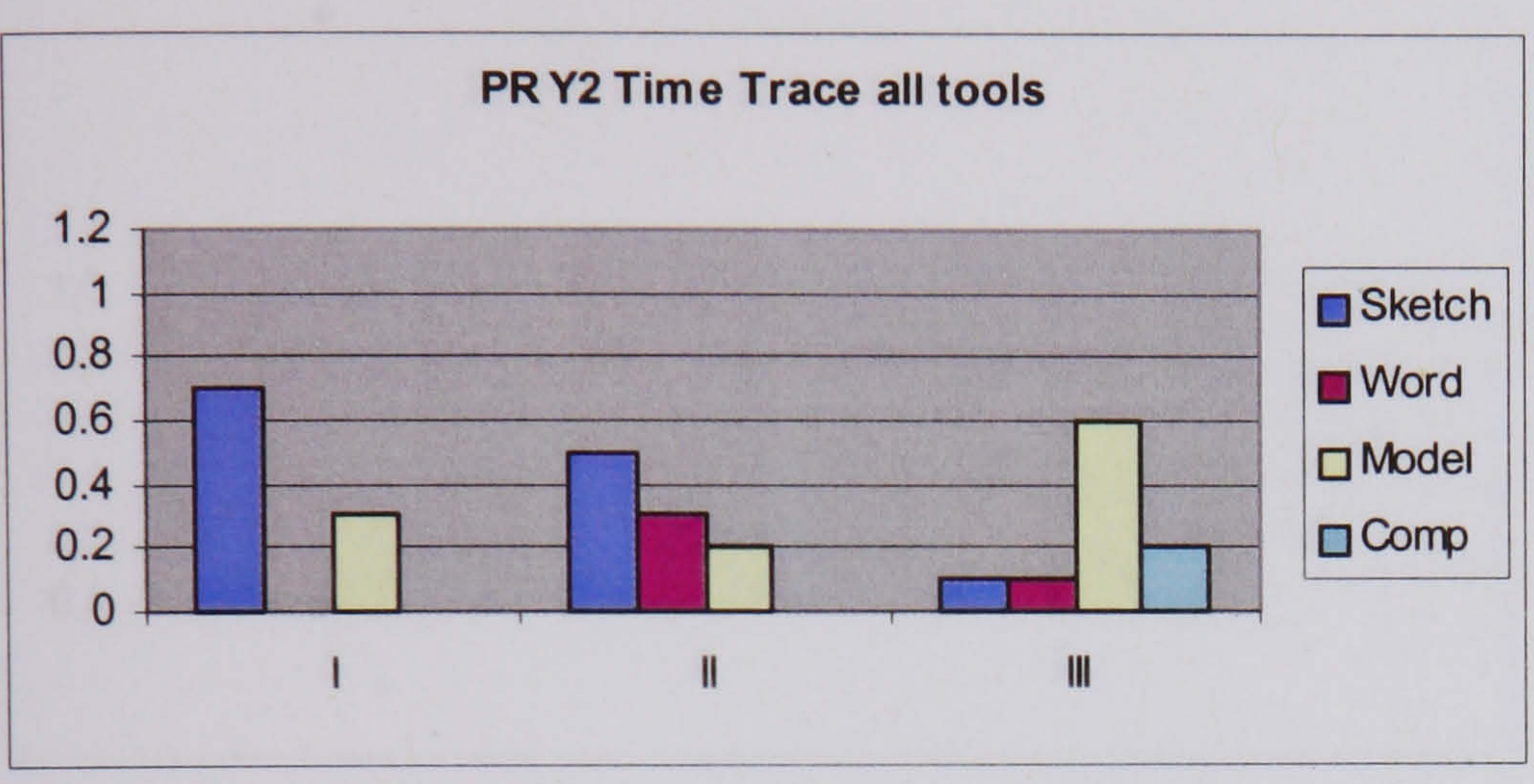


Fig. F:20 Product design student: Time trace all tools

PR Y2	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.8	0.0	0.2	0.0
II	0.6	0.2	0.2	0.0
III	0.2	0.0	0.6	0.2

Table F:21 Product design student: Time trace essential tools

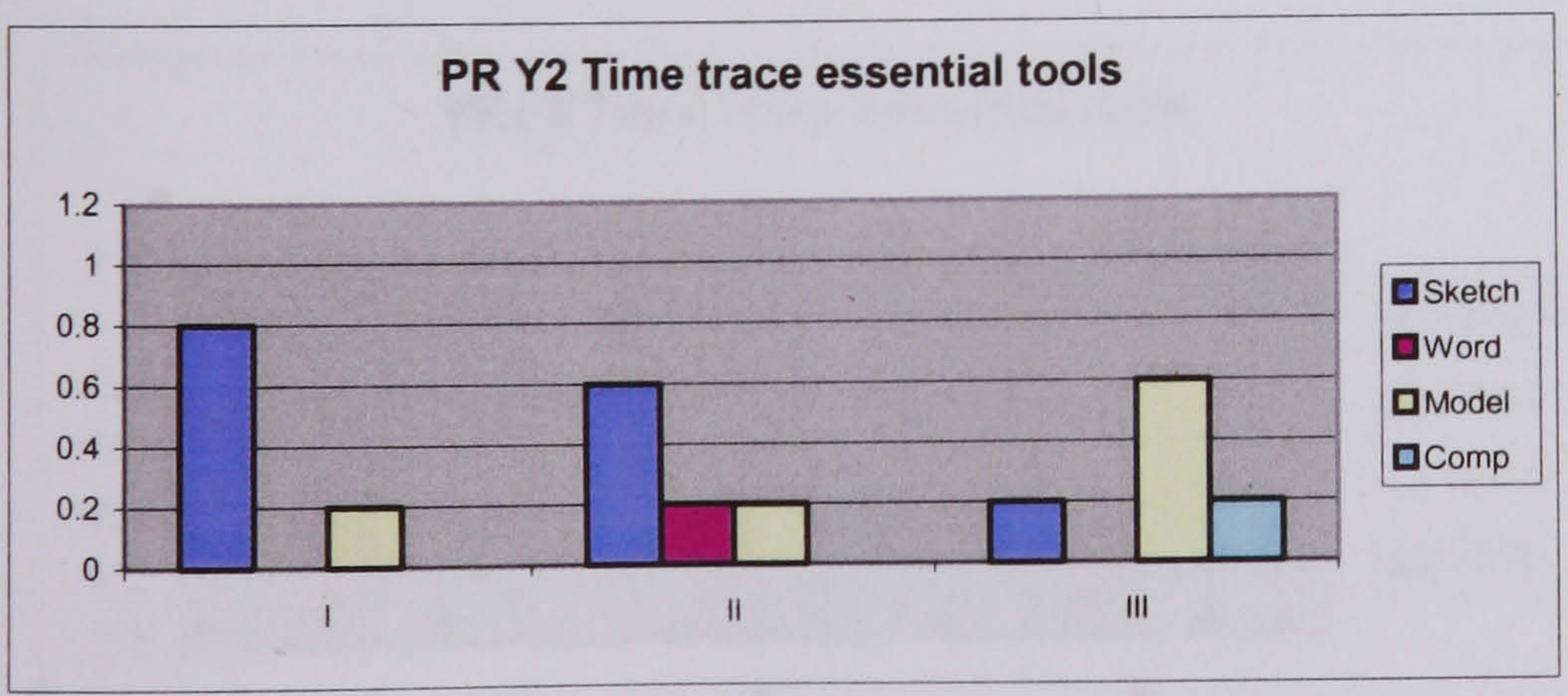


Fig. F:21 Product design student: Time trace essential tools

PR PR	All tools			
Phase	Sketch	Word	Model	Comp
I	0.0	0.8	0.0	0.2
II	0.0	0.5	0.0	0.5
III	0.0	0.5	0.0	0.5

Table F:22 Product design practitioner: Time trace all tools

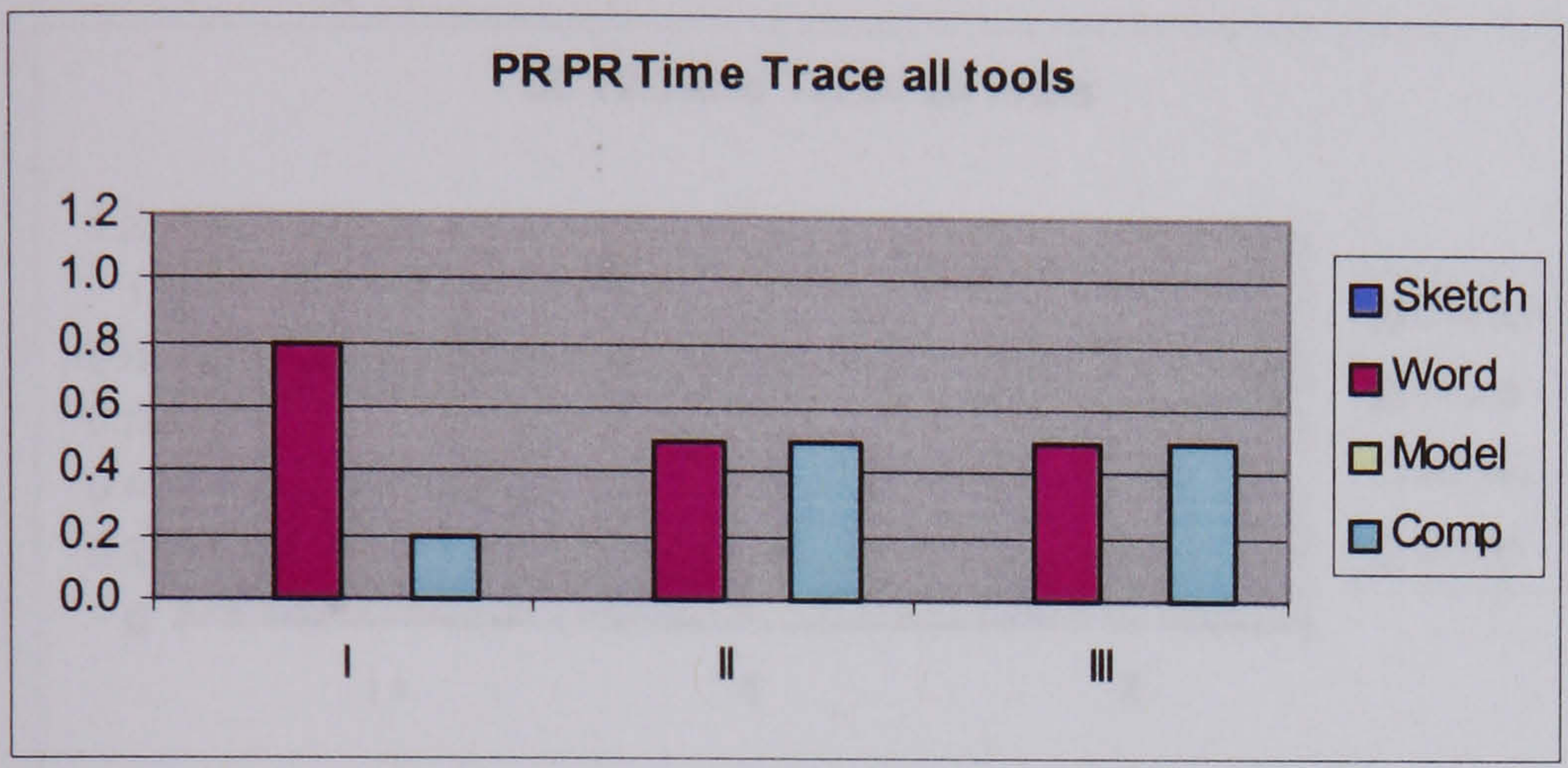


Fig. F:22 Product design practitioner: Time trace all tools

PR PR	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.0	0.8	0.0	0.2
II	0.0	0.5	0.0	0.5
III	0.0	0.5	0.0	0.5

Table F:23 Product design practitioner: Time trace essential tools

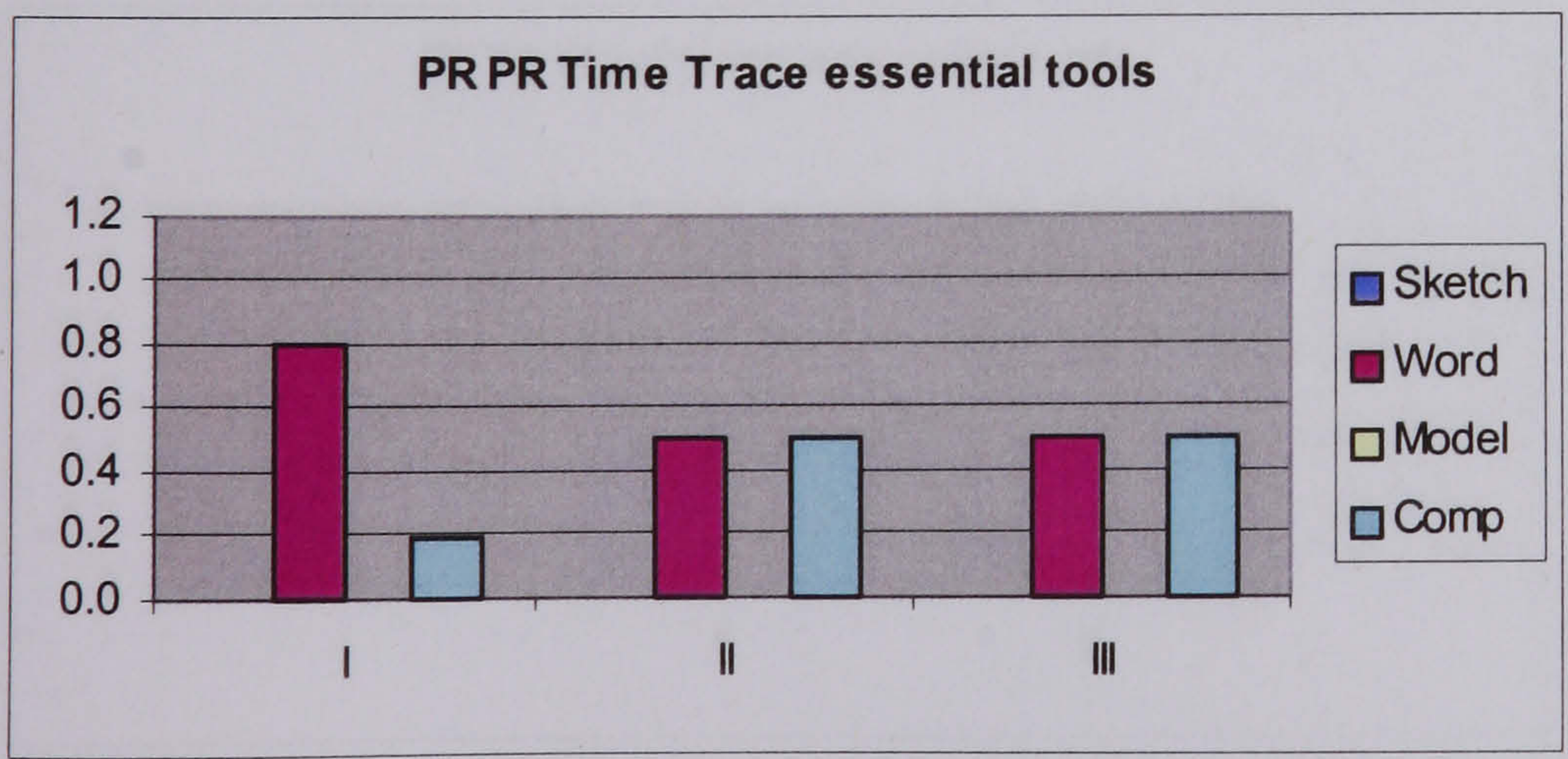


Fig. F:23 Product design practitioner: Time trace essential tools

DE Y2	All tools			
Phase	Sketch	Word	Model	Comp
I	0.2	0.4	0.0	0.4
II	0.2	0.5	0.2	0.1
III	0.2	0.0	0.0	0.8

Table F:24 General design students: Time trace all tools

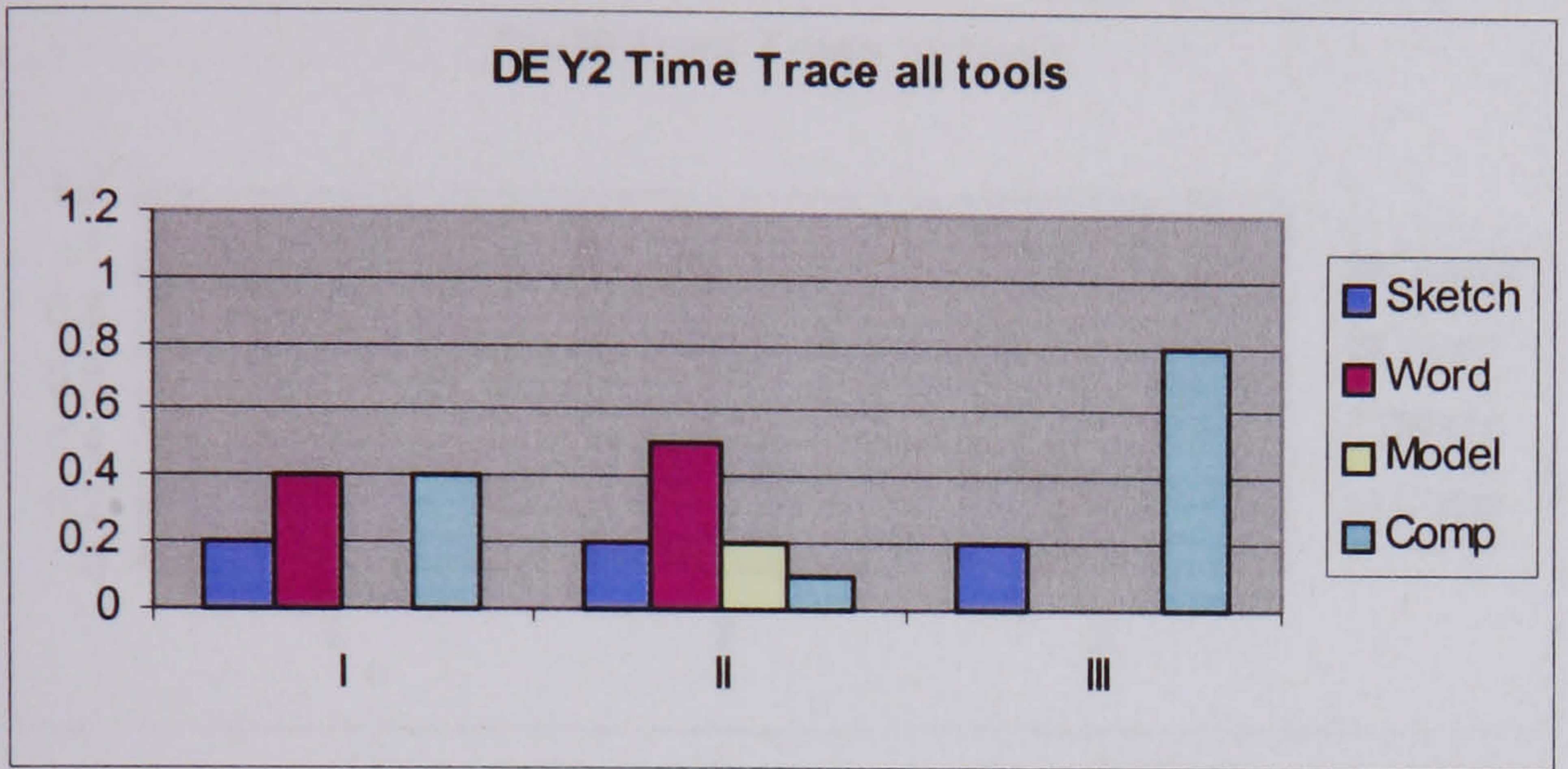


Fig. F:24 General design student: Time trace all tools

DE Y2	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.2	0.4	0.0	0.4
II	0.4	0.4	0.0	0.2
III	0.2	0.0	0.0	0.8

Table F:25 General design student: Time trace essential tools

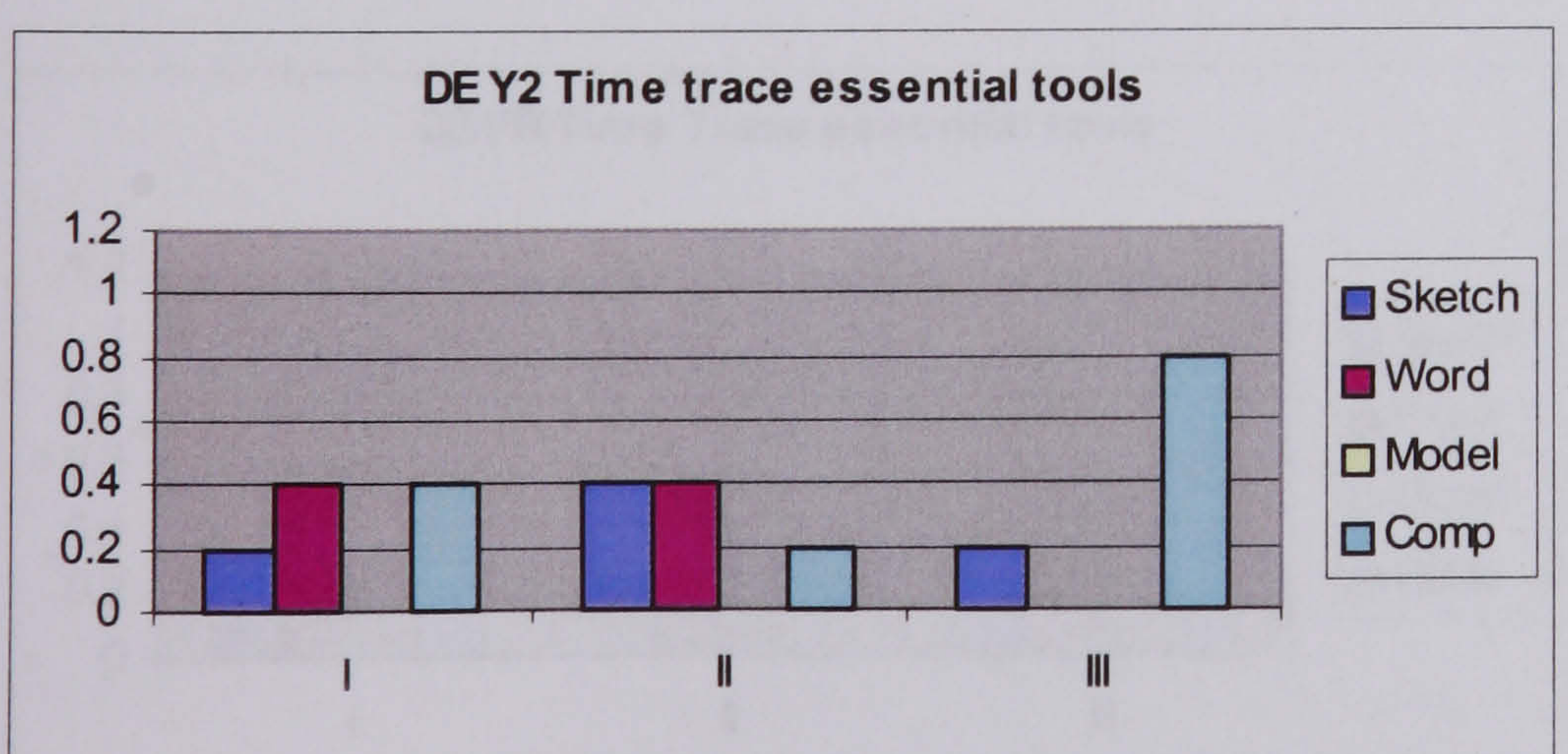


Fig. F:25 General design student: Time trace essential tools

DE PR	All tools			
Phase	Sketch	Word	Model	Comp
I	0.3	0.4	0.0	0.3
II	0.0	1.0	0.0	0.0
III	0.3	0.3	0.0	0.4

Table F:26 General design practitioner: Time trace all tools

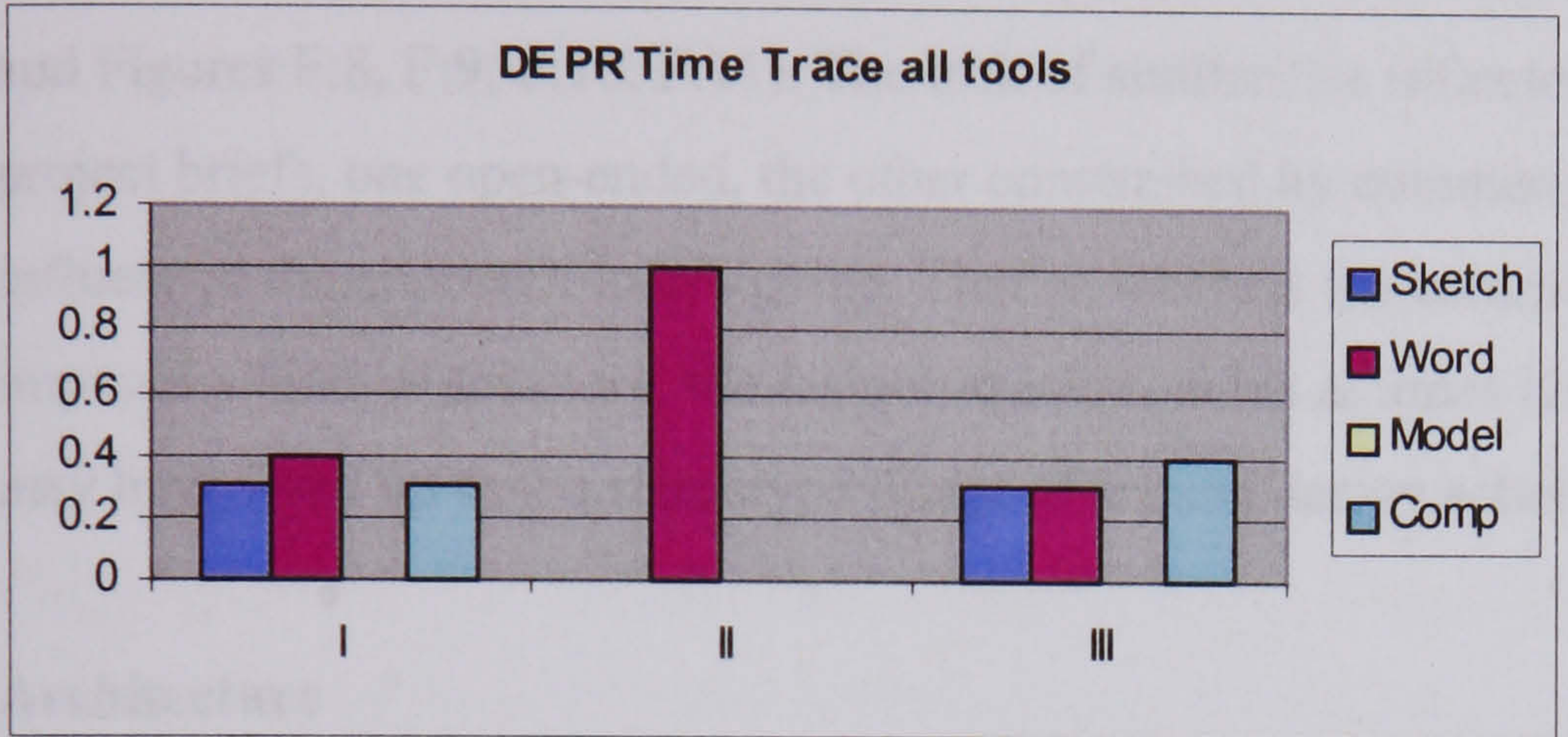


Fig. F:26 General design practitioner: Time trace all tools

DE PR	Ess. Tools			
Phase	Sketch	Word	Model	Comp
I	0.3	0.3	0.0	0.3
II	0.0	1.0	0.0	0.0
III	0.3	0.3	0.0	0.4

Table F:27 General design practitioner: Time trace essential tools

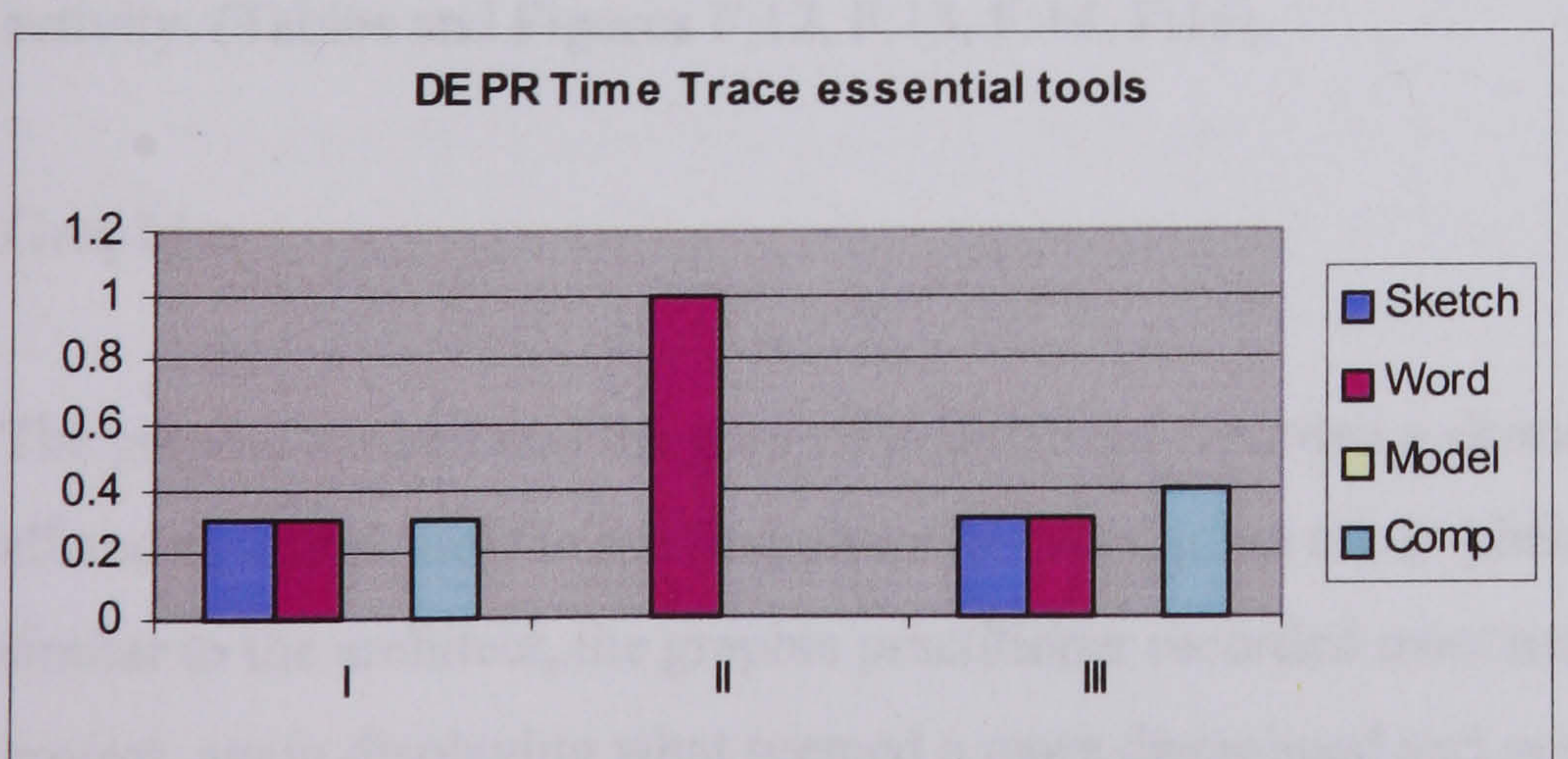


Fig. F:27 General design practitioner: Time trace essential tools

Tool frequency

Fashion

The fashion student and the fashion practitioner showed no similarities in their respective tool usage over time (frequency patterns). This applied both to all tools and essential tools (Tables and Figures F:8, F:9, F:10, F:11). The lack of similarities reflected the differences between the project briefs, one open-ended, the other constrained by commercial concerns, which also influenced the approach to designing. That is, whereas the commercial design environment imposed a kind of structure, the fashion student, in his at times idiosyncratic ways of working, may have lived up to the stereotype image of art and design schools and their students.

Architecture

The architect student and the practising architect showed no similarities in their uses of tools over time. Again, and similar to what was illustrated in the case of the fashion practitioner, the design process was quite pronounced, although not linear, in the architect's practice, and influenced by the commercial reality, whereas the student operated much more in a trial-and-error mode free from business constraints. The rigour and discipline of the architect, which could be explained by his skills and experience as well as the commercial studio environment, were also reflected in how no distinction was made between uses of all tools and essential tools. In contrast, the student used only modelling [M] in the second phase yet without recording it as an essential tool, which reflected his view that modelling was a 'useful', rather than 'core' activity. (Tables and Figures F:12, F:13, F:14, F:15).

Graphics

The graphic student and the graphic practitioner recorded a similar pattern of tool usage for both all and essential tools in the first phase [S+W+C], but not in phases II and III. Therefore, and similar to the architect, the graphic practitioner recorded most tools as essential throughout the project, again displaying what seemed a more disciplined and systematic approach to designing over time. In comparison, the student, apart from the first phase, recorded tools very differently depending on his view whether they were essential or not (Tables and Figures F:16, F:17, F:18, F:19).

Product

Both the product design student and the practitioner recorded a fairly regular spread of tool usage over time, both in terms of essential and non-essential tools. Again similar to the architect, and the graphic practitioner, the product design practitioner made no distinction between all and essential tools. This was also the case with the student, whose pronounced professional aspirations suggest that he was keen to emulate commercial design practice and process as much as possible (Tables and Figures F:20, F:21, F:22, F:23).

General Design

The general design student and the practitioner recorded their respective uses of all and essential tools almost identical. The non-distinction between what was an essential tool or not, was also made explicit by the practitioner in her interview saying that every tool was important. Similar to the graphic cases, both the general design student and the practitioner recorded a similar tool usage pattern in the first phase (I). That is, and to expand on the metaphor of design as a tribal activity (see Chapter *Literature review*), there may be certain "initiations" to designing that depend on the design programmes (curricula and teaching and learning styles) of individual schools (Tables and Figures F:24, F:25, F:26, F:27).

Summary: No distinct patterns of uses of conceptual tools emerged over time (I-III), in respect of designer status or design domain, which reflected the diversity of briefs and design approaches. For instance, very irregular patterns of conceptualisation emerged in the cases of the fashion student and the practitioner, and the architecture student. But when similarities did occur among the participants, they were not repeated in any statistically significant sense but rather they were patterns that might be better described in musical terms, such as rhythm, melody and harmony. Or, perhaps, ideation was similar to strumming a guitar, rather than conducting an orchestra with a full score.

Looking at single tool usage, as a decimal fraction of all tools, by each participant over time (phases I-III), the following observations were made (Tables and Figures F:8 – F:27).

Sketching

The fashion student used sketching in the first and third phase (I + III), whereas the fashion practitioner used sketching only in the middle phase (II). The architecture student used sketching only in the first phase (I), whereas the architect engaged in sketching at a consistent level in all three phases (I-III).

The graphic student used the sketching tool throughout the project (I-III), in contrast to the graphic practitioner, who only used sketching in the first phase (I). The product design student used sketching in all phases of the project (I-III), although distinctly less so in the final phase (III). In sharp contrast, the product design practitioner did not use the sketching tool at all.

The general design student consistently used sketching in all phases of the project (I-III), whereas the general design practitioner did an equal amount of sketching in phases one and three (I+III).

Words

The fashion student did not record any use of words as a conceptual tool. For the fashion practitioner, in contrast, words figured strongly in the first and second phase of the ideation process (I+II). This reflected how the student worked very much on his own, in contrast to the practitioner whose job entailed much *socialising-through-design, or* "talking design".

The architecture student used words in the first and second phase of the project (I+II), whereas the architect used words consistently throughout the project (I-III). This, again, reflected differences in the design environment where the architect was much more exposed to working collaboratively than was the case with the student.

The graphic student verbalised ideas in the first and second phases of the project (I+II), and notably in the early phase (I). In contrast, the graphic practitioner used words consistently throughout, which reflected how the practitioner conceptualised through talking to the client throughout the project (I-III).

The word tool was used in the second and third phases by the product design student (II+III), and mostly in the middle phase (II). In contrast, words played a dominant conceptual role for the product design practitioner throughout the project (I-III).

Words were the major conceptual tool for the general design student in the first and second phases of the project (I+II). Verbalisation was a dominant conceptual tool for the general design practitioner throughout the project (I-III), particularly in the middle phase (II).

Modelling

The fashion student used modelling throughout the project (I-III), particularly in the middle and final phase (II-III). The fashion practitioner did not use any modelling tool, which reflected both personal preference and relative high set-up cost of sketch modelling tools in that particular commercial design environment (modelling was done off-site).

The architect student used modelling extensively in the middle (II) but less so in the last phase of the project (III). In contrast, the architect used the modelling tool throughout the project (I-III) although slightly more in the middle phase (II). This reflected how the practitioner used conceptual tools in a parallel mode, rather than in the student's serial mode of working, that is, one tool at the time, which amounted to a discernible "modelling phase".

Neither the graphic student nor the practitioner used modelling, which reflected the two-dimensional character of their respective projects.

The product design student used modelling throughout the project (I-III). In contrast, the product design practitioner did not use modelling at all, which reflected the demand of the brief, which was expressed exclusively in words and images.

The general design student used modelling in the middle phase of the project (II), whereas the general design practitioner did not use the modelling tool at all.

Computing

Both the fashion student and practitioner used computing in the first and last phase of the project (I+III).

The architecture student used computing in the first and third phase of the project (I+III), whereas the architect used computing consistently throughout the project (I-III).

Both the graphic student and the graphic practitioner used computing in all three phases of the project (I-III), and increasingly so as the project progressed, which may suggest that computing was used to develop and refine ideas as the project progressed.

The product design student used computing only in the last phase of the project (III), whereas the product design practitioner used computing throughout the project (I-III).

The general design student used computing in all phases of the project (I-III), but distinctly so in the final phase (III). The general design practitioner used computing equally at the beginning and the end of the project (I+III).

Summary

The students did more sketching [S] and modelling [M] than the practitioners, with the exception of the architect, who did more sketching and modelling than the architecture student. However, the practitioners recorded more uses of conceptual tools in the verbal mode [W] compared with the students, which illustrates how differences in the design environment had an impact on uses of conceptual tools. That is, the practitioners worked largely collaboratively within teams and with clients where ideas were exchanged and discussed verbally, compared with the students who worked more independently but also more isolated. Similarly, the practitioners did more computing [C] than the students, with the exception of the general design student, who used computing more often than the general design practitioner.

However, all the students used computing [C] in the final phase of the project (III). In contrast, most practitioners used computing fairly steadily throughout their projects (I-III), with the exception of the fashion and the general design practitioner (I+III). This reflected how the practitioners were more experienced with computing, and, arguably, could use it to greater effect in support of the ideation process because, 'The computer seems to promote different ways of working, and inexperience *seems* to limit design possibilities' (Coyne et al. 2002:271).

But also, the practitioners were more dependent on computing in their daily working practice. That is, the computer was an integral part of their work desk ("desktop"), always switched on, and therefore part of a calculated set-up cost for everyday design practice for which a return was expected. In contrast, the students seemed to work on their projects largely on a semi-permanent or ad-hoc basis, and sometimes at home or other places outside college. That is, they were less bound to a computer workstation, which typically had to be accessed in a designated area in the college. Under these conditions, however, the students had more scope for play and improvisation than their counterparts in industry. Therefore, the students seemed to be leading a more "nomadic" existence as designers compared to the more "settled" (office/studio bound) practitioners, notably the architect, the graphic and product designers, who represented the most traditional design disciplines. Interestingly, however, recorded "Aha!" moments often happened outside the workplace also among the practitioners.

SUMMARY & CONCLUSION

Sketching the future

In investigating the impact of digital technology on design ideation, particularly on uses of freehand sketching, a major challenge was how to deal with the *assumption* that freehand sketching is *generic* to conceptual design, whereas CAD is not, or, "How can you be a designer without a sketchbook?" The generic view, which is rooted in the *Renaissance drawing paradigm*, holds that freehand drawing, as it developed through engineering (drawing systems), and fine art (decorative art), is the foundation for design. That is, *drawing-for-design* was an outcome of the industrial revolution with its need for engineering drawing and styling of manufactured goods. Moreover, the drawing paradigm was central to the *arts and crafts* movement and the modern movement of *form and function*, as celebrated by *Bauhaus*.

However, the research suggests that conceptual sketching does not depend on formal drawing skills. Furthermore, in a post-industrial or post-traditional digital design culture of multifarious and transcending paradigms design is no longer defined by engineering and painterly approaches. Therefore, when many sub-fields of design have little to do with traditional design practice, the future of freehand sketching, as a mainstream design activity (process), embodies the ambiguity of the sketch itself (outcome). In this, the assumption might take the guise of common ground, or the manifestation of a theoretical understanding of design drawing, rather than the *actual* practice of it in current design curricula and industry.

The lack of communality across domains was reflected in the findings. Thus, in the ideation workshops, sketching among novice designers registered as the most used single conceptual tool, and across domain tasks (Figures E:2 and E:3). In contrast, in the multiple case study of Y2 students and design practitioners, sketching was not recorded as the most used single conceptual tool in any of the projects across domains (Figure F:2). True, most of the senior practitioners interviewed praised sketching, but the *actual* everyday practice of sketching in the design studios was rather flat although there were shining exceptions (see Chapter *Introduction*).

Furthermore, the assumption that designers typically start with sketching (see Chapter *Literature review*) was challenged by the findings. That is, the Y1 students got started with words rather than by doing sketches and, surprisingly, words together with sketching was the most used ideation tool in Square One, and in all assignments irrespective of domain (Figures E:12 and E:13). Similarly, in the multiple case study, when looking for how Y2 students and practitioners *actually* began their projects (Square One), only one participant recorded doing sketches first thing (Table F:7). Again, words [W] or the word/sketch [S+W] combination emerged as the most used conceptual tool for initiating the design process (ibid.).

The strength of verbalisation as a conceptual tool, rather that sketching, was unexpected and challenged the dominant view in the design literature of the primacy of sketching as an ideation tool. Moreover, in overlooking, or underestimating verbalisation as an ideation tool another assumption was being questioned, that is, that design concepts are ideas largely expressed visually. Instead, the findings showed how design ideation was essentially an *interaction*, or a dialogue between visualisation (non-verbal) and language (verbal). In this, verbalisation also underlined the social and collaborative aspects of ideation.

These were important findings because the visual-verbal interaction reflects how all forms of human expressions are 'just the surface structure created by the deep structure of the human language instinct' (Nolte 2001:106). That is, visualisation is the surface structure of ideas whereas the meaning of ideas is embedded in the deep structure of language. Arguably, then, what matters is not *what* tools are being used, or *surface* structure, but *how*, and *why* they are being used, or *deep* structure, because deep structures signify how tool usage is rooted in language, that is, in meaning and our sense of self and mental and social faculties. Therefore, "sketching about for ideas" is a *sense-making* activity that is not so much about mastering techniques (surface structure), in which designers are looking for "the right tool at the right time", but rather signifies the underlying relationship between designers and conceptual tools (deep structure). As deep structure, then, conceptualisation is contextualised in creativity as a construct of language.

Furthermore, visual-verbal interaction reflects how ideation processes are often *rhizomatic*, hence "chance discovery" or, "Aha!" moments. In this, ideation may be described as on the cusp of *openness* and *closure,* oscillating between ambiguity (openness) and resolve (closure), although never fully closing, as in the incompleteness of the sketch. Openness, therefore, by way of analogy, may be represented by the single or poly-line, rather than closure, represented by the polygon (from the fact that many two-dimensional objects cannot be converted to three-dimensional vector shape without being closed first).

However, in broadening and semantically upgrading the conception of sketching, the term *sketcherly ways of designing*, applied to representing deep structure (meaning), seeks to defuse differences between freehand sketching and drawing packages (vector) for ideation purposes. True, the notion of the *vectorsketch* can be refuted from a programmer's perspective because it is technically wrong, that is, the vector line segment, unlike the freehand squiggle is mathematically controlled by the end points. Yet, from the designer-user's point of view sketcherly ways are idea-driven interaction with any technique, tool or medium. Therefore, by broadening the conception of sketching, this suggests a shift from CAD as a technical drawing tool to that of a conceptual tool and medium. Consequently, the dominant view in the design literature that CAD is inappropriate for ideation seems a preconception of conceptual tools as surface rather than deep structure. Arguably, then, the impact of digital technology on ideation is an issue of creativity, context and language, rather than analogue versus digital technology.

Implications for design practice

However, what complicates the debate about CAD for ideation purposes is that current commercial CAD systems are driven by production needs (efficiency and accuracy), rather than creativity, focusing on automating routine tasks and on increasing drawing productivity. That is, improvements of existing products and systems, which constitute the bulk of designing, for example consumer electronics, motorcars and software development, in which reducing product development costs is a design priority. Therefore, Jonas suggests that the styling of frequently changing products will be increasingly automated under the control of intelligent CAD modelling tools (Jonas 1997). Moreover, CAD routinely used suggests the notion of 'robust design, in which innovation arises for incremental modification of existing, tried and true concepts rather than entirely new approaches' (Lansdown 1987:76).

The distinction between routine and innovative design, however, seems to rely on conventional CAD applications that are too rigid to reflect new practices in digital environments, as illuminated in the multiple case study. That is, new concepts are not exclusive to innovations because changes or improvements to existing designs (products and processes) can be inspired or driven by fresh ideas. Therefore, designers who focus on innovation through analogue tools alone might effectively censor CAD during conceptual and schematic design phases (Gibson 2000).

Yet, as long as human-computer interaction, HCI, remains a separate command-based interaction task (menu-driven systems), the creative needs and desires of designers in the early stages of designing suggest that manual drawing and physical modelling may have an advantage in that they leave strong traces of physical contact and attachment. Yet, when research into design devices found that although CAD in general induced designers 'to do things differently, such as "more sketches"', this was because of inexperience with computing, which seemed to limit design possibilities (Coyne et al. 2002:270-271). The multiple case study also challenged the view of sketching as the primary ideation tool in that practitioners recorded sketching as the least *essential* conceptual tool, and sketch modelling not at all (Figure F:6).

However, as computers are becoming indispensable across design domains, as showed in the findings, digital, rather than analogue tools might be perceived as "conventional". This is because innovative artists and designers, like creative people in general, are said 'not to accept conventions, neither the conventions of the image nor of culture' (Penone, in Zegher 2004:34). Yet, in recognising ideation as deep rather than surface structure what seems to matter is that conceptual tools, and whether analogue or digital, are used to disclose meaning. In this, the multiple case study illuminated how computing was an *essential*, rather than a *supplementary* conceptual tool (see Chapter *Findings Y2 Students and Practitioners*).

Implications for teaching and learning design

The research revealed ambivalence as to the place for conceptual sketching in design education. Thus in the workshops, where sketching was the most used single tool (Figure E:3), attendance declined over time, whereas the Y2 students said they wanted to do more freehand sketching, which they considered a skill, but found lacking role models or opportunities in design schools (teachers and curricula), or industry (demand). The practitioners interviewed also voiced their support for drawing classes in design schools but to what extent designers actually did, or *expected* sketching in everyday practice was uncertain (see Chapter *Introduction*).

Although not a dominant conceptual tool, all Y2 students recorded sketching as an essential tool, with the exception of the architecture student (Figure F:5). From the position that ideation is central to design, and that sketching can be nurtured and taught, it would therefore make sense to include sketching in design curricula, but how? Seymour, for example, suggested that the drawing agenda would have to grow from underneath speared by young designers, or that industry could run in-house drawing classes (Interview Richard Seymour; see *Appendix A*). However, the research findings illuminated how design ideation is driven by the visual/verbal interaction, rather than freehand drawing. Moreover, re-conceptualising sketching, or *sketcherly* *ways of designing* suggest a non-formulaic approach to conceptual sketching and therefore the need for a different skill set that acknowledges ideation as deep, rather than surface structure.

This, then, suggests an alternative to making drawing either compulsory, or *"sketch you must!"* (modernist mission statement) or, leaving it to individuals to pursue at leisure, or "*laissez-faire*" (post-modern statement), That is, the positive feedback from the participants on the usefulness of self-reporting showed that recording of uses of conceptual tools could provide 'a good basis for reforming one's own strategies of thought in self-reflective thinking' (Dorner 1999:409). Therefore, looking critically at one's own ideation process increased awareness of conceptual tools and therefore better understanding of *why sketching?*

Self-reporting, then, as a discovery method, may encourage a broad range of conceptual tools, as in *sketcherly ways of designing*. Moreover, reflecting on one's own practice may not only heighten tool awareness but also lead to inspired action that build skills, knowledge and experience, and therefore self-confidence for new designers. However, even in this simple grounded theory on self-reporting there is a presumption that critical thinking through engagement with ideation tools would need to be supported from an early age and sustained through life-long practice. Therefore, design ideation is a curriculum issue (rigour) for general schooling too (flexibility). More specifically then, to build a common ground for freehand sketching would involve general schooling *and* higher design education *as well as* industry.

Design ideation in a digital design culture also suggests that designers' ideation processes could be captured by digital means. For instance, software, based on the self-report design, could be developed for a screen-based self-diagnostic, or self-improvement tool, with the aim of increasing conceptual tool awareness. Moreover, such a tool could be incorporated in, say, mobile phones or other personal electronic devices.

Implications for design research

From a methodological viewpoint, the observed discrepancy between what designers said they did and what they *actually* did highlighted the danger of relying on verbal protocols alone because of the risk of post-rationalisations and hidden assumptions, which might distort reliability of research methods and therefore validity of outcomes. Thus the combination of methodologies in the study (triangulation), that is, self-reporting (reflection-in-action), interviews (reflection-on-action) and observation checked the *authenticity* of the results. In this, self-reporting was also an effective means for raising ideation awareness.

Furthermore, the investigation revealed reluctance by industry to engage in academic research at the creative end, where sketching could touch a nerve (see Chapter *Introduction*). This suggests new collaborative ways between design research and professional practice that would focus on *authentic* rather than simulated design situations. For example, design schools are increasingly seeking "live" projects from industry. However, this seems an under-research area, which may offer opportunities for researchers to position themselves in partnerships with design schools and industry. Moreover, such partnerships may encourage wider industry participation in design research, not only locally but also globally, in which shared *ideation* projects may help bridge the worlds of academia and industry.

Moreover, the enquiry raised the issue of individual versus team research because, 'the conduct of a multiple case study can require extensive resources and time beyond the means of a single student or independent research investigator' (Yin 2003:47). However, as I found younger designers in general more receptive to research than their older colleagues, it may take the effort of a new generation of designers before collaborative *case study* research becomes more widespread in the creative industries. Arguably this is so because there is a new, emerging class of design graduates who is taking a greater interest in how scholarship may benefit professional practice in the context of lifelong learning, and therefore help bridge the gap between education and professional practice.

Conceptual tool strategies

The multiple case study findings showed that the impact of digital technology was largely independent of design domains. This highlighted how ideation is a *contextual* matter in which both personal constraints (skills, knowledge, aptitude, and experience), and constraints imposed by the design environment played a part. For example, commercial concerns (time and cost factors as well as client expectation) seemed to prompt most of the practitioners to use words and computing relatively more than sketching. The practitioners also tended to use tools more collaboratively that the students, particularly when sketching and computing (Illustrations F:13 and F:16). The lack of model-making facilities among the practitioners was reflected in how only the architect did sketch modelling (Figure F:4). In contrast, the fashion, architecture and product design students all used the sketch modelling tool (Figure F:3). However, all tool categories were recorded as *essential* for ideation, with the exception of sketch modelling, which did not feature as an essential tool among the practitioners (Figure F:6). Computing was particularly essential for the practitioners in architecture, graphics and product design.

Therefore, industry and design schools may differ in their attitudes and approaches to conceptual tools. That is, in corporate design, where business can be an end in itself, efficiency implies speed and certainty, not ambiguity, and therefore early closure in ideation, which may favour computational systems or models of high predictability of "Aristotelian logic". In contrast, design schools, in embracing cultural, artistic and ethical values, may see ambiguity as an intrinsic part of ideation, and therefore openness, or "Platonic open-ended inquiry". Arguably, then, in industry, where ideas are part of marketing and branding strategies, competition implies that ideas cannot be deferred or left open-ended for too long. Therefore, in *the branding of ideas*, ideas typically have to perform and therefore be acted on at an early stage, as in "closing a deal", which may stifle or cut short ideation. That is, the business client typically demands fast delivery of *the idea promise.*

Therefore, the economic imperative of early closure suggests that the greatest diversity of conceptual tools would be nurtured and taught within design schools, rather than industry. Disappointing then, that industry, whilst regretting the decline in sketching skills, is not more pro-active in supporting the medium because design, as an affirmation of life-long learning, suggests that ideation skills are important not only *in* design schools, but *before* and *after* too.

Future of ideation tools

The generative and projective nature of design ideation implies "what if?" and therefore speculative thought about next generation conceptual tools. Yet, the inventiveness of man and the evolution of tools already tell us that human intelligence(s) have always envisioned new technologies. But also, near-future developments are likely to be based on already known technology. For example, the current trend for computer technology to enmesh with telecommunications was already established in the late 1970s (Rickaby 1979:122). Similarly, the trend that 'it is easier to work with smaller, rather than larger technology' (Nolte 2001:239). Therefore, we may expect on-going miniaturisation of electronic devices, such as memory pen technology, that may help organise and communicate ideas in hypertext format. Also, the speeding up of around-the-clock, asynchronous ("24/7") design processes through seamless software applications, or wide application of rapid prototyping systems, will cut lead times between ideas and their realisation.

Extrapolation, then, rather than forecasting, suggests that information and communication technology, ICT, will become increasingly embedded in design processes and products and supported by *wireless and mobile technologies* breaking down barriers between the physical and the virtual worlds, for example, conductive textiles and smart materials. However, global intensification of design through digital technology may accelerate preferences for highly organised design processes in time and space to the detriment of the representation of analogue design cultures, leading to *digital sameness* through universal software applications. Such preferences may further polarise craft and design, that is, while design becomes global, craft remains local. Yet, the risk of digital sameness on a global scale highlights how design is not just styling but a knowledge-based, user-centred activity. This elevates the importance of difference and therefore strengthens, rather than reduces the case for diversity of ideation tools.

However, in the play between the same and different, wireless and mobile technologies may facilitate greater interaction between analogue and digital conceptual tools, thereby bridging local and global approaches to design. For example, global positioning systems (GPS), in mapping, storing and transmitting electronically every inch of the objective world may extend to ideation in which every artefact or system may ultimately carry its own ideation code. Ideas, then, like images, become ready-mades, cut-and-paste, or pop-ups on computer screens.

Biotechnology may also help designers reassess visual and spatial reasoning (Spiller 2003), where computerised "morphing" processes (topology) may be used for design ideation (Gibson 2000). Also, complex ideas might be explored and synthesised into a design solution through algorithm or quantum logic in which 'the stylistic characteristics of the digital tools form their own visual vocabulary' (Cleveland 2004:152). Moreover, areas such as neuroscience and child development might be highly relevant for further ideation research.

In short, the thesis argues that the impact of digital technology on ideation has more to do with the deep rather than surface structure of conceptual tools. Therefore, CAD is not just a tool for simplifying the mechanisms of drawing but a *catalytic medium* that can help designers re-evaluate or re-think what sketching is, and what it is for. As such, CAD can expand, rather than reduce designers' creative options strengthening the visualisation of ideas, for example, in creating *virtual idea objects* or, producing *real idea objects* through Rapid Prototyping, RP, thereby supporting ideation in ways that traditional methods cannot. Therefore, a better understanding of digital processes may broaden the understanding of conceptualisation in a digital design culture because the digital medium itself may foster new patterns, relationships and aesthetics. Arguably, then, *computer-aided ideation*, CAI, can enhance creativity and design thinking. In this, CAI is an emergent research field where scholarship may help close the application gap between design theory and practice.

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APPENDIX A
Interviews Introduction

(Interviewees listed in alphabetical order)

Interview Ron Arad
Product designer
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17.05.02

Ron: (telling and showing a number of "sketch designs" on his laptop): Everything you see here is not on paper.

Ben: So you use the graphic tablet almost in a similar way to pen and paper?

Ron: Exactly in a similar way to pen and paper.

Ben: Do you use any particular program?

Ron: I use a program but it is just as if I had all the paints and brushes I need.

Continuing telling and showing.

Ron: You can see here how things start happening and developing, like in a sketchbook.

Here's a sketch for an idea how to display CDs, in a cafe.

Ben: Sort of similar to your bookworm.

Ron: No it's not, not at all. But never mind (faint laughter)....So that's sort of a mixture of a sketch and already a model.

Ben: Did you set up a perspective and used it as an overlay?

Ron: No, I don't need to set up a perspective.... Here you can see the process here in the office ... from the sketch ... da-da-da-da ... and because it is all networked it can go into a different program.

Ben: So you turned into an animation (an object turning and moving on screen)?

Ron: Turned it into modelling ... I'm designing. And from the 3-D we do the 2-D lines, not as before building 3-D from 2-D. The other way around. And from there ... (he shows an image of the final product).

Ben: Do you use these sequences of events as a presentation tool?

Ron: They are all here in this archive (on the computer disk). This is what we use for a presentation (shows a title page followed by a number of images, still and moving – not a static PowerPoint type of presentation).

Ben: Are clients interested in seeing sketches?

Ron: It depends who they are. We don't know them, we get to know them.

... This project is about how to cut a mould of a chair, and get two out of one because the machine is very slow, you can only take out 25 pieces a day. ... This is a sketch how to double it, similar to using pencils and markers (a rotating cylindrical form yet sketchy on screen).

Ben: Would it be more difficult to this without the computer?

Ron: Not impossible but more difficult.

Ben: Do you work in full-scale models as well?

Ron: No, we don't build models, we sent the computer files for prototyping elsewhere. In the old days everything relied on the artisans to turn your drawing into a model. But now it is all done by us (on the computer).

Ben: Do you reckon it has change you way of working in a big way?

Ron: Most of us designers came to this world through drawing with pen and pencil.
At Royal College there's no department to put drawing any more (Deanna Petherbridge, RCA professor of the Drawing Centre resigned last summer). Is it part of fine art ...? But why should we compartmentalise it? Does it matter?

...I sketch on my tablet exactly in the same way as on paper. The only difference is that I can put it on any computer in the office ... I can show you now what we are doing (we move to the monitor of one of his assistants, Yuko) ... here's my sketch, imported into the program and Yuko is now working on it ...then (back at our table) ... to finish the cycle... here is the geometry of it ... and then it goes to rendering. The same file, not just for presentation but also a photograph. No one seen this chair before. But also this drawing makes this mould (up on the screen).

... and right now we are going to sue our friends Microsoft ... this is in the current issue of Newsweek (he shows me an Microsoft advert featuring his chairs) ... the chairs we are sitting on ... they are not mentioning my name ... and also this stupid idea of the inspiration is (the advert has a shell image counterpoised to the chairs) ... and where it comes from ... they couldn't do it to a singer, an artist. Also it wasn't done on the software.

Ben: But this is part of how the computer industry appropriates language ... this is to me a is desktop (I touch the tabletop).

Ron: But this is also a desk top (point at the laptop screen). We shouldn't panic about it.

... This is another project that started as sketches ... I have a tablet at home as well (Wacom). Like the last collection we did in Milan ... another sketch ... another sketch ...

Ben: Do you scan in sketches?

Ron: No, but it's not the same program (through the design process). Whatever sketch I do is saved as a JPEG and everyone can use it ... why don't I show you the tablet ...(we move to his desk farther down the office).

...I can do a little bit of airbrushing (telling and showing using various application tools: Painter 6:1). I can blur the whole thing if I want, I can make textures ... it's just endless. ... I can have flowers if I want ... I can play with fibre ... whatever.

*Ben: In your experience, to what extent does conventional drawing skills lie behind?
To what extent do we need conventional drawing skills to perform well on a tablet?*

Ron: Ummm ... if you draw you draw, it doesn't matter. This is made of wood and graphite (holds his stylus).

Ben: Do you think a novice designer could go straight into a tablet.

Ron: They would draw as good or as bad ...

Ben: But you could just have a blank piece of paper, and just you, your head and a pen, but here you got a prompt, these things stimulate me (the icons, the rapid effects of colours etc).

Ron: If I needed all these colours I'd need a huge ...

Ben: I just wonder if an experienced designer like yourself take your skills and creativity for granted?

Ron: ... yeah, it's part of the skills ... you can have the most sophisticated 3-D software, but you have to have a mind to understand it. The same thing with drawing. Everything I do here, even if I'm just doodling, for no purpose at all, even that somehow is knowing how to look at drawing. It's not only the drawing skills, even this can tell you about my visual culture ... where it comes from ... it's just drawing. Before we used ink pens ... what's the difference? The tools are better, that's all it is.

Ben: But do we still need the traditional drawing classes, life drawing, objective drawing ..

Ron: I don't know ... it's a big thing what you teach people.

Ben: Do you think it will work if we just give new students or novice designers a graphic tablet and a software package, and off they go?

Ron: It will work as well as the pencil.

Ben: But instructions?

Ron: No, you can't tell where to take a pencil ... what is important? For some people it is important, it depends what you want to do.

Ben: But in an education setting we have the curriculum ...

Ron: Yes, that is a problem. But nobody knows. To anyone who draws cows ... if all you want is to cut them in half and put the in formaldehyde ... who cares how well you draw the cows. It's about different things.

Ben: But we know from experience from an undergraduate programme that if there are no rules, conventions ....nothing would come out it.

Ron: I don't think so.

Ben: Perhaps it would work at RCA ...

Ron: Engineers should know how to draw and it's a bliss when en engineer can express himself with a pencil, that's as important as with a designer.

Ben: Do you think engineers can do that now?

Ron: Some, the good ones can.

Ben: Should we then rely on designers having talent, drive ...and just developing themselves.

Ron: Yeah.

Ben: So not what teachers say?

Ron: You can have a good conversation with a teacher that can be very useful to you.
I don't know ...I'm very grateful that I run an MA course, I don't have to worry about what should we do and the panic, are we teaching them the right things, should we not teach them computers instead of ... should we not teach them ... I don't know. You don't know because the world is changing. All I know is that I come from drawing but it doesn't mean there are not other ways of doing it.

Ben: But how do we express ideas ...

Ron: Ideas are also overrated. Ideas are not important at all. What is important is how to select ideas. We have millions of ideas. The question is what you do with the ideas.

... I find most of it not useful at all (teaching). At the end of the day there are individuals, people who can have a bit of advice, and in an inspiring place with lots of debate, not so much of instructions, not so much of oppressive.

Interview with David Chaloner
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April 30, 2002

Ben: How would you define a sketch?

A sketch for me could be words. Could be a diagram it could be an abstract drawing, and I am using the word drawing loosely, or a diagram. It could be a photograph, or a series of photographs as an aid memoir for an idea. But sketch in its purest sense is the hand drawn manifestation of an idea. I believe you work through the brain, through the nervous system onto pen and paper.

My sketchbooks are a daily record, carefully kept. A sketch can be diagrammatic, a scribble, the beginning of a drawing. (D opens up and flick through one of his sketchbooks, bound in black chamoix roughly A6 size) I prefer plain paper....ideas, details, process. Various stages, words, annotated sketches, more often than not annotated because I think with words. I use them when I travel.

B: A kind of sketch journal!?

D: Absolutely! Almost like journals. Both 2-D and 3-D. They are as much journals as they are sketches. They work very well. Convenient, they fit into my pocket. I'm using several journals at the same time, they go into the same bag when I travel. In the studio I use A3 size sketch paper. But I much prefer to work in this small scale. That's for me Sketching – it's about ideas.

B: Do you use your sketches mainly as means of self-expression or means of communication?

David: Communicate with others. When they are not personal. I might photocopy them, blow them up to show others, or for others to work with. I was thinking through, writing down and describing at the same time. I take down quotes. And sometimes I would read them out in the studio, I would say ... by the way...sometimes via email ...just to make people think a little bit. Sketches work on a number of levels.

Designers too easily accepted technology in the early days, for example in web design. The "techies" became the high priests of the 20th century. We got hoodwinked about computers that they could do everything. They can do everything but they do it in different ways. We often present on laptops. Do little movies for our clients. I love the freedom the computers give but they are just another tool, part of the massive jigsaw to express ideas. But if you in a meeting and walk up to a flipchart and do a little drawing, people who don't do it [designing] for a living adore it. Or bring nothing but a bag of materials into a meeting, a piece of wood, string...and dump it on the table.

If education allows itself to close itself down to this area [tactile engagement] it is its own worst enemy. Our designers who work on screen can draw. But I haven't mastered computers ... I 'm too old, I don't have the time, I don't have the inclination.

B: Is there a link between drawing skills and computer drawing?

D: I don't know. But we have good people on computers who can't draw. But although they are Mac operators, they see themselves as designers. But they often lack the appreciation of scale when working on screen.

But although people say computers are quick they aren't actually.

B: Can you generate ideas just by being on screen?

D: You have to scroll, unlike paper sketches when you can compare. But I think there are people who can, although perhaps not the most brilliant.

When we select people we tend to look for sketches. More and more designing is about the strategic nature of the problem, and how you get to a solution through, questions, answers, possibilities, describing why you are doing it. Like a storyboard. Most of our storyboards are hand drawn.

I sketch with the client then and there, this is what we are talking about (showing sketches from his book). For example, here, in Germany, I was drawing out the placing around the meeting table, to know who was who.

I personally think there's a need to exercise sketching.

B: Is sketching a generational issue?

D: Of course, they work on computers all the time. But some younger designers are returning to hand drawing, naturally. Naturally they gravitate towards it as they find it helps them expressing ideas. I don't think you can do a perfect curve on screen without a lot of work. People are more and more realising that sketching gets you to a lot of places.

B: Are there links between commercial drawing systems and sketching?

D: Drawing classes help but not absolutely necessary. But for a simple perspective sketch you need to know the conventions to understand. Everything we do is about communication, that's why it is so important.

B: Have you tried graphic tablets?

D: No

I'm the oldest person in the office, and laughed at for being a techno-phobe. But I'm not, I love my titanium Mac laptop. But I don't like the screen being called the desktop because it isn't true. It is a vertical thing with a glass front. But there is a big industry behind technology. For me, the best thing it is still scribbling on piece of paper. You can't hide, like the internet. Sketching is honesty, close to the origin.

My daughter studies classics and prefers to write longhand but is for her finals forced to write her notes into a word processors. Does sketching precede language? Was man mute wen he made his first marks.

B: How to encourage young designers to sketch?

D: There's a difference between teaching and preaching. Teaching a skill in itself. I lead by example. Doing things that people like and enjoy. I said to people go and get a sketchbook and draw! But there are bigger things, to make people understand creativity as a process.

B: How do we do that?

D: By talking about observing, talking about looking, things to see. Travelling. It's about finding. I like my Art. It follows Man, or perhaps it precedes Man. But is is certainly parallel to Man and his development. And it is about synergies in life. I love music. I talk about music. Jazz. Look at improvisation. DJs use their hands when mixing. The hands on the vinyl, the tactile, are totally in control. You talk about film, photography, the image. You look at the light in a particular way. The evening sunset shines down the street, the other week, a gold cold sky. I like the sky, the drama.
It's about sharing as broadly as you can..

I talked recently at a conference about inspiration. Sketching as words. Academics work in a controlled way, technically they are brilliant. They know their distance. But is also about passion, emotions, after everything else. Commitment, yet turning everything on its head. We have responsibility to exchange, engage, embrace, enthuse with other people, relying on our experience. I like talk. Giving people moment in a day, in a month, in a year, when they see another way of seeing, they see another form, they feel another emotion.

Everything is about sketching a moment, a conversation. The spoken word becomes a sketch. I do say sketching is terrible important. We will mix media now in order to get across a particular idea or expression of whatever.

B: Do sketching vary within design disciplines?

D: What I've been surprised by is the complexity of our approach to projects, presenting it is far, far in excess of an architect. Architecture is more of a formulaic, contained process about a building and its context. Here we do branding typology, psychology...but I wished I had done architecture although 80% of architects do shit architecture destroying the fabric of society in the process.

B: Is there a link between drawings and good work?

D: I know some good craftspeople who do some appalling work. You can be a skilled craftsperson but the product at the end of that process is not necessarily good. But who is measuring good, brilliance? That's a judgmental one.

There is something slightly resisting in the material one is using (stylus and Palmtop). The missing bit is the bit of graphite, the ink that is pouring out at the end of the nib. Is there something really happening when using a palmtop/laptop on the go, or is it just a psychological mechanism? Status?

It wouldn't trouble me to share my sketchbook. I travel with a camera, taking photos of banal things, seedy little dumps, orange, moulded wall tiles, rock formations. Associated text with photographs in planning a group. A sketch with a reference to music. I select a few sketches and put them together. I talk to students at colleges. Assumptions about management: generosity of spirit and enthusiasm joined with acceptance. A person can be demoralised by the slip of a tongue. Brainstorming to ease people up. Bring out the tactile appreciation of the clients.

Interview with Jeff Daniels (via email)
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Pan Design (advertising & branding)
06.03. 2002
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With regard to your questions relating to the overlap/interplay/interdependence between sketching and design, please find attached the following responses:

Ben: Is freehand sketching a core or peripheral activity in your everyday practice?

Jeff: I think there are no easy answers to this because it depends on the practitioner in question's background and influences etc. It also depends on the type of client you have.

Take me as an example. I come from a background where drawing skills were an absolute requirement. Period. Don't get me wrong. I'm not talking about being an 'artist' (and I'm certainly not), but even to get into art college you obviously had to be able to draw. Then to get your first job, you also had to be able to draw, but only well enough to give the real artists an idea of what you wanted them to produce to a high degree of finish. So in that sense, by sketching out rough ideas for other more talented and skilled people to execute, I have been sketching all my career. My initial sketches don't exist anymore, and indeed were never intended to. What I have, in every instance, are the finished items (whatever they might be) that are end results of my initial sketches. For me therefore, sketching was and still is a core activity. Let's call that one extreme, the 'old way' if you like (Paleoteric?).

At the other end of the scale, (and there are of course many points in between) there is a new breed of designers doing things the new way (Neoteric?). What is interesting is that some of them don't/can't draw at all. They just don't have the ability. Yet that's not seen as a hindrance, and they are still 'designers'. Their initial thoughts don't start at the pen and paper stage, but at the computer/mouse/graphics tablet stage. Some of them – no, a lot of them – don't even seem to have what I would call original thoughts but rely on making use of existing imagery/designs. In other words, instead of having a thought and putting it down on paper, however badly and primitively, they have the mental thought and then seek to find an existing image that best equates with that thought. So their starting point is not really what they had in mind, but what they can find that already exists that is nearest to it. Sounds perverse doesn't it, but I can assure you that I see it happening every day.

Ben: In a peripheral activity, do traditional drawing skills really matter in a digital design culture?

Jeff: In my opinion they should, but in my experience they don't seem to. Having said that, I believe everything is cyclical. Part of the rapid adoption of technology in design is due to clients' inability to decode sketches. The designer and the client can look at and talk about the same rough sketch but still 'see' completely different things. So the more highly finished a visual is, the more likely it is that the same thing is being 'seen' by all concerned. For me, this reached the crazy situation where some clients would only consider an idea if it was presented in its finished form, photographed, retouched, everything. You could literally ran the idea in the press. You can imagine the cost. It cost thousands for each idea, all but one of which would be binned, and all because the clients couldn't understand the sketches.

And then the computers came along. Now you could have the same degree of 'finish' but at no/low cost. What used to cost a fortune because it involved the skills of many could now seem to be produced by some 'designer' with a computer. Except it wasn't the same thing. It 'looked' all finished and seductive, but it was a case of the Emperor's New Clothes, and he wasn't wearing a stitch!
Take typography. At the beginning of the 1980s (when I graduated and just as computers were starting to be used) there were perhaps a dozen of what I would call top typographers in London, and I knew employed most of them. These people were fantastic. They had trained in type. It was their career. It was all they did. These people could calculate and cast off type in their sleep. They understood type and they charged a lot of money. Back in the early eighties a good typographer would cost you £400-500 a day and they were worth every penny. Add in the costs of art directors, copywriters, graphic designers, illustrators, photographers, lettering artists, art workers, etc and you can see why the costs were as high as they were.

Then with the computer, there was the operator/designer doing more and more these activities, but without the training and understanding that those people had. So the computer allowed one person to a lots of thing badly.

Getting back to my point about things being cyclical. I am now seeing a new breed of client. These clients are agreeing with me when I say. 'let's forget computer and high degree of finish, let's go back to rough sketches'. And they are rediscovering the excitement of evaluating sketches. Sketching could become the new fashion.

Ben: Are digital sketch techniques still a basic and under-developed routine?

Jeff: If there was a way of realising what you are thinking directly by sketching into the computer – so the hardware/software would have to be much more tactile and practical than anything I have seen so far – then that would be great. I'd even give it a go. But as things stand I think they are underdeveloped, and no substitute for pen and paper. But I know people who would disagree with me. For instance, I have one particular employee, a Mac designer, who is absolutely opposed to using pen and paper on principle. He believes that pen and paper just 'gets in the road' and adds nothing to what he would have done anyway using a computer alone. I think he is wrong and often force him to draw on principle. He can't draw of course, but only because he doesn't practise. Anyone can draw. But he would just as soon find a photograph, scan it, convert it into a 'sketch' using a Photoshop filter, and say 'there's my sketch'. I think a lot of people do that. They're not creating anything in my opinion. We have had some good argument about it. It's a funny old world.

Interview with Christophe Egret (AA) and
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10.05.02

Benedict: I find myself single-handedly crusading for drawing at the Architectural Association. Out of hundred students or so I have a very small group doing hand drawing.

Christophe: Without sketching I would grow mental. My sketches are instructions. It's like putting notes on paper.

Ben: A bit like the annotated sketch.

C: The analogy would be the annotated sketch. But, to be candid here, I think you are overly predictive about sketches. But I can also show you some digital sketches where the paper hasn't been touched. Will Alsop has a graphic tablet on his desk with a digital pen. He can draw, and he can import photographs from the Web, he can animate his images, he can create ambience. Then sometimes he prints them out on special canvases and paint over them.

The people who are the most creative are those who say it is never one way or the other. The way we sketched a thousand years ago and between now has evolved. When you have different kinds of pens people tend to be a little bit conservative toward this type or that type..

Benedict: What perhaps Ben is addressing is that the art of sketching is rapidly dying skill among young people in this country (Benedict was trained as an architect at Yale in the USA where the Beaux Arts tradition is still alive being carried on).

C: My argument for a long time was that if you can't draw, for example a beautiful spiral staircase, and I'm thinking of Art Nouveau, and they knew how to draw a balustrade and the ornamentation beautifully, and have no knack of proportion, you won't even be able to dream about that staircase. Yet you can use the computer (CAD) and sketch forms you could not do by hand.

But there is also a burgeoning breed of designers who do things that sketches could not do.

Benedict: That's very true. But the simple quick graphical sketch is super low tech, you can do it on the beach, on the train, although technology is getting better at this too.

C: And then you could send it by email (laughter).

What you try to discover is the right proportion, does it look nice, (he doodles on a page in his bound sketchbook) ...in a matter of seconds. Developing that eye is about how to sketch ... the eyes are gymnastic. You get better and better at seeing if something is right or not right.

One thing about this office and sketching is that the sketch is loose. A lot of architects would start drawing quite rigidly ... (he draws a thumbnail box) ... the entrance here ...the means of escape here and here ... and suddenly they kill the projects to have a chance to have beauty and magic about it. And what sketching allows you to do is to bring some excitement about the building (he draws an amorphous shaped plan in contrast to the box). And so sketching relaxes the mind in terms of discovering avenues of solutions for buildings.

Ben: And this can happen irrespectively of analogue and digital medium?

C: No, it has nothing to do with medium. I'm talking about the importance of sketching (a little irritated). Do you differentiate between sketching and painting?

Ben: Yes. Because I'm not talking about sketches as rendered drawings.

C: Is that a sketch? (he points at the large, framed colourful abstract paintings by Will Alsop hanging on the studio walls).

Ben: What is confusing about that is the framing and the size.

C: (Pointing at a series of framed abstract paintings on the wall behind us for the art museum in West Bromwich). These were done to explore what goes on in an art gallery. These are very much sketches in that they talk about ideas without talking about architecture.

Ben. Sketching, from the origin of the word, means unprepared. But with computers, using a software application, you are prepared in a way.

C: But the paper has also been prepared. What the computer has is a prepared graphic tablet and a stylus.

Ben: But are you then talking about using the computer screen similar to a piece of paper, without using any complex software?

C: Yes.

Benedict: But I use the computer for 3-D modelling. It can be very quick, drawing rectangles ...

Ben: There is no dispute about the computer as an indispensable tool when dealing with complexity and rendering, but what I'm intrigued about is the first stage of designing, where do you take your first idea that comes up in your head. To the sketchbook?

C: Personally I feel I am in a transition. I could as well use a tablet for sketching because the advantage is that I can enlarge it, colour it, transform it, make the image as big as a wall, use it in a PowerPoint presentation, send it as an email to New York or Manchester.

Ben: So are we now looking at the sketching as history?

Benedict: No, not at all (C laughs). I think Christophe is just going through a phase He's got a big box of colours under his desk.

C: Here are some computer images I've done (he shows strips of rendered images pasted into his sketchbook). This is a sketch I did yesterday, it is a hand sketch on paper that has been water coloured, then reversed on the colour copier, so the reds turn green etc.

It is related to a 3-D computer image of the site (canal site in Manchester for the "Millennium" urban village project). We use these digital sketches, made from photographs of the site showing existing buildings, images of boats are from the Internet, the sky is from here, and we make a story out of it. Now, I did a hand sketch of that before, but it didn't have the life of the digital images which successfully enables us to talk to the non-architectural members of the public to sell them the concept without having to sell them the architecture. To talk about public spaces without having to talk about plans and elevations, to talk about quiet and busy spaces between buildings.

Ben: To me these images are for the purpose of presentation.

C: Yes.

Benedict: What design trades have you been looking at?

Ben. Across the design field because we are talking about design ideas.

Benedict: Computers arrived in our trade about fifteen years ago, when I started my architectural training. I use computers mainly for modelling.

Ben: But what about conceptual sketching?

Benedict: Most students now coming out of architectural schools feel most comfortable with computers. And they can produce very lively images in 2-D graphics. In our office our younger designers have a very strong affinity with the machine. I'm the last generation who studied architecture on the drawing board. As a draftsman I learned how to the use the machine in practice. But I like to be connected with my heroes, Inigo Jones or Peter Paul Rubens. These are draftsmen who are important to me, and I think it is important to continue the tradition of draughtsmanship.

Ben: I would like to make a difference between draughtsmanship and penmanship.

Benedict: I think they go hand in hand. In my experience, people who are good at drafting are also good at penmanship. You can see from the way the mark has been made on the paper, the drawing of line …

Ben: How would you react to the notion of the bad or the ugly sketch? Pause. Is there such a thing?

C: There are sketches that are better than others, but I don't think that there are sketches that are *that* bad. A lot of the sketches here (pointing at his sketchbook) are poor but not bad, in the sense that they are not absolutely what was meant in the five seconds that you had to explain something to yourself or to someone else. Some have more love and care.

Ben: But who should judge?

Benedict: It doesn't matter. As a big practice we accommodate different attitudes, and I presume Christophe brought me to this able because I have an extreme attitude to sketching.

Ben: Can you be extreme about sketching?

C: Yes, Benedict doesn't go out at lunchtime. Without sketching he goes all shaky (laughs).

Ben: Do you look for sketchbooks when you recruit designers?

Benedict: They bring all kinds of stuff and we look at whatever.

C: We still value the art of drawing. But sketching has to be a little bit difficult, a little bit of struggling. Look at Rawling (the author of the Harry Potter books). Her fifth book is late because she's getting married, she's got more money she'll ever need, she's very busy doing other things, so nothing is that difficult. When she wrote those wonderful books she was a single mother in Edinburg with hardly enough money to buy a cup of coffee. What I'm trying to say is that to sketch the way Benny sketches takes ten years of daily practice. It's been difficult. If you compare it to learning a computer package in six months, that's easy. It's so abstract and so one-dimensional. With the sketch it is more intent, more layers, more complexity, more vision of what is really intended. And that's the key. Sketching is not something you'd acquire overnight. That (pointing at one of Will's sketches) is of someone who knows the meaning of drawing outside of graphics.

Ben: You make links between drawing and painting. Are there similar links to music and drama, for example? Are there any links between conceptual sketching and improvisation?

C: Yeah. You see I think those pictures are sketches (pointing at Will's paintings on the wall). Because here drawing is about discovering and dreaming and therefore when those drawings are started there is no clear idea what the result is going to be. It's not like someone painting a seaside or riverside which is about imitation of what you see. Here it is about a tool of discovery and of testing and of dreaming. There's a huge emphasis in this office about dreaming and one of Will's favourite phrases is that "in dreams begin responsibility".

Ben: How do you then externalise your dreams?

Benedict: We also do it in working drawings.

Ben: Do you scan in sketches and render them?

Benedict: Yes.

C: I do actually like scanning hand sketches. But I think we also want to avoid any kind of characterisation. It's the same with our buildings. Once we've done above ground an L-shaped building we don't want to do another one of those. We want to do something else.

Benedict: Sketching is one of many different skills we need to have. I do a lot of rendering and 3-D modelling on the computer. It's not being encouraged particularly here, or in any other practice I know of. In a high-tech practice like ours you'd describe sketching as a traditional practice.

Ben: Does sketching matter then?

Benedict: Having a good 3-D sense is essential to doing architecture.

Ben: How important should it be in education?

Benedict: It really depends on the teacher. At AA where I've been teaching for eight years we have a unit system. There are about 20 units and each of the unit masters has a very distinct sense of what they think a young architecture student should be all about. And some of them do very magical things with the machine. Computer or pen and paper, what you pin up on the wall is still part of that school. At my own school in the States (Yale) we made big final models in wood or cardboard that were an important part of the way we presented projects.

C: What I noticed in general is that architects sketch better than the average person on the street. But what I do find, and that is unbelievably disappointing is that engineers and structural engineers are not very good sketchers. That means that columns are just columns (he sketches out a straight column). No desire to do a column that shape (he sketches a tapered column).

Benedict: When we do encounter engineers who can draw we always remember them.

C: Name an engineer who can draw? To them, for example, an exit vent is 2 by 3 metres (he sketches) and they go away thinking that they done their work and when we look at it there's this clash between them and us two-thirds into the project.

Benedict: But working in 3-D packages also forces engineers to think in a more sophisticated way. Perhaps it is the computer that will lead people to be more 3-D oriented. In this practice we have designers who can whip up a 3-D structure on the computer which could not be done by hand. So that's encouraging young people to think 3-D, so in that sense we are being led by the machine.

C: People like Gehry are designing buildings that could not have been built without the digital input (he describes in more detail how).

Ben: But like the medieval cathedrals the time factor is important too.

C: True, like the Segrada Familia, but the commercial pressure is real. What I say in my lectures is that the price of the curve is getting close to the straight line. No I can give a piece of steel that shape (he draws a curved beam in plan) and all I have to give is the digital file of this to the manufacturers and their rollers will produce the shape to extraordinary precision. That would have been very difficult twenty years ago. At least it would have cost you. So these are interesting times.

Ben: So where do you see the trend: graphic tablet or pen and paper?

Benedict: You can't let the kids go through school without teaching them how to draw in a traditional kind of way. That would be irresponsible of the school. My modest contribution to AA is that people can draw a little bit. It goes together with architectural history that I also teach at AA. In the context of schools you just have to let them know both sides of the coin.

Ben: Here in the studio setting, do you do the five minute sketch?

Benedict: Yeah, big time. It's really important. We go through huge amounts of tracing paper.

C: We give you the dustbin content!

Benedict: I worked with Nicholas Grimshaw and his high-tech buildings were mostly drawn by hand on A3 tracing paper. But we did the GAs (General arrangement layout drawings) all on the machine because you can update that stuff very quickly. But the casting elements, although they could have been drawn in CAD, were very quickly and efficiently drawn by hand.

Ben: That is if you know how to do it.

Benedict: Yeah, but you learn that at school and from the people you sit around.

C: As for teaching drawing, there's a wonderful book called something like "drawing with the right side of your brain". Developing sketching is about developing a muscle in the brain. A 7-year old girl I knew draws fantastically well. Now, at ten, she's given up, because she can't draw what she sees, say a motorbike on the street, or a footballer on TV, because she hasn't been taught how to draw. So you have 80-90 per cent of the population who drew beautifully when they were five but at fifteen cannot draw a single line. And that is a scandal!

Benedict: What's the problem with that?

C: Because maths, English, science, history, geography is perceived as more important than drawing.

Ben: Is this a particular British problem?

C: No, it's a civilised world problem. If we created a curriculum where drawing was as important you'd get a layer of the population that would be more intuitive, more lateral thinkers, more open to unconventional things. They would be able to take the moon and Shakespeare and make a new play out of it.

Drawing skill is sketching!

Well, we have to leave you now. But I hope we can meet up again and then Benny and I can show some of our sketches.

Added 25.07.02.

My third studio visit to Alsop's when Christophe shows me his sketchbooks and photocopies a few examples of sketches and sketch developments from three projects for me to include in my research.

On trying to "define" what is a sketch C again cautious against being prescriptive but suggests that in essence sketching is about generosity, dreaming, relaxing, giving meaning, starting an exploration. In particular he finds sketches are expressing and conveying ideas, amplifying the narrative. But they are also instructions to other members of the design team who deal with details such as stairs and fire regulations, and rendering using 3-D computer programs. 'Sketching is over when I pass it on to others', says C.

Yet it is also about 'capturing the idea rather than solving the problems because sketching at Alsop is more generous than solving the brief.'. Also, on the theme what is a sketch, C. suggests that 'anything more than ten minutes is not a sketch'. Benny, an architect colleague, who joins us for a little while, says 'an hour'. Benny says that there are many types of sketches, for example "the careful sketch", which is not ambiguous but expresses a clear intent. Benny objects to my suggestion that sketches are ambiguous: 'ambiguity is not inherent in the sketch!'. Both C. and Benny agree that sketches are good for clients who want to input something in the design process: 'Ongoing discussion is the quality of the sketch', concludes C.

Interview Jenny Frean
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Ben: What is the role of drawing in your practice? Do you use sketchbooks?

Jenny: I don't know about sketchbooks but drawing is very important. It teaches to look and see properly. Yes, drawing is about how to look. It helps to find balance and structure in the design. It helps to optimise solutions.

B: Do you use computers in your practice?

J: No. We are eleven textile designers here in the studio and we all draw, as well as using watercolours. It is probably different in say architecture, although Will Alsop uses paintings in his designs and I like them. Yes, we use computers but only for administrative tasks. We document all our work and sales in the computer.

B: Have you or your studio colleagues tried a graphics tablet?

J: No, I don't see how you can draw with them. Drawing is separate from computers. The computer is a tool that does a certain job. It's very different from drawing.

B: Students challenge the notion of drawing on paper. They experiment with drawing in any medium. What interests them is what happens in your head when you draw. It's an attitude as much as a chosen medium. In textile, e.g. at the Goldsmith final year show last week, students exhibited "ways of drawing" using the actual physical material and whether in 2-D, 2.5-D and 3-D form. Or, similarly at this week's BA Fine Art Drawing Degree show at Camberwell.

J: Hmm, I haven't thought of that. Do textile students use computers in designing?

B: Yes. At Chelsea, it is commonly used now. So is learning drawing important?

J: Yes, because if you can't draw how can you judge things, how can you understand and appreciate things on flat? We work a lot on "54" width of fabric, and the design has to work across that surface. For example, it all shows when you pull the curtains. It's about balance, it's about proportions. It's about scale. How can you do that on a computer screen? Also, learning to draw takes effort. Drawing has the effort of human quality rather than mechanical. Very different form learning computer skills.

B: Do you use computers for presentations? Say, when you meet clients?

J: I know some studios do. They show their work on the Web. But we don't. Clients want to see the design in the flat, to feel the texture, to appreciate the quality. And see the real colours. Yes, colours. They look very different on the computer screen.

Interview Rama Gheerawo
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Rama: On the industrial design and engineering course (RCA), it was 50/50 ratio of those who could draw conventionally speaking. I remember one particular student who always went straight into sketch modelling because 'I can't draw'. He became stuck as soon as he got the page. He would fill it with some sort of scribbling, and that would be it. In his final show he produced over a three-week period a sketch model that was much admired. And the prototype didn't change much from the sketch model.

My own work involves web design, when we first go to a client we sketch in words the site in terms of its quality, the words hold the content. If I sit down in front of the screen I cannot sketch because of the limitations of the drawing packages. I can't visualise on the screen at that stage. I visualise onto the paper. They drawings may not look like anything but for me they are personal and I use them later on to build up images on screen. It then becomes another level of sketching, it becomes something that is a firm proposal.

Ben: Is this a kind of sketching as a means of self-expression (I outline my three means of sketching).

R: Yes. I want to show you a sketch that later became an actuality (a web site). An actuality in the sense the web site is a product at the end of the design process. Philosophically it isn't an actuality but I term it an actuality for business.

B: When you sketch out ideas, do drawing skills come into it? Can we talk about a bad or ugly sketch?

R: I'm quite precious about the bad and the ugly sketch as well because I love drawing outside work and that gives me a chance to sketch that catches a moment, a feeling or a form. In web design the bad and the ugly come into it, the slip of the pen, it doesn't look quite right, you start thinking what happens if I do that, or if I do that. And quite often good ideas have come out of utter mistakes. Or things that don't look right. The bad and ugly push you outside your accepted field what is good. And instead of getting annoyed I see it as doing something dfferent.

B: Does it make a difference whether we sketch 2D or 3D?

R: 2D. It's horses for courses. Sketching is about pushing boundaries, exploring and not being afraid of failing. The student I mentioned before felt his creativity was being stifled when sketching in 2D. His medium was sketching in 3D. A vehicle designer here doing his PhD doesn't drive a car, he's not a petrol head, he' a deep thinker. He uses very precise drawing to illustrate a scenario in his thinking. He relates words to sketches in his research. Perhaps you could describe him as a sketch head (laughter).

B: Do you see yourself as a sketch head?

R: I love sketching as a creative outlet. Although the emphasis shifted to doodling from when I was as student because here at work (Hamlyn's) I'm engaged in programme management, research and pastoral work.

However, in my final a paperclip gave me an idea for a chair. I'm also interested in the user, the lynchpin on which it all sits. Ergonomics, user information. Fiddling with a paperclip ... (he sketches it out on paper). One piece of plywood supported by cantilevered steel ... the clip solved the design problem. I wanted to be one continuous piece. The benefit of this was to throw into the air all our preconceptions about furniture, especially in the school environment. Also the fact that employers complain that half their workers are off with back complaints, the most common reason quoted by employers. From where do people get bad backs, from sitting badly. I did an observational study in a school and took 300 photographs in one day. And in every photograph I took the children were sitting like this (shows by slumping forward). There's the answer. The furniture project was to create a solution. I solved it 2-D wise, arranging it on page. It may look static on page but it is moving in my head.

B: Like a storyboard?

R: That's interesting, I hadn't thought of that, storyboarding.

I wanted to show you how I sketch out the process in building a web site but unfortunately I didn't bring it with me. I'm an inheritedly a lazy person and don't wan to do more than necessary so looking for streamlining processes.
I got three concepts for a web site in my head that I'd like to take into the screen but I capture it in a sketch. You start to work it up, to make it look like an object.

Ron Arad is a great doodler, I sat next to him at a RCA meeting. They were amazing.

Within the engineering community, I found drawing cathartic, relaxing and exciting at the same time. Paper is a medium for creation. I found that a lot of people afforded a lot of respect to my ability to draw. Building up a concept through sketching.

When I was at Rover, I learned rendering. The whole process was deciphered for me in one week by a visualiser. But I separate that from sketching. It was kind of limiting. Numbing creativity. With sketching you can go on many different journeys.

I don't know the reason for respect. Every body in design, including engineers and technicians need to sketch not only in order to create but to realise.

B: At RCA you said the ratio between students who sketch on paper and sketch in modelling was 50/50?

R: 50 per cent could draw, i.e. you could understand what they were talking about. But even the doodle was useful at some stage in the process.

B: Do you produce better designs if you can draw well?

R: That's a contentious point because personally at a basic level it doesn't. It comes more instinctively than something that comes by hand. But in terms of communicating those ideas, in getting them known. It becomes a little bit more difficult to communicate, to engineers, to clients, if you can't draw. I've seen it work very well when designers who walk into a client's meeting saying, oh, you mean like this, or you mean like that... they cut down the time needed immensely. When you talk about it everybody got the wrong end of a different stick. If you go and work it up on a computer they say, no, no, no.

There's a parallel with music. Everyone has music in them, reacts to music in an emotional way. Every musician needs to play an instrument or sing.

B: Superficially then a synthesiser is a bit like designing out of a box.

R: Yes, but at a deeper, creative level designer needs to be able to sketch in some form. To bring out ideas especially the emotive side. I sing Indian music, so the music analogy is natural to me. Classical music forms, including jazz or blues, require a certain amount of skills and learning. My teacher trains 6 hours a day. You need that accumulation of skills, compared to designing out of a box.

B: So you need to know how the voice works, similarly to how drawing works?

R: I think drawing is pretty essential. I think drawing should be central to most design related disciplines. Even if it is to find out you don't need the skill. It is a part people should explore. And, especially for designers, life drawing. The understanding of the human form. Which will also influence a lot of the forms you place around people.

B: And still life?

R: I see still life as a form of discipline. In that discipline I also see the freedom because going back to the analogy to music, if we play different beats ...

B: What a bout scale?

R: It's something I noticed mostly in architecture.

B: Should we push drawing classes?

R: It needs a softer dynamic approach, because the world seems divided between those who can and those who can't draw. At school I remember those who hated drawing because at the end of the class it was stuck on the wall. Maybe it's more like a form of self-expression and exploration it needs to be there. My course was much about that. But then you were allowed to use it in a way you saw fit, although students some used it very little.

B: You can only lead a horse to water ...

R: At least you've shown the horse the water.

When I worked at Rover I was an asset to the engineering team because I could draw. I could draw and I could think, I could think materials, spacing ...Bringing together two different skills. I then worked in small design consultancy doing injection mouldings before coming to RCA. The company used a designer to do the rendering on an ad hoc basis but I kind of changed the working practice of the company by taking out a pencil exploring about 20 different ideas. It was used in-house and then built up to a computer model. I also worked fo a civil engineering firm building bridges and such likes. Everything was done on CAD. They had people in the design department they called CAD-monkeys siting at the back of the room working up ideas sent to the clients.

It is at the beginning of the design cycle that the pen and the sketch is the most useful.

B: What do you call that stage?

R: I suppose I call it blue-sky, white board. To be totally jargonistic I call it the creative bit. Anything goes, anything comes.

B: Do you sketch outside the time line?

R: Yes, in the workshop. With web design there's more of a definite cut-off point. Also it has a sense of impermanence so you can change it anytime, within the minute.

B: How do you se the computer as process that might limit freedom?

R: I couldn't put a creative face onto the screen. Because you are limited by the program.

I haven't come across anyone in design who doesn't use pen and paper at some stage during conceptualisation... perhaps it is between the Casio synthesiser level and classical music ... perhaps it is Britney Spears, pre-package. Sort of Pop-tastic. You know you don't expect that much. An example is web design package solution offered by some designers.

B: What do you think of approaching recent design graduates now working in industry as a methodology to find out about sketching?

R: I think it is the best way. The year they spent with us is a bridge, a pocket of innovation between the academic, or rather college atmosphere and college energy where anything goes in terms of creativity, and commercial realism. It pulls the best of both strands. How process is used.

B: Is sketching important across design disciplines?

R: Talking to individual designers could show. My personal feeling is that it differs from discipline to discipline. It's fairly crucial for everyone though. Perhaps in interface design one starts to wonder if sketching is needed, but it is an emerging area. But I think it could do know harm.

Patricia Herbert Interview (response by letter)
Director
JHP (Interiors)
9 Berkley Rd
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Trisha.h@jhp.design.co.uk
Date: 09.04.2002

In response to your letter of 8 April. You have certainly hit upon a raw nerve with our senior staff who view with some concern the reluctance to sketch on the part of designers. It is not a generational issue here at JHP.

Our principle John Herbert (64 years old) has always struggled to get young designers to sketch and experiment and be prepared to change before committing their ideas to detail design. The advent of the computer has certainly exacerbated the problem. It seems to encourage going straight into finished work without the critical and creative thought period. It also presents problems for construction detailing. When you are designing on paper you are at the same time thinking through the construction and can detail full size. It is not possible to do this on a computer as it takes far too long.

Roy Wilkinson (36 years old), our creative director believes passionately that using a computer at the conceptual stage of the project can severely impair a designer's ability to think and draw. A computer forces you to follow out a set of instructions and is all about processes. To draw a simple square you first have to go to 'rectangles' then decide a size ... meanwhile on paper a designer can have drawn and roughed-up circles, triangles, squares, organic shapes and different rectangles – all comparable with each other and all disposable. The pen and paper sketches are therefore a direct link to a complex series of thoughts and images – There is no quicker connection than mind and hand.

Once a concept has been committed to a computer designers are often reluctant to change – they are scared or lazy.

Having said all this obviously computers are excellent as tools, particularly in large scale projects. Design companies could no longer function without them or indeed would want to.

G.E. Kirk (response by letter)
Chief Design Engineer
Rolls Royce
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Derby DE24 8BJ
11.06.02

'You asked for my views on sketching which I have interpreted as freehand sketching rather than detailed artwork.

Sketching still plays an important part in the engineering design process and is just as important today as it was before the introduction of computer aided design.

Why do designers sketch? Generating concepts either individually or in teams is an intellectual exercise and concepts need to be captured in order to record them for future use or to communicate ideas to others. Freehand sketching provides a rapid, easy means of capturing ideas and is available any time, any place, given a flat surface, a pencil and a piece of paper.

A CADDS system is fixed and is not quick enough to capture fleeting ideas but obviously provides a more powerful tool once the ideas have formed and the more formal part of product definition had begun.

Sketching can also be an aid to creativity and many ideas can come from abstract doodles allowing the brain in the fingers to do the work, analogous to a musician searching for a melody.

In summary, sketching even on the crudest scale is important to engineering designers and a conscious effort should e made to encourage its use'.

Interview with Pauline Muscant
Creative Director
Portland Design (Interiors)
24.07.02
pauline@portland-design.com

Ben: Design is now becoming more conceptual, not least in education.

Pauline: Yes, more esoteric.

Ben: And where does the sketch fit in there? The computer image tends to become finished very early on.

Pauline: Already in graphics there seem to be a reaction against computers and a return to a more craft based form by hand. Graphics and interiors are moving in parallel but at different paces. Interiors, to start with, they were behind computers in general use because it was client driven. Most clients have a computer at home and so they think they can design anyway. It is very difficult to sell the nebulous idea of design. Now people have all these software packages at home, desktop publishing, colour rendering and interiors combined with these awful television programmes about home interiors that devalue the whole design process. We are therefore walking a terrible tightrope because the client expects to see something quite finished. But unless you see the design process and illustrating it you are devaluating the whole exercise and there are all sorts of repercussions. E.g. Why should clients pay all these fees when you can pluck something out of air, which of course it isn't. Certainly here in-house we have the ambition to present our thought processes as well. We fight very hard to present anything up to acceptance of initial concept that has been hand-drawn. Obviously we can't stay with the art so we modify it so we use computers to render, but we don't design with a computer to start with. We see it as a technical tool that comes after the thought and creative process that starts putting it into a technical format such as reproduction.

B: Does that mean you scan in the sketch?

P: Yes. We tune our presentations to the project. The majority of our work is abroad so there are cultural differences.

B: So it starts with the sketchpad?

P: Yes.

B: Do you use graphics tablet?

P: No. I'm afraid we haven't got that investment. That's another problem. Once you are on the treadmill the money you have to keep putting in just to retain the programmes you've got is very difficult. Our capital investment runs into tens of thousands [pounds] just to keep still basically.

B: Do you show your sketches to your clients?

P: We all get a brief, we obviously scrutinise the brief. We then have a brain storming. We are small enough so that anybody who wants to be involved can come in and make their comment. So you at least have a sense of direction what you are setting out to achieve. As to what you said about education in these days being esoteric, I think in education they are now beginning to lose the plot as to what they want to achieve as the end result. We need to know right from the beginning where we are going. Otherwise we might go in the wrong direction and wasting our time. And commercially there are time limits. After the brainstorming the team members will go away within an allotted time, determined by the programme, fees etc. to sketch ideas. Then, after a few days or whatever, there will be some feedback when we talk about it again. What did you think about this... but.... etc. Then the team fine-tunes it. And then for the first presentation it is being scanned or hand-rendered, or CAD. And at times we include some sketches. Or you take the sketchbook if you need to. Most clients think they know about computers. But if you get out your sketchpad during a presentation to explain something... are we talking about so and so ... we always get their attention. Because that's something they can't do. It shows the skills they are paying for, and it shows the design process.

B: Do you do this to all clients?

P: The process of design is basically the same: The brief, the rationalisation, the initial presentation. We always do an initial presentation before a final presentation so it is not "take it or leave it". They know their business better than you do so we have an initial discussion. And once approved that's when you come into production drawings etc. So the creative part is always presented at least in two presentations because there is also a risk of over-delivering too soon. The other day we did a presentation that was too slick, it was too much like a final presentation, I think.

B: This is often a criticism of computers – they take you too soon into the finished work.

P: There's also the danger of the client feeling he's being put in a corner because it looks so finished you're almost saying: well, take it or leave it. There's no feeling that they can have an input or make a comment. They feel they have to totally condemn it but are afraid to say so. It's a bit looser, it allows for the client to interact which is what we want. Also, on most initial concept presentations we might present two or three ideas just to gauge their thinking.

B: Is this independent of the design product, that is, graphics, interior or branding?

P: Graphics is slightly different. But they still do concept drawings in the form of mood boards, they still do two or three directions at the initial stage. But very much the same sort of process.

B: How many designers are you here?

P: The whole team is fourteen.

B: On a daily basis how many would you say are engaged in freehand sketching?

P: About ten, eleven.

B: So it's a daily activity?

P: Absolutely. Obviously it depends at what stage the project is at. And some team members are more computer literate than others.

B: Do you think sketching is a generational question?

P: Probably it is influenced by education. We have an architect who used to be creative head of Conran's. He doesn't work on the computer at all. You can see in our studio we still have drawing boards. There's a drawing board for every three CAD station. In my days at college in the 60s we didn't even have parallel motions – only T-squares! There's the influence of culture. We have a gent from Hong Kong whose sketching is very good. He was a product designer in Hong Kong before he came over to Leeds o do interiors. We wouldn't employ anyone who couldn't sketch.

B: Do you interact with sketches during brainstorming?

P: Yes ... (a bit vague).

B: Do you encourage people to sketch, or they just do it?

P: Uhm... you have to remind them at times. But we have an outstanding computer renderer who is also an exquisite sketcher. And he was delighted, when reminded, to find it again. I try to balance things so people don't spend too much time just computer rendering. It's variety that keeps us all stimulated. So I have a responsibility to maintain it [sketching in the office]. Sketches on computers can be very accurate but have no souls. But you can lose confidence in sketching if you don't keep at it.

B: Do you sketch outside work.

P: No. But only last year did I get a computer at home. But computers are under your control – don't allow them to drive you.

B: But isn't a computer also a medium in the way we look at the world around us?

P: Yes, absolutely.

B: When you recruit do you look for both sketchbooks and computer skills?

P: Unless we want a CAD operator we never specify candidates should have computer skills. We have two people here who don't work on computers and, perhaps uniquely, our creative head [Lloyd] can't use a computer! We don't see that in any way as it unable him to do the job. He only uses the computer to type letters. And until last year our most senior designer, who left to set up on his own, didn't use a computer either. When we recruit, and we have a slow turnover [of staff], we always specify about sketching ability but never computer skills. We have this idea that we want creative people and it takes a long time to find the right people. But if you want CAD people you can phone up an agency and you'll have one in the afternoon.

B: So in your opinion it is difficult to find young and creative people?

P: Very. We are looking for candidates who have majored in a vocational course. We have never found anyone who has neither finished a graphics course or a BA in interiors. We had one candidate from Royal College interior course coming to se us the other week. The work was so esoteric and the architect here and I couldn't understand what on earth he was doing or what it was about. It was not his fault, I think this an education problem.

B: Did the computer play a part in that?

P: He had no sketches whatsoever. Even the computer drawings were difficult to get information from.

B: If you were head of a design school what would you like to see as far as drawing goes?

P: I think it would change during the course. You have no better time to be theoretical, esoteric and experimental than when at college. But you are going to hit the real world at some point. I used to lecture in colour theory so I think during the first year sketching, rendering, form, shape, etc is important. But by the time they leave they should be prepared for the real world. I think that's a duty of a college. They have to turn out employable people. It's only fair they should be expected to make a living. So it's catching the enthusiasm, the creative to start with gradually blending it with something that is of use.

B: But isn't that part of the problem that industry expect students to have down to earth skills and that those skills are being seen as computer skills?

P: Possibly, but in our industry, when a student doesn't know what a working drawing is that has nothing to do with the computer but just knowing how something fits together. That's part of the education system. I wouldn't blame that on computers.

Computers are good for modelling and rendering and for making something look solid and real. But they still look like computer drawings. They are wonderful tools for technical drawings. They are wonderfully quick to change compared to scratching out the ink on tracing paper. There is so much emphasis on computers as rendering tool in graphics and interiors.

B: So we come back to education.

P: Yes, I think students need direction.

B: What is the role of in-house training?

P: There are no apprenticeships. We try to give students their placement year. We try to put something back into the industry.

B: So pen and paper are still relevant.

P: Yes, the computer is an added tool. But like the TV set, it doesn't always have to be on. But what is appropriate? But computers make things slow, it's quicker to draw by hand! And sketchbooks are useful for storing ideas. Two weeks ago I had a new project and I remembered a sketched ides I had never used. It was like "My God, I had forgot about that!

I brought some sketchbooks for you to have a look at. Here, e.g. a kind of scrapbook, not just sketches but things stuck into it.

We structure all our projects: The initial concept/research stage; the final concept stage; working drawing stage and final production. All very clear stages.

B: Do your clients enjoy seeing your sketches?

P: I never had a negative response.

Here, e.g. we scanned in the actual product into the hand-drawn exhibition design.
So mixed presentation drawings. The freehand drawing does reveal the design thinking. First ideas … sense of scale, quality of line. How things fit together. Transparent or solid. The initial idea is still in the outcome.

You can't be an interior designer without thinking three-dimensionally. And the sketch helps in doing that.

Interview Benedict O'Looney
Alsop Architects
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31.05.02

A. Benedict: This project is a house project, quite unusual for our practice. But it is representative of one approach to sketching. So the deal here is an extension to a regency terraced house by c. 1830.

1. The first sheet [of five] of this little suit of drawings describes the first quarter of working up the scheme. They are some simple plan sketches with below some perspective studies trying to tease out what some special relationships are and what some of the rooms might look like. The scheme, which my bosses

suggested, will take out some walls inside the ground floor to give it a more kind of open spatial feel. And having had these preliminary instructions, I started with a few sketches on a piece of tracing paper.

2. The next drawing is, I must have, I probably made a computer section and laid a piece of trace paper below it with a thick bit of trace which I love to draw on which takes a lot of abuse. And then I stated inhabiting that computer outline with some people, where storage might be and what kind of things one might want to be around. And at the bottom of this sheet you can se I was teasing through the idea of a balustrade now when we were removing the back wall to give the ground floor more space.

3. The next stage was to work up what I describe as a computer model which shows the new space at the back of the building with a garden room we are aspiring to. And we took those first sketches and modelling using Macro Station, a powerful 3D package a lot of us use here at the office and completely throw some of the structure around. And throw some of the stairway and some of the envelope of the building around, the glass and the brick outer wall of the building. And to see what all that kind of stuff might look like and get a very definite spatial register on this thing. I define exactly the amount of space we could get out of this new room and how tall I thought we could get away with. Putting it into the computer put some definite dimensions and special sizes of this thing. And then one relies on the power of the machine, often working overnight. One sets it off its rendering path as one is leaving the day and when one comes back the following morning it has made this kind of picture bouncing light around which this kind program does.

4. Having made that computer model, I went back to a piece of thick trace paper and sketched over the computer model to make variations on a theme. Much fast, of course, by hand to work through the ring of changes of what this thing could possible be. And then sketched out a sort of matrix of different shapes we thought planners might let us get away with having asked us to have a great deal of brick on the outside of this garden room. So that's from the computer back to the sketchpad.

5. This final sketch shows the before and after drawn by hand, sketched out using a fine Rapidograph pen but very much tracing over a computer drawing gave me the shape. The computer drawing was important because one knows exactly how big this building is going to be. When I took this sketch to the Westminster planners there was no ambiguity about how big this thing was going to be and in that sense the computer study that I made kind of offers a kind a thick truth I suppose.

B. Benedict talking through a couple sketches from his sketchbook on his voyage to Italy 2001 (on bicycle!).

When I first arrive to a new place I size it up with a few thumbnail sketches that may be worthy of a more lengthy study, say over a couple of afternoons. For example you can se the breaking line of the sun here in the sketch. I was interested in underlying plans as well as in the facades, e.g. the arcades. They made a perfect sequence of indoor and outdoor spaces that celebrates the communal aspects of city life.

The annotations are aiming at fixing historical information in my mind. I had a Baedecker from, I think, 1921 which had a reasonable treatment of these buildings, and I quote from them.

I paced up the plan, something I learned from my Victorian drawing master (19^{th} century Architectural News) who first, in my youth, encouraged me to do architecture as my trade. I'm not able to do that kind of stuff in my professional work. It's my sketchbooks that receive that sort of treatment. And there is nothing like a plan next to a perspective that shows how things work. I just draw it, I don't set up a perspective.

My mum got a bit annoyed with these sketches because she preferred my previous sketches when I used a lot more different mediums, e.g. water colour or colour pencils. These are all pen and ink. I get more confident over the years but colour I release in my paintings I do in Peckham where I live, and where I paint landscape. So I'm not disconnected to colour.

The other photocopy from my sketchbook I made for you shows some aspects and details of a building by Renzo Piano, one of my hero architects. There I picked on various parts, for example how this curious sliding screen worked, or how a minimal glass canopy was set together. And also how an ingenious terracotta cloying system worked in section which Piano has become very well known for. And here trying to fill every inch of the sheet with tiny little writing, some added later.

The more I put in into these studies, the more you see. It will probably surface in a subconscious way in some of my future work. They sit beside me most of the time so I can look at it at the same time you get the sensibility of this kind of high-tech detailing. Anyone would freely admit that, compared to a camera, this kind of drawing pull you close to the subject in an intimate kind of way.

A line drawing gets the information so much faster than a tonal thing, like a photograph. Line drawing is immensely specific.

My drawing skills have changed, and improved over time. And periodically I go back to source by copying drawing by Rembrandt or Michelangelo. These guys can draw like crazy and that where my heart is. I thought when I first got into this bag that I wanted to draw to be a good sketcher and that was somehow the route to getting somewhere in this trade. This was about the time I started seriously to study architecture, and I'm now thirty-seven. I wondered then if I was still going to be passionate about sketching in ten or fifteen years time and I thought as I got more into my trade my interest would wane, like I know it has done with my comrades out there on the floor. I got tons of encouragement from my mum who draws quite well, and from friends.

As I look back I'm hungry as ever to draw. And better than ever, hopefully. So don't think I'm ever going to stop because this is the way I like to communicate. It really helps I'm lucky to work for a practice that accepts and I got this job because Wil [Alsop] knows that I love to draw. But there are so many things to be a great architect and having good three-dimensional skills to make me able to sketch is really one of a whole bunch of other things. You have to be very tough, very aggressive, very confident. I'm getting there but unfortunately being able to draw well does not guarantee a smooth career.

I see drawing as a core skill but at the same time being very deft in computer automated design is a core skill too. That means being good at composition, knowing what makes an interesting and dramatic composition. All those basic fine arts skills will bring that to bear. And I grew up in a family of painters so I had that added strength. I took a few art classes but I didn't go to art school. When I started drawing in NYC, and did life classes, I thought a lot of people were much better at it than me. So when I'm in a teaching mode I know if you keep bashing at it you'll get there. Life drawing is great. I like drawing people. Nature is tops. The human body is central. All great architects, like Gaudi, totally focused on nature. And contemporary architects too, like Colatrava (?).

Our chief Wil is completely sympathetic and connected to the fine arts scene. That architects and engineers go round the table and sketch together happen all the time in London practices. Wil has a studio where he paints – he used to do it here.

I paint too, but not large scale as Wil. 16" by 20" is my favourite size. I work in a Canelletto townscape tradition in the Peckhan area

Don Norman
Verbatim email
Professor Computer Science and Psychology
Northwestern Unviersity
Norman@nngroup.com
10.05.02

'My professional opinion is that tools have to match the needs. Paper still affords many advantages over any other medium. Paper, along with whatever writing implement is preferred: Fountain pen, ballpoint, pencil, crayon, charcoal ... etc.

Most of us take notes with paper and pencil, for this is the most flexible of all media – you can move around the paper, mix text and drawing, use space in a powerful way, etc.

We should not let the advantages of digital media take away the advantages of our conventional tools. Most of the designers I know start with sketches. They than scan them in to the computer in order to translate them into machine tools specs, but still, the sketch is the superior medium.

Some years ago I visited Disney and was shown a wonderful input device for their computers which allowed their artists to sketch with their preferred tools onto whatever kind of paper they preferred, but that also, simultaneously input the sketch into the computer.

It is true that conventional tools have problems. I used to hate mechanical engineering drawing simply because I would always mess up the ink. It is good to get away from the problem of ink and spills and continual reworking.

My hope is that someday we can use pens, crayons, charcoal, pencils, etc. on media, but have this immediately entered into the machines, so that we can copy, trace, distort, manipulate. Yes, very much what Disney was trying to accomplish'.

Jim Paterson and Jason Turner Wood Interview
Venue: BDG McColl
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23.04.02 15.00-16.45

BDG is a medium sized all-round design company, from architecture to branding and corporate communication packages. The firm operate with an external face (market/client oriented) where most of the conceptual design takes, led by two Managing Directors of which Jim is one. Jim is a trained architect (RCA), with 22 years of experience, and in charge of studio design. Jason is an Associate designer who has been with the firm for five years.

Both are enthusiastic about sketching, and Jim reckons that about 60% of their designers (4 associates and 10 team designers) use freehand sketching sometime at the conceptual stage of a project. But only 20% are what Jim calls "originators" who work directly with clients. 60% of staff are in the "delivery business". An example of delivery transpired when Jim showed me a few design examples pinned up on the walls in the studio. They were all computer images of executed projects. But of the computer-based designer (Macoperator?) when asked about conceptual designed, answered "it's all in the package", [this was what might correspond to back office - My afterthought].

For the "originators" sketching is an important way to communicate within the studio: "You have to establish a design language early, both in-house and vis-à-vis clients", emphasises Jim.

They both consider drawing skills (they both had drawing classes at college) important and believe that such skills not only inform sketching but are also are needed to understand design (spatial articulation and construction). When they interview new designers, and whether college leavers or second job applicants, they expect to see portfolios with sketches, as well as decent CAG/CAD skills. They believe sketching can be learnt, as part of drawing.

However, they don't see sketching as "artistic", yet they don't share the notion of 'the bad' or 'ugly sketch'. The sketch/drawing has to perform. It is a tool! But a tool that support an idea.

Jim emphasises the importance of "Elegant thoughts" in design which he claims show in the way a designer sketch, and whether in a flow diagram or in an idea for a building. The sketch reveals the designer's "feel" for both sketching and designing, and thus the sketch is an integrated part of design thinking. Interestingly, Jim says that CAG enhances and CAD produces "Beauty" (you can draw and render a space very realistically but the sketch is "Truth".

Jim talks about sketching as Off-screen-activities, OSA, and "creativity above computer (CAC?). [Or could it be OSDA (Off-SCREEN DESIGN ACTIVITY?]

Freehand sketching is the "Raw material" that is often scanned and rendered in PhotoShop of PowerPoint for client presentations. However, there might be pre-sketches, or even pre-pre-sketches, says Jason.

CAD is used as a sketch development tool once they won a contract because it is time consuming to enter data and cannot replace freehand sketching.

CAG/CAD has replaced traditional sketch planning although in pitch presentations they use freehand plans and elevations, sometimes rendered by hand (thumbnail sketches), although more often using a paint program or PowerPoint. E.g. for pitching they may only be given a preliminary floor plan which becomes "the sketch pitch", so a quick way is to use overlays, draw freehand, add some spot colour, scan it and the result is a set of plans that have a creative raw yet professional look.

A third designer, with thirty years under the belt designing anything from interiors, graphics to furniture, joins us at the table for a moment. He shows as a simple set of 5 elevations for what appears a fairly simple bar interior (refurbishment project), sketched by hand and rendered in a paint program.

For a typical spatial/interior project they typically would sketch initial ideas on yellow layout paper using fine Pentel marker pens (black ink), mainly for internal use (I-sketch and We-sketch). Jason shows me a couple of these, rescued from the bin (sic! – normally he doesn't keep sketches although "important ones" are included in their Image bank). Jason is a fluid sketcher and says that he is computer illiterate (he point out that when he joined five years ago the firm had three computers, the rest was drawing boards – now it's the other way round!).

He loves the immediacy and expediency of the sketch, in the studio or on site (for checking and "problem solving" in situ). He finds "5-minute quick sketch" useful as a recording medium (It-sketch) which can be fed back into studio sketching ("I-sketch" and "We-sketch"). His conceptual studio sketching as part of sketch development for a client is typically in ink on layout paper, which takes about an hour each, still quicker than CAD.

However, he also finds vagueness in design both in analogue and digital medium.

Both Jim and Jason agree with my "I-., We-, It- sketch description but adds that there might be sub-categories to each depending on how polished they are ("fidelity").

They also find my "Matrix" for locating the sketch in the design process (Free/CAG/CAD/CAM) useful. For example, a freehand sketch when scanned moves from Free to CAG. A concept presentation would be in CAG mode. However, Jim points out you can move in any direction within the matrix, e.g. Free/CAG/CAM, depending on type of project. You could also see the matrix as a matrix (sic) for virtual overlays.

Interview Mark Stewart (RIBA)
Bennett Interior Design
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07.06.02

Mark: I went through College (Glasgow School of Architecture) when computers were not that prevalent and as a result and during my career I sort of managed to stay clear of them. I feel I missed out a bit on the technological era although I do train myself. But not on a everyday basis. And there is the big difference between software packages and drawing. Once you learn to draw you never forget it. Once you don't use software packages on a daily basis you forget them.

Computers here have become much more part of everyday practice particular for certain types of project. We may be different from some other practices in that we still have drawing boards. But we use in them in tandem with computers although not in a prescriptive way.

Ben: As a designer do you have a choice?

M: Yes we have.

B: You don't feel the pressure to abandon the drawing boards?

M: No, but it depends on at what stage a project is. Clearly at the production and information stage then computers are the way to go because things change all the time and computers are the easiest medium to response to these changes. But, again, it is not totally prescriptive. So if a member of staff can't use computers but still can do and think detailing they can use whatever form they want to produce it. People are not becoming redundant because of computers.

[When later touring the studio I notice a fair number of senior "grey-haired" staff].

B: So when you take on new designers do you look for computer skills?

M: Yes, but again perhaps different from some other practices – and I do recruitment (laugh) – we are 120 staff, so quite a large practice. Some insist on computer skills because the way they work. Others would be less prescriptive. We look for ability and talent than just computer skills. Again, I think that is atypical within the industry.

B: When you assess applicants is that by the traditional portfolio?

M: When we advertise we ask for examples of their work. At the end of the day, a drawing is worth ….. everybody can write a CV to sound much better than they are. But examples of work are not the only judgement we make. We do look at CVs as well. But from a sketch or a technical drawing you can tell what is behind that.

B: Do you expect a sketchbook among the portfolio work?
M: Yeah, we expect college work, even if they left college ten or fifteen years ago, especially for architects. And even if they become more specialised … we still look for all-rounders. I expect to see an all-round portfolio.

B: Where do you se sketching in the design process?

M: It tends to be in the early part but, again, it is what people feel comfortable with drawing on. We are not prescriptive. Some people are more comfortable on the computer.

B: Do you make a distinction between sketching and drawing?

M: Eh, not really. But I suppose there are extremes of each type. There is the technical drawing and the quick sketch. There is almost a scale, not black and white. You can have quick sketches that are quite detailed. Or you can have a concept sketch that is transferring a feeling or something. An emotion rather than information. It's difficult to make a distinction in my mind because it is such a wide area. Although it might depend at what stage the project is.

With a concept sketch it can take quite a while before we commit anything to computer.

B: Is this on traditional layout paper?

M: Yeah, on layout paper, on table tops. It's only when we have some concepts together or some structure that we start thinking of using the computer. And we do that together with our internal 3-D department who is very good at Studio Max [software application]. We actually involve them in the design process. So once we got all the sketches we create some 3-Ds or wire frames.

What we always use in conjunction with sketching is modelling. Card board or foam board in sketch form. In fact, the actual models are quite rare in the studio, they tend to be of the sketch type. And that's almost a sketch substitute.

B: It seems that there's a bit of the design school here?

M: Yeh, very much so.

We also use the rendered sketch a lot. We scan the sketch into Photoshop and render it. I think that hand rendering is a bit of a dying art now. You can achieve much more a persistent and professional result with computers although it depends on the project. For example for a heavily engineered or clinical project, like the Swiss Re here [shows A3 book with computer rendered images] – the Foster "Gherkin". Lots of coloured renderings for interiors would not look that appropriate. More a case of CAD or Photoshop. At the other end of the scale we might use a lot of colour renderings for say a domestic project.

I do mostly pencil sketches myself.

B: Do you make a difference between 2-D and 3-D sketches?

M: There are. Some people can't think in three-D. And that's a problem and sketching is wonderful from that point of view. Even a computer shows 3-D images too much like 2-D.

B: Do you think there's link between in 3-D computer skills and freehand drawing skills?

M: Yes, our 3-D people may not necessarily come from an artistic background but their sketches are very subtle. It's almost like paint on paper.

B: Do you sketch in a collaborative way, in meetings around the table like we are sitting now?

M: Quite often people tackle the same problem independently and then we come together and go through everybody's contributions and then, not designing by committee, take and respond to each others' ideas.

We use PowerPoint but much later in the design process. Not early on.

B: What do you call this stage?

M: Concept design

B: Do you use freehand sketches or computers in the sketch development phase?

M: We can use either or a combination of the two. Lots is done in sketching even at the detailing stage before committing it to the computer.

B: How many designers are working here?

M: We are 150 staff of which around 50 architects.

B: And among those 50, are sketching widely used?

M: No, but perhaps fifty-fifty. Again it depends on peoples' skills. If they are not good at sketching or thinking in 3-D they quite often go to the computer to help them. And it is not a generational thing.

B: To what extent is sketching a talent or a learned skill?

M: I think it is a talent initially but it's a talent that can be learned to a degree.

B: From your own background, is it something you picked up at college or improved on since?

M: No, I have always had the ability to draw. I always did it as a hobby. And at architecture school I got better at it. So a combination of the two. I think there's still a big place for sketching.

B: Did you do life drawing?

M: I haven't done much of that. But I think it is valid. It is observation. It has to do with construction as well.

B: One on my rhetorical questions: 'Can you be a designer without a sketchbook?'

M: At the moment, no. It's difficult to look into the future and see what software will develop but then in the last ten years we didn't anticipated some of the developments say in Studio Max. Then we said that the computer wasn't going to take over from a professional rendered. But now they've died out because programs have got so good.

B: Do you see the freehand sketch as an interface with clients?

M: I think clients like that. Very much so. They like being involved in the design process and if you sit in front of them sketching they can see it happen. It depends on the client, of course, but in general they appreciate that. But it is nice to show all facets of a presentation, including videos and PowerPoint. Although I remember how we lost a project when someone drew the scheme in front of the client. Obviously a PowerPoint client.

B: Some would argue that it is the less sophisticated client who prefer PowerPoint presentations.

M: Clients are used to looking at photo realistic images and sometimes they can't imagine hand-rendered images.

B: Do you therefore adjust your presentation to the type of client?

M: Yeah.

B: Do you tend to collaborate with firms working in similar ways to yours?

M: We don't actually have a strong corporate identity like Fosters' do who control all their output. We are much more flexible. We don't really have a house-style. It can be a benefit as well as negative.

B: Your strong engagement with sketching, you wouldn't call that a house-style?

M: That's more of a working practice.

B: When you communicate with clients and sub-contractors etc, is that mainly through computer files?

M: It is at that stage, or hand-drawn details. Bur quite often we have meeting with sub-contractors or other consultants and sit down with them and sketch in 3-D exactly what is meant. And because people are of different training, backgrounds, and abilities sometimes freehand sketches can overcome these differences.

B: Do you use intranet when designing?
M: I think we will get there, sadly.

B: How do you see the balance between traditional drawing and computers in art and design schools?

M: It's difficult. I think it has to be flexible. People have aptitudes for sketching, for computers, sometimes for both. But both should be encouraged equally. Allow students to develop whatever media they prefer. . I don't envy the position. But they should have a basic understanding of computers like Photoshop and drawing packages like AutoCAD, Microstation or other industry standard programs.

B: What about the importance of subjects like design studies, design history, and design philosophy?

M: I think that's very important. The problem with architecture is that every aspect is important. I think we should just strive to do everything better.

B: And writing essays as well?

M: Yes. It is important too. Overall, I think design education should be all-round. A really broad experience in part one, and then in part two very much tailored to the individual, specialist skills, what direction they want to go. If they want to go to Bartlett… as long as they have had that initial. At the moment things are swinging too much towards the technical minded and students are coming out ill prepared. And I think some colleges are training primadonnas.

B: Is it difficult finding good designers?

M: It depends on the time. At the moment it is quite difficult because the market is buoyant and people particularly architects with technical skills are being snapped up. And that is people who have been working for a few years.

B: Do you train designers in-house?

M: Yes, we take on a number of part one students every year and graduates are well worth taking on. They got the enthusiasm and the design skills and they are quick to learn. They are probably the best candidates to choose. Some schools prepare them quite well, others don't.

B: Have you tried a graphics tablet?

M: No (laughter). At the moment I scan sketches and render them. Well, I'm, learning to do that in Photoshop. But you need to be able to sketch, be able to think. It's what goes on behind that's important. That's my personal opinion. Conceptualising with sketches is still more evocative.

B: And sketch modelling?

M: Very much so. Many people can't sketch so modelling is a way around that.

When you sketch you learn more about what you are looking at. I don't believe that the video or the still can be a substitute for the sketch.

[Looking at in-house sketches/drawing rendered in computers].

M: Everything is designed by designers although modelled in a computer. Or a pure hand-rendered sketch. And some sketches between the two. And here a hand-drawn sketch rendered on the computer in Photoshop. A basic sketch given that harder graphic edge in the computer using Photoshop. The problem with sketches is that it can be rather individualistic, not necessarily what you want all the time [for presentations]. And here some more computer rendered hand-drawing.

Richard Seymour Interview (notes during a telephone conversation)
Product designer
17.04.02

Richard was in an ebullient mode. He told me had ten minutes to talk – we actually talked twice that time (he turned down a request for a face-to-face interview). As we spoke, he told me that he was sitting at his desk opposite Dick Powell, his design partner, poised for sketching on his graphic tablet. He talked incessantly, jumping from one aspect of drawing to another, which made it difficult to follow his line of argument at times.

He calls his very cerebral yet sensuous approach to sketching *Meta-sketching*. 'Sometimes just six strokes are needed to express an idea, or feeling' (which he says he does all the time with Dick Powell). That is the economy of sketching, providing instantaneous memory or 'the sketch welded into memory'.
Or, 'the five-minute pen and paper sketch'.

He says that talent and attitude to drawing show in the primary school (5-9 years) formed by education and training ('formulaic). Even in the 1950's and 60's art and design schools were for those very talented or those 'who insisted on doing it because they couldn't do anything else'. But also, many talents were discouraged because art, apart from architecture, wasn't a profession, and certainly 'not to be made a living from'.

Attitudes to drawing has of course changed too, and more so with the advent of the computer. 'Then [before computers] it was an effort to draw, today drawing is not being celebrated'. Yet he argues that to push the drawing agenda is not for 'the grey hair brigade'. It has to grow from underneath, like 'a guerrilla revolution, speared by young designers in their early twenties to have an impact'.

He says that drawing is empirical yet also a cognitive activity. 'What does drawing do in the brain?' His design firm is planning, as an experiment, an in-house drawing class to encourage sketching. He already had a kind of motivational session with two teams of ten designers in a presentation exercise combining verbal and sketching.

Matthew Wood Interview
Venue: Conran & Partners.
Shad Thames. 2nd floor meeting room
Date: 16.04.02. 3.15-4.30 pm

Matthew is a fast talking Bartlett trained architect in his mid-thirties and a director of Conran & Partners. The interview is more of a dialogue/conversion. The firm is a multidisciplinary practice (architecture, interiors, product and graphics) but increasingly engaged in architectural projects, which is Matthew's main area.

His strong interest in drawing stems from his art foundation course prior to studying architecture, and he brought to our meeting a stack of ten A5 bound sketchbooks spanning several years. Although he says he doesn't sketch on a regular basis he sees sketching as a core activity, in his own personal practice and across design disciplines. He is confident about his drawing skills as evidenced in his sketchbooks, from simple line drawings to presentation sketches, including drawings of his holiday in Spain. He draws almost exclusively in ink (Pentel) – he says he can't be bothered with sharpening a pencil! He likes to 'tell and show' through drawing, which, by the way, his wife finds overbearing: 'Can't we just talk about it?' ("it" being home interiors ideas).

We start by talking about the merits of sketching, immediacy, economy and so on, but Matthew emphasises how important drawing is, in his own experience, for understanding design. 'The stuff you learn on a foundation course, e.g. life drawing, still-life, objective drawing etc are transferable to design (or used to learn!?). He finds though that most designers in the firm have poor freehand drawing skills, both 2D and 3D, and don't use sketches either for self-expression or communication with others in team situations.

He admits, somewhat embarrassingly, responding to my question, that when they interview candidates for jobs they don't ask for sketchbooks, or don't even expect the portfolio to include them. 'Haven't thought of that!' But all designers must have good computer skills although Matthew often discovers that they don't feel confident about the underlying structures of design including graphics layouts, whether they talk about or try to visualise it on paper, which they try to avoid. Without the computer they seem lost and communicate poorly in freehand drawing.

Matthew said he was surprised when asking designer for ideas, they don't go 'the quick sketch', say 'the twenty minute sketch', but prefer 'the verbal mode' or seem stuck with the computer drawing systems.

Thus, they go straight into CAD and produce, say, three "solutions" in half a day, all very similar. In contrast, he himself reels off a dozen sketches with pen and paper in a couple of hours.

Matthew comments that it is as if designers invest so much time in the CAD mode, which is very process-oriented, that they feel reluctant to take risks and change the design. The permanent look/feel to design produced on CAD might also hold backs experimentation, and CAD leaves little tracing of thoughts: 'What If?', doesn't pop up on the screen (Perhaps an idea for a 'What If Wizard'?! – my reflection).

I mentioned the notion of the 'bad sketch' and how we still carry the Renaissance image of what drawing is ('the Leonardo complex'). Matthew agrees that there should be a place in design for 'the ugly sketch', but he finds many designers don't seem to make the difference between 'the ugly sketch' and 'poor drawing skills'. They seem to feel embarrassed, or they lack confidence in their drawing skills. One way of dealing with this lack of confidence might be to encourage 'the throw-away sketch'.

Interview Meirion Jones (architect; via email)
WMLWB (architects)
13.05.02
mjones@wmlwb.com

My comments are related to personal experience within a few essentially architectural studios.

Within many office situations not many people are designers. Production and assembly information is a big part of the office. The 'grunt' is CAD technician. If a designers learns how to use computer graphics, they can easily became the CAD technician.

Offices are businesses, about making profits, speed, consistency. Designing can reflect the office hierarchy, directors, who can usually just about open an email, sketch for the design to be worked up by a technician. Generally directors don't do CAD.

Sketches are usually included in Quark and Powerpoint presentations and pitches. They can show idea development and artistic inspiration, which clients like. The story goes that a secretary follows Norman Foster around his office collecting his sketches. Presumably Michelangelo's secretary did the same.

I am not aware of clients becoming sick of computer presentations. Photo realistic material can often be used to great advantage at later marketing stages. I am not aware of raw nerves in relation to sketching though I have felt reluctant to sketch certain aspects of a building knowing that CAD could in theory produce a perfect picture. Those who view sketches expect that level of realism and accuracy. Sometimes it is possible to develop a sketch from the CAD base gaining a level of accuracy.

I have little experience of 3D modelling but it is having a major impact on the shape of the building being produced, and consequently the materials used. 3D modelling has, I think reduced the amount of physical models produced. Whilst I was in college there seemed to be a clear distinction between the medium and the realised products.

'Modern' product designers used Pantone pens to illustrate their plastic or painted proposals.The 'chippies' usually worked in pencils and watercolours more sympathetic to timber and framed construction. If a product designer deigned a piece of furniture it was usually a sofa or upholstered.

CAD is more closely aligned to the Pantone than the pencil. Colleges should, I think allow students to experience all types of graphic communication as tech drawing, sketching, art, etc. became bundled and the range of CAD packages. The effect of the medium on the consequent output should also be stressed. Individual skills and aptitude will influence the choices of medium the student develops and the individual will have to adjust her/his career accordingly to suit their priorities. College is just the start.

APPENDIX E1

Design Ideation*

Self-Report
(Reflection-in-action)

NAME: YEAR:

Ideation Workshops

Fridays 10.0-13.0 (Groups A&C); 14.0-17.0 (Groups B&D)

Assignment 3. **Architecture**

Task:

1. Generate and present ideas for *a single studio space* to be occupying a maximum of one square metre floor area and a height of two metres. Use any conceptual tool(s), such as sketch modelling, computer graphics, annotated sketches, words etc.

2. Keep a track record of the tools you used throughout the assignment in the overleaf Self-Report, and answer the questions on page 4.

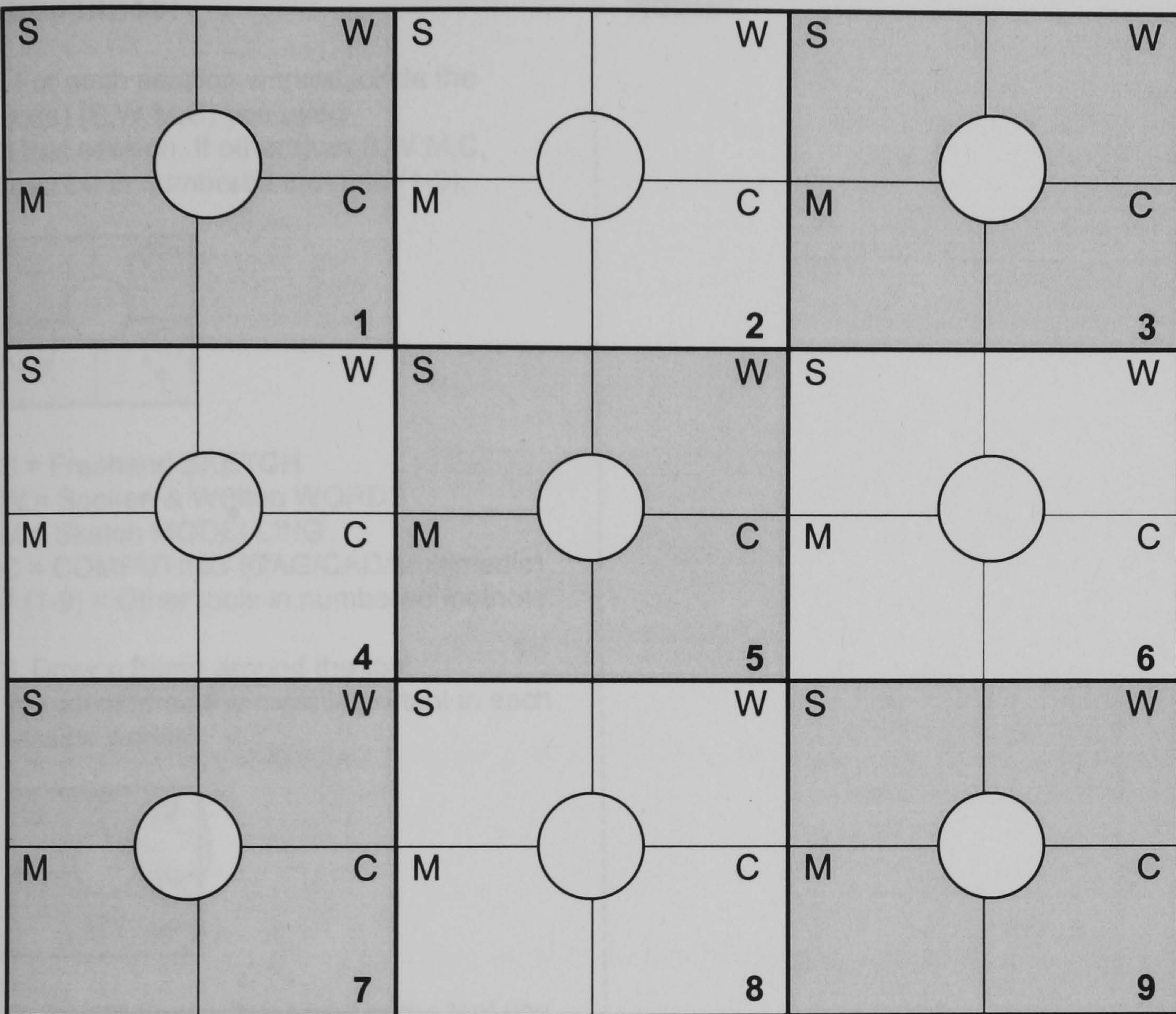
Outcome:

Brief presentation of your idea(s) to group + Self-report, with evidence of tool(s) used, to be handed in at the end of the assignment.

* *Design Ideation* refers to the generation of new ideas using conceptual tools with the intention of identifying, developing and communicating a solution to a design problem

REFLECTION-IN-ACTION

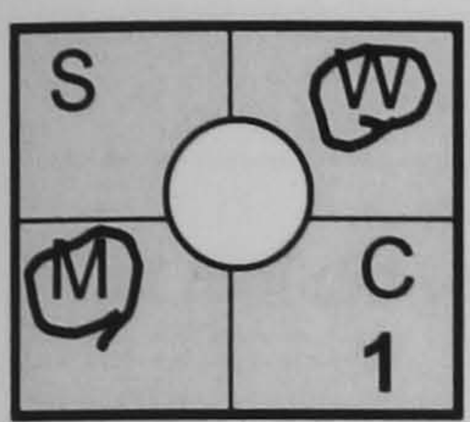
Each numbered square (1-9) represents one 15-minute session worked.



Footnotes: Using the square numbers as reference (1-9), add other tools, special circumstances or "landmark events" ("Aha!") you experienced during the sessions worked.

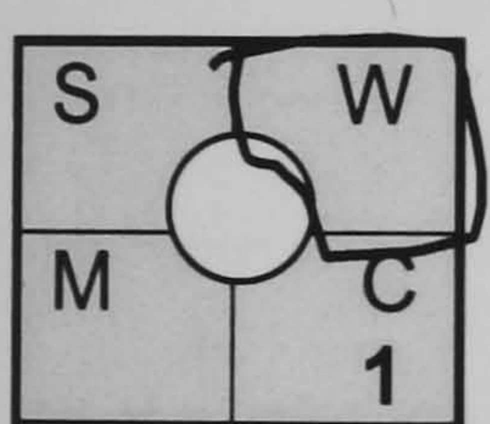
Guidelines:

I. For each session worked, circle the tool(s) (S,W,M,C) you used in that session. If other than S,W.M,C, describe in numbered footnote (1-9).

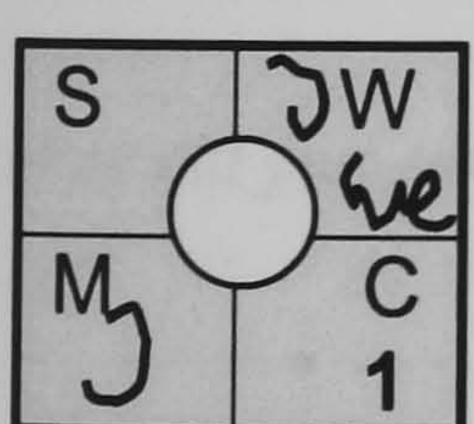


S = Freehand SKETCH
W = Spoken & Written WORDS
M = Sketch MODELLING
C = COMPUTING (CAG/CAD/Multimedia)
1 (1-9) = Other tools in numbered footnote.

II. Draw a frame around the tool you considered the most important in each session worked.

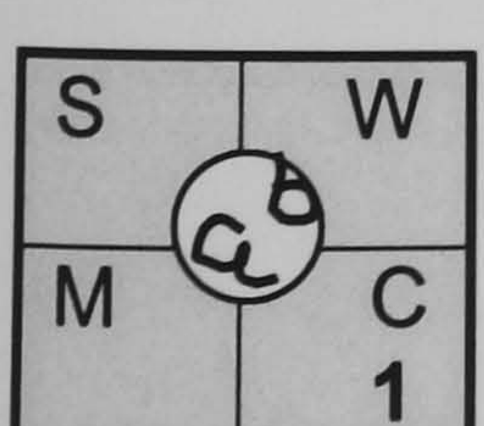


III. Add "I" and/or "We" next to the tool you used to indicate mode of communication.



"I" = Inner-personal communication
"We" = Inter-personal communication

IV. In the circle, indicate the reason(s) (a,b,c,d) why you chose the tool(s) you did.



a = Because I could not do without it
b = Because I liked it (personal preference)
c = Because of tutor/peer/client influence
d = Because of assessment criteria

Notes:

REFLECTION-ON-ACTION

QUESTIONS:

What tool(s) did you get started with, and why?

....

....

What tool did you find the most important, and why?

....

....

What tool(s) did you use because of personal preference?

....

....

What tool(s) did you not use because of lack of skill or practice?

....

....

What tool(s) did you find the least appropriate for this assignment, and why?

....

....

How did you communicate your ideas ("I" and/or "We")?

....

....

What did you learn from this assignment?

....

....

APPENDIX E2
Y1 STUDENT PARTICIPANTS

Reference number:	Name:
1.	Kirsty Minns
2.	Victoria Nagy
3.	Sophie Allen
4.	Fabienne Winkworth
5.	Jonathan Rose
6.	Chung-Chi Chiu
7.	Jayne Potter
8.	Bysshe Wallace
9.	Nina Anuar
10.	Li Jonsson
11.	Kyo Ho Lee
12.	Nicholas Marsh
13.	Mike Whelan
14.	Emily Atkinson
15.	Victoria Creevey
16.	Alexander Holmes
17.	Jacob Howard
18.	May Foster
19.	Zeinab El Maikatti
20.	David Goodwin
21.	Steven Lee
22.	Sam Hulbert
23.	Iara de Castro
24.	James Cuddy
25.	Charlotte Woods
26.	Bonnie Lo
27.	Jonathan Buchan
28.	Marek Connell
29.	Vivian Chung
30.	Nadine Jarvis
31.	Matthew Graves
32.	Claire Hall
33.	Anna Gover

APPENDIX E3
Outline Ideation Workshops

Four Short Assignments: (Fashion, FA, Architecture, AR, Graphics, GR and Product, PR)

Duration: The time set aside for each workshop was 3 hours of which 2 ¼ hours were allocated to the actual ideation task (assignment), and the remaining time to briefing, completing the Self-report (Questionnaire) and idea presentation to group (peer-group learning).

<u>Assignment 1: Fashion</u>:

Task: Generate ideas and communicate (present) at least ONE idea for *a fashion accessory,* in any style or material., using any conceptual tool(s), for example, sketch modelling, computer graphics, sketches, words etc. Keep a record of the tools you used throughout the assignment in the Protocol provided, and answer the Questionnaire at the end of the assignment.

<u>Assignment 2: Architecture:</u>

Task: Generate ideas and communicate (present) at least ONE idea for *a single studio space* to be occupying a maximum of one square metre floor area and a height of 2 metres. Record keeping as before.

<u>Assignment 3: Product:</u>

Task: Generate ideas and communicate (present) at least ONE idea for *a walking aid* for disabled people. Record keeping as before.

<u>Assignment 4: Graphics:</u>

Task: Generate ideas and communicate (present) at least ONE idea for a "Save-the Ozone-layer" *campaign- logo.* Record keeping as before.

Outcomes: For each workshop, give brief presentation of your idea(s) to group. Discuss. Hand in the completed Self-report and include in it at least one piece of evidence of the ideation process, for example, a written note, sketch, photograph or physical sketch model.

APPENDIX F 1

Self-analysis Protocol
(Reflection-in-action)

Design Ideation*

ID:

* *Design Ideation* refers to the generation of new ideas using conceptual tools with the intention of identifying, developing and communicating a solution to a design problem

Each numbered square (1-36) represents one half-Day session worked.

S W M C 1	S W M C 2	S W M C 3	S W M C 4	S W M C 5	S W M C 6
S W M C 7	S W M C 8	S W M C 9	S W M C 10	S W M C 11	S W M C 12
S W M C 13	S W M C 14	S W M C 15	S W M C 16	S W M C 17	S W M C 18
S W M C 19	S W M C 20	S W M C 21	S W M C 22	S W M C 23	S W M C 24
S W M C 25	S W M C 26	S W M C 27	S W M C 28	S W M C 29	S W M C 30
S W M C 31	S W M C 32	S W M C 33	S W M C 34	S W M C 35	S W M C 36

Footnotes: Using the square numbers as reference (1-36), add other tools, special circumstances or "landmark events" ("Aha!") you experienced during the sessions worked.

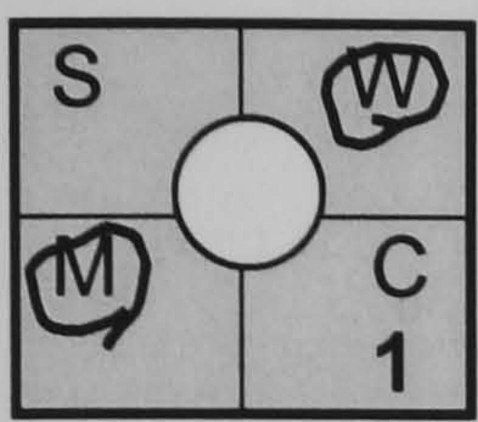
Each numbered square (37-72) represents one half-Day session worked.

S W M C 37	S W M C 38	S W M C 39	S W M C 40	S W M C 41	S W M C 42
S W M C 43	S W M C 44	S W M C 45	S W M C 46	S W M C 47	S W M C 48
S W M C 49	S W M C 50	S W M C 51	S W M C 52	S W M C 53	S W M C 54
S W M C 55	S W M C 56	S W M C 57	S W M C 58	S W M C 59	S W M C 60
S W M C 61	S W M C 62	S W M C 63	S W M C 64	S W M C 65	S W M C 66
S W M C 67	S W M C 68	S W M C 69	S W M C 70	S W M C 71	S W M C 72

Footnotes: Using the square numbers as reference (37-72), add other tools, or note special circumstances or "landmark events" ("Aha!") you experienced during the sessions worked.

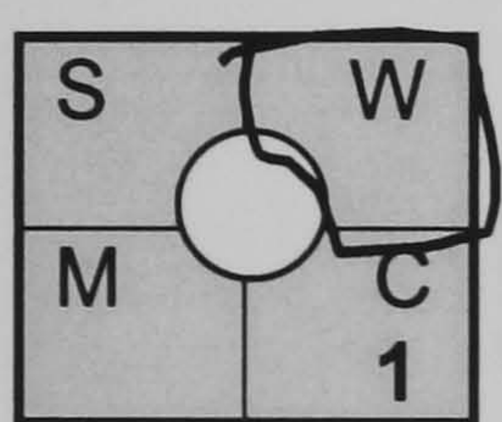
Guidelines:

I. For each session worked, circle the tool(s) (S,W,M,C) you used in that session. If other than S,W.M,C, describe in numbered footnote (1-72).

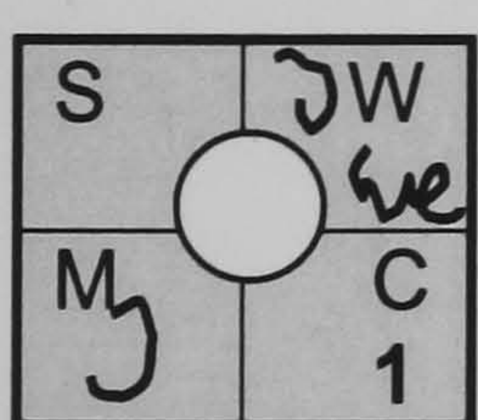


S = Freehand SKETCH
W = Spoken & Written WORDS
M = Sketch MODELLING
C = COMPUTING (CAG/CAD/Multimedia)
1 (1-72) = Other tools in numbered footnote.

II. Draw a frame around the tool you considered the most important in each session worked.

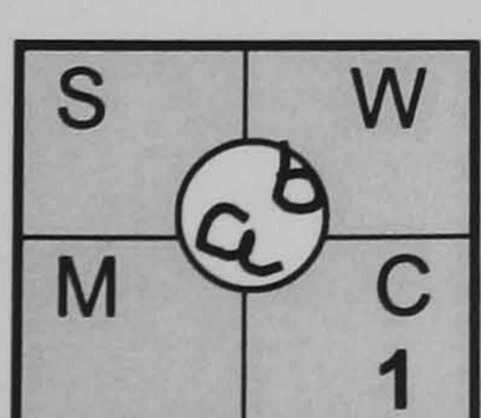


III. Add "I" and/or "We" next to the tool you used to indicate mode of communication.



"I" = Inner-personal communication
"We" = Inter-personal communication

IV. In the circle, indicate the reason(s) (a,b,c,d) why you chose the tool(s) you did.



a = Because I could not do without it
b = Because I liked it (personal preference)
c = Because of tutor/peer/client influence
d = Because of assessment criteria

Notes:

APPENDIX F 2

Interview Protocol
(Reflection-on-action)

Design Ideation*

ID:

* Design Ideation refers to the generation of new ideas using conceptual tools with the intention of identifying, developing and communicating a solution to a design problem.

Participant Profile:

Education:

Design discipline:

Skill standards: S W M C

Years of experience
(0-1, 1-3, 3-5, 5+)

Other:

Design project:

What was the design task?
(Include written brief, if possible)

How much time did you spend on the project?

Did the brief prescribe any particular tools for the project?

What conceptualising tools did you use (use graph)?
(S, W, M, C, Other)

Where in the design process did you use the tools (use graph)?

What "landmark" events ("Aha!") did you experience while using conceptual tools?

What were the strengths and weaknesses of the conceptual tools?

	Benefits	*Drawbacks*
S =		
W =		
M =		
C =		
O(ther) =		

If you could do the project again, would your choice and use of conceptual tools differ?

Would you have communicated your ideas differently?

Distribution of tools used (S,W,M,C,O)

Plotting the most important tools using the grid

● = sequential session

Reasons why tools were chosen (S,W,M,C,O):

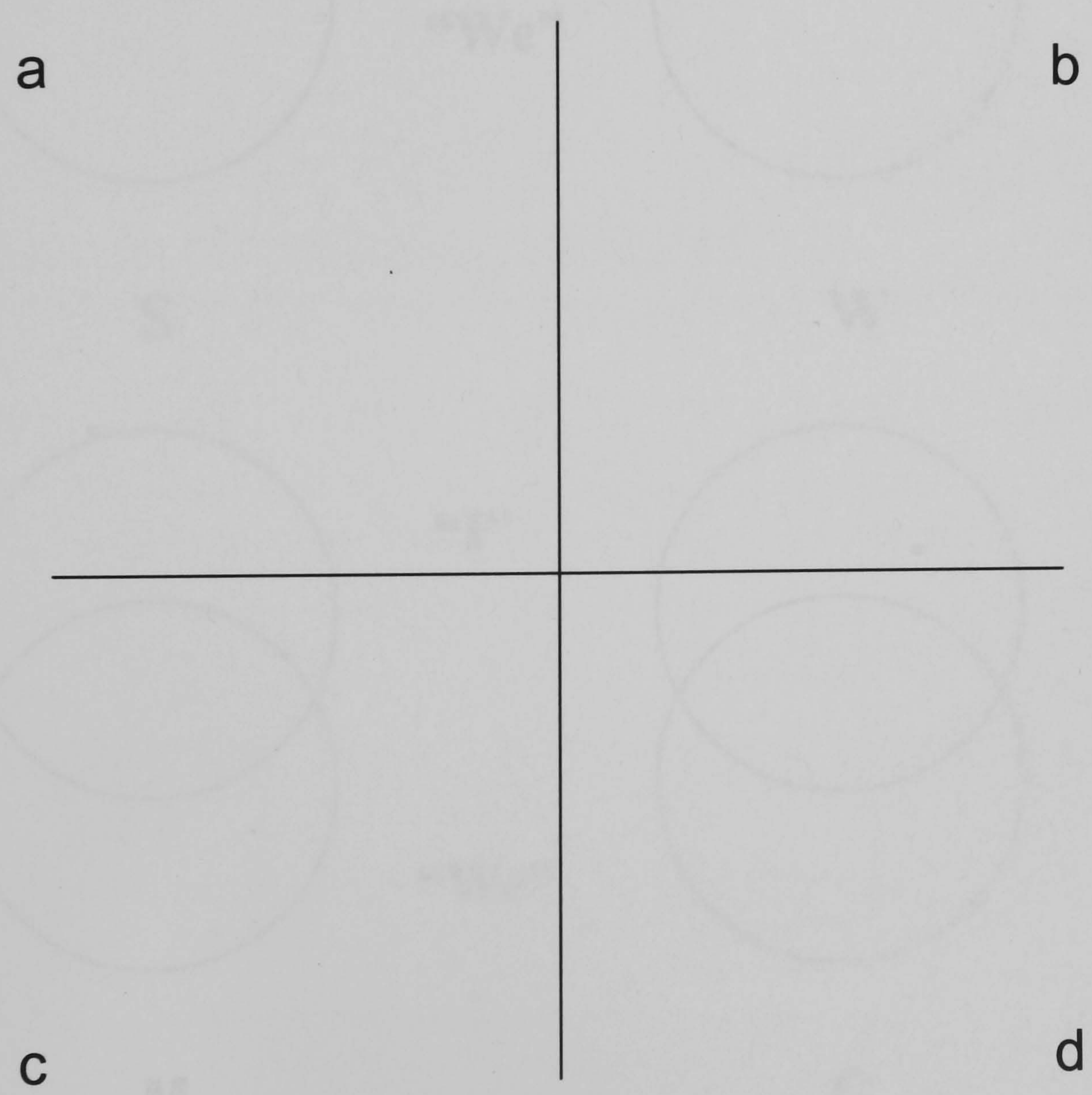
Plotting S,W,M,C,O using the a, b, c, d grid

a = because I could not do without it

b = because I liked it (personal preference)

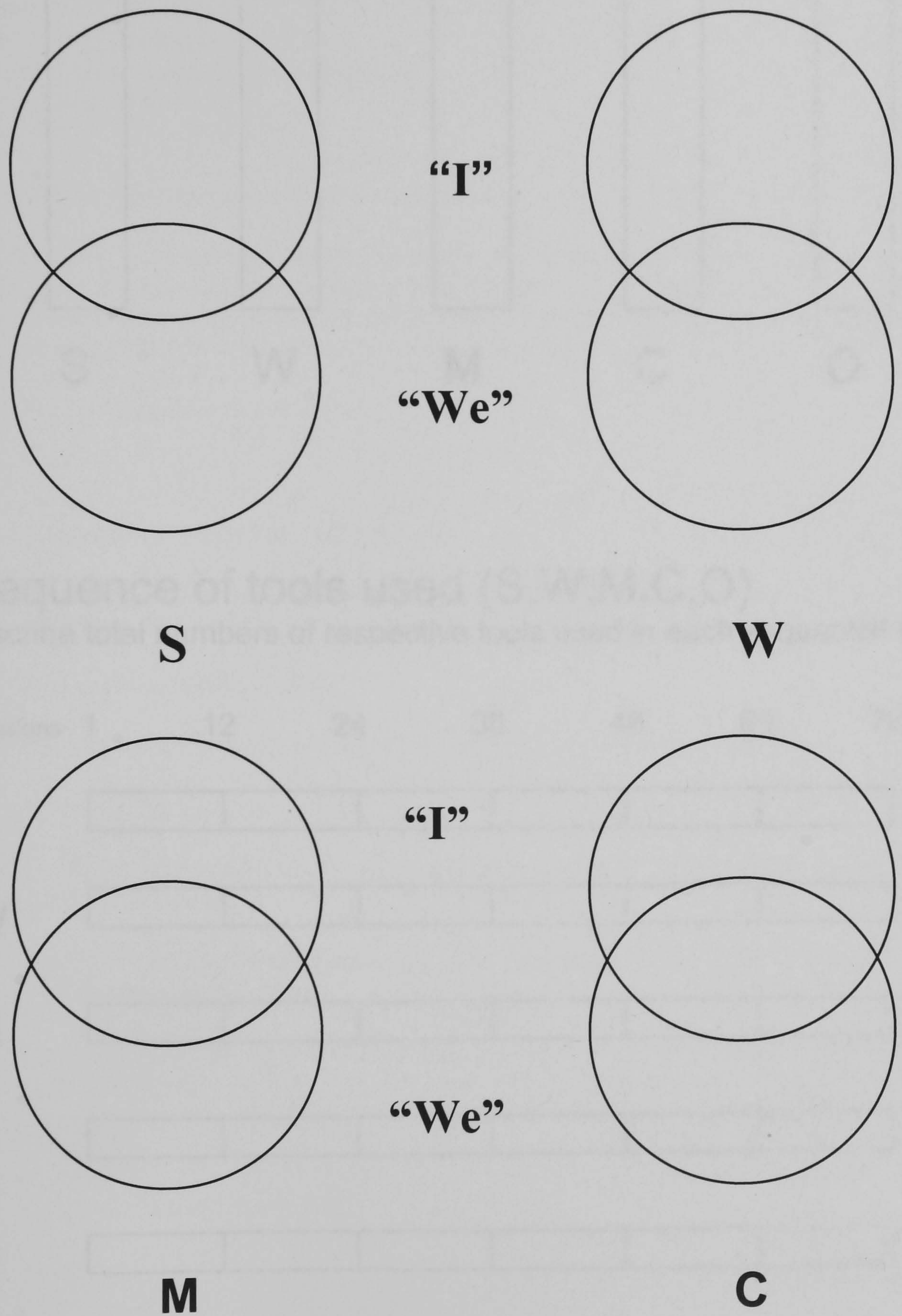
c = because of tutor/peer/client influence

d = because of assessment criteria



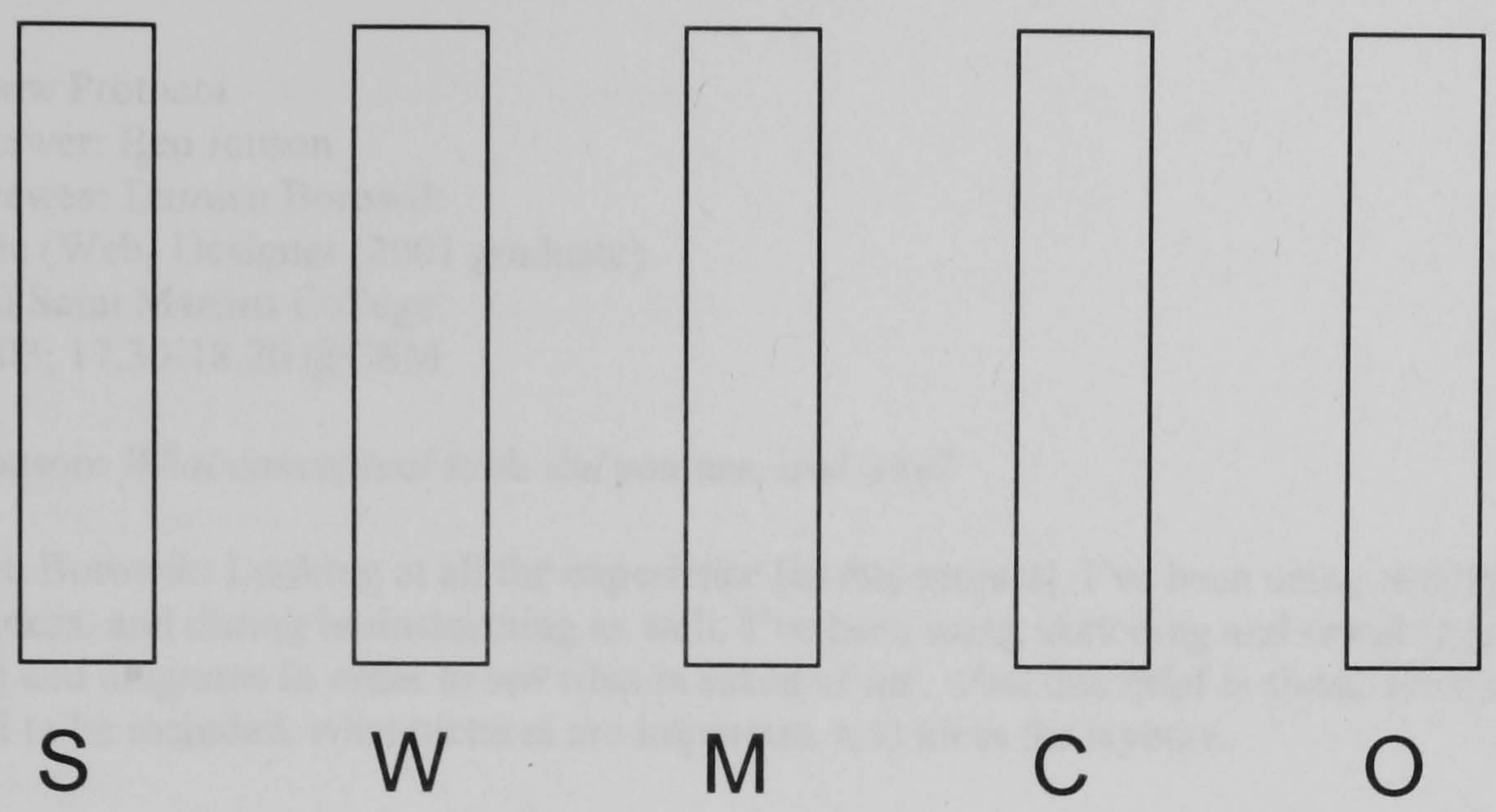
Modes of communication (S,W,M,C,O):

"I" (inner-personal) and/or "We" (inter-personal)
Plotting S,W,M,C,O using the circles



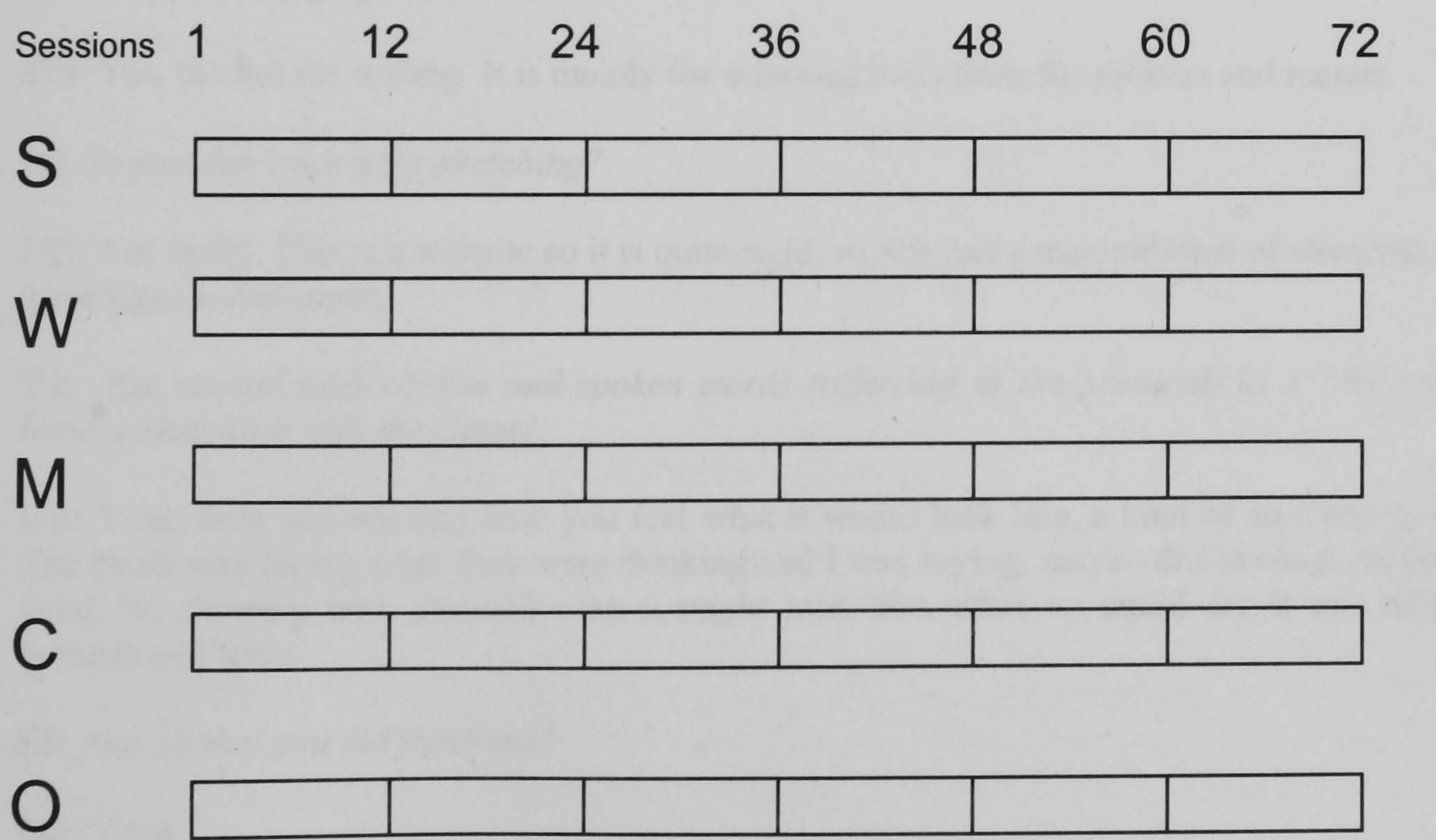
Frequency of tools used (S,W,M,C,O)

Inscribe total number of respective tools used in each bar



Sequence of tools used (S,W,M,C,O)

Inscribe total numbers of respective tools used in each sequential bar



Researcher: Ben Jonson; Goldsmiths College; Department of Design; b.jonson@gold.ac.uk

APPENDIX F3
Interviews Practitioners
(Interviewees listed in alphabetical order)

Interview Protocol
Interviewer: Ben Jonson
Interviewee: Damien Borowik
Graphic (Web) Designer (2001 graduate)
Central Saint Martins College
25.03.03; 17.30-18.20 @CSM

Ben Jonson: *What conceptual tools did you use, and why?*

Damien Borowik: Looking at all the experience [in this project], I've been using sketching mainly to get some ideas, and during brainstorming as well. I've been using sketching and wording [spoken and written words] and diagrams in order to see what is asked of me, what this brief is about. How many things needed to be included, what pictures are important, and ideas for layouts.

BJ: *And this you did with pen and paper?*

DB: Yes.

BJ: *Could you have done it on computer?*

DB: I could but not as free as with paper. It takes more time and when you do brainstorming and try to get ideas I think it is easier with just pen and paper

BJ: *Do you use a graphics tablet?*

DB: Yes, but not for writing. It is mainly for selecting tools from the toolbox and menus.

BJ: *So you don't use it for sketching?*

DB: Nor really. This is a website so it is quite rigid, so it is just a manipulation of elements. The web is quite rigid and planned.

BJ: *You started with written and spoken words (referring to the protocol) in a "We" mode. Did that involve sketching with the client?*

DB: Yeah, how you see and how you feel what it would look like, a kind of conversing with the client. The client was saying what they were thinking and I was saying, maybe this is okay, maybe this is not so good. So showing with drawing what it might look like, what we could do. It was mainly layouts of pictures and texts.

BJ: *And all that you did freehand?*

DB: Yeah.

BJ: *Was this specifically for this project, or is that generally how you get started?*

DB: I always ask what the client would like and what solutions we can have.

BJ: *And do you use sketching for this?*

DB: Yeah, very much.

BJ: *And do the clients appreciate that?*

DB: I think they get involved. At first, when you get a brief, you can't go to the computer and do something in two minutes, not really. I can ask for some keywords, ways and directions the project can take for them so I know what they are talking about, what they want. So I'm trained to get the essential parts of what the client requires. And then I can shape and incorporate them in my thinking.

BJ: *So ideas started to emerge at this stage?*

DB: Yeah.

BJ: *Did you use the computer at the conceptual stage?*

DB: Yeah. Quite early.

BJ: *And what actually happened?*

DB: On this project I was doing layout, how text and images can work together in a certain format, in a kind of storyboard of how it would look like. And from that I can go back to the client and show different ideas. And then they say "I like this, I don't like that", or "I would like it this way or that way". A kind of dialogue again.

BJ: *Did you use scanned in images for this?*

DB: Yeah, these were images produced by the client's marketing department, such as promotional material, prints and so on.

BJ: *So the client gave you a lot of material?*

DB: Yeah.

BJ: *What software did you use?*

DB: PhotoShop and Illustrator (points at Square 21 in the protocol). Here I started to do the interactive and navigation part of the site because we were kind of happy with the look and feel of the site, in terms of pictures and layouts.

BJ: *Did you present that on screen or on paper?*

DB: That was on screen, very much so. And also having meetings and printing out what was on the screen to show to different people at the table around the computer (points at Square 22 in the protocol). And this was also where I prioritised written and spoken words.

BJ: *Where in the design process did you use the tools?*

DB: As I said, I think sketching appears at the early stage for research, brainstorming … getting ideas. I like to use sketches and wording because I get something out of my brain, some ideas, and put in on paper and reflect on it, taking it back [backwards and forwards'. And working as an exchange at meetings. And I do that with computing as well, placing an image on the left, then on the right, to see how they interact.

BJ: *What "landmark" events ("Aha") did you experience while using conceptual tools?*

DB: In 33 (point at Square 33 in the protocol), it sort of came together.

BJ: *Was there any particular factor that made it happen?*

DB: There always is but then it is also the work that has been done before. What I can say is that from the first day I had some ideas, sparks. So [together] those were the main events

BJ: *And what were the tools you used?*

DB: Sketching and computing.

BJ: *Would you say they complemented each other?*

DB: Yes, very much so.

BJ: *What were the strengths and weaknesses of the conceptual tools?*

DB: Strength of sketching is visual thinking.

BJ: *Any drawbacks?*

DB: It's a sketch so it's not something final. I don't know drawbacks of sketching.

BJ: *What about speed?*

DB: It could be one [drawback]. But then I think sketching is quicker than computer. It depends if you want something final or just ideas.

BJ: *What about spoken and written words?*

DB: This is sometimes difficult because it's hard to convince people, or understand what they are thinking. I like to use diagrams or using sketching and wording at the same time. It gives me an idea how to place things together. To be more clear about an idea and then I can reflect on it and interrelate it.

BJ: *Any modelling tools?*

DB: Not really.

BJ: *And computing?*

DB: You can change things quite easily but in the studio it is also time consuming to do all the scripting and links between pages. So it's not as free as sketching or wording.

BJ: *Do you see the computer as a tool for ideas?*

DB: Yes, very much so. It helps me to see and produce something and take it back and work on it again.

BJ: *Some would argue there's a risk in going to quickly to the computer. What do you think?*

DB. Yes, Very much so. But then time matters. So I can go on the computer too quickly but then sketching and wording are essential as well, with paper or something you can touch. It's very important to use you hands. But the computer helps you to do web design. You can't do without it.

BJ: *Have your use of conceptual tools changed from college to professional practice?*

DB: Yeah, I do less sketching.

BJ: *Why is this?*

DB: Because of time. And lack of freedom with the client. There's a difference when you do something for a client and when you do it for yourself.

BJ: *So it is client directed?*

DB: Yeah, and I've been focusing on computing since I left college. At college I could do any tool, sketching, painting ... or whatever. But after college I've been more interested in computers, doing graphics.

BJ: *Would you like to do more sketching in commercial practice?*

DB: Yeah.

BJ: *When you said you did more sketching at college was this because tutors or the briefs told you to.*

DB: Yes, it was the process, which I still do at home.

BJ: *How do you see the impact of digital technology on conceptualisation?*

DB: It can be pre-conceptualisation. The digital medium can give some already established scripture. And that doesn't allow you to create from scratch.

BJ: *Have you experienced that technology can take over?*

DB: Yeah, you have to watch out. That's why sketching and wording are very essential in the process.

BJ: *Do you think that's [technology] something we just have to accept?*

DB: I think this is something you have to deal with when you use the computer. It seems easier but it is actually more complicated.

BJ: *Would you say that the computer is neutral, just a tool?*

DB: It's a medium.

BJ: *If you could do the project again, would your choice and use of conceptual tools differ?*

DB: No, I don't think my client would have allowed me to change. It was a process that had been approved.

BJ: *Would you have communicated your ideas differently?*

DB: I don't think so. I was influenced by the client (pointing at "Computing" in the protocol), and also what I had to do ("a's" in the protocol = "essential tool"). And criteria set in meetings ("d's" in the protocol = "client influence"), when I had to produce these kinds of things. In the beginning I had some preferences ("b's" = "preferred tool"), but then I couldn't any more.

BJ: *Do you feel controlled by the commercial environment?*

DB: Yeah, it's this thing of money. The client writes ...you are debating with the client, trying to convince them that this is the only good thing for them. There are pre-conceptions on their side and it's not easy to deal with. It's quite delicate to find a balance.

BJ: *Did you get something out of the protocol?*

DB: Yeah, I can see these kind of [conceptualisation] patterns, how and which tool I've been using. What was important, if it was just me, or with another person. Yeah, it's interesting.

BJ: *Did you learn anything from it?*

DB: I can see I used the tools. I can see that I worked like that. Maybe I can put that on any other things I do, on a computer base mainly.

BJ: *Do you think it [self-report] might influence your work?*

DB: No, not for sketching

Interview Protocol
Interviewer: Ben Jonson
Interviewee: Gemma Bunston
Central Saint Martins; BA Fashion Design 2001
Fashion Designer/ Top Shop Design
Printed Luggage Range Project
02.04.03; 15.45-16.15 @ Top Shop, Berners St, London WC2

Ben Jonson: *What conceptualising tools did you use, and why?*

Gemma Bunston: The first part was all words (points at Squares 1 and 2 in the protocol). And that was the research part, which was essential so to see what the market currently had luggage-wise. And also Internet-search (points at Square 3 in the protocol). So just to see what was out there, what I could do differently or improve on. And then sketching obviously (points at Squares 5 and 6), to draw up my ideas basically, and then the computer (points at Square 7) was just to present them in a clear, technical way.

BJ: *When you say sketching, is that conventional sketching with a sketchbook?*

GB: No, we use a design sheet and that has all the legal stuff on it so when the sketch is sent out to the manufacturer they can't be copied.

BJ: *Do you draw with a pen or pencil?*

GB: A pen, on an A4 sheet. And colour swatches with a code.

BJ: *What computer software do you use?*

GB: We basically use CAD, or Prim-vision [?]. But also Photoshop.

BJ: *What about sketch modelling?*

GB: Because it was a luggage project we don't have pattern cutters involved. But if I were making a garment I would draw a sketch and then there's a separate pattern room with pattern cutters and it is their job to translate my sketch to a garment.

BJ: *Would you have liked to work with sketch modelling?*

GB: Not really.

BJ: *Did you use any other tool, say photography?*

GB: No, not really.

BJ: *Where in the design process did you use the tools?*

GB: In square 7 (points at protocol) I sent off my sketches to the manufacturer to make a prototype in the correct fabric and everything. And then we have a look at it when it comes back to us, with an in-house buyer, and any changes that have to be made will be made at that stage. When I draw it is like drawing a building, I draw it in indifferent aspects and in different views so you have to have all the correct measurements. So you sort of know what to expect. And it takes practice to get things right. The longer I've been working here, and it's now almost two years, the better things come back that I've drawn the first time.

BJ: *Could you do without the computer?*

GB: I could do, but it gives it more of a professional finish. Also, because it's not a garment so there isn't someone here who could cut me a pattern so I had to ensure it came back correctly to save on wasting time and money. So I used the computer so everything was right and clear so there was no mistakes.

BJ: *Would you show your sketches directly to manufacturers?*

GB: Yeah, it is often normal practice for me to go with my sketches and buyer to the manufacturer.

BJ: *But are they freehand sketches?*

GB: What I did is that I scanned my sketches in, they are fine and clear, but just to put the colours on I use the computer. And because I was using a print for this project so I scanned the print into the computer, and scaled it to the right scale, to the scale I wanted it to be produced.

BJ: *Did you design the print?*

GB: No, I bought the print, here at square 4 (points at the protocol), from the print studio.

BJ: *It is sometimes said that clients prefer the photo-realistic sketch to the more artistic sketch. Is that something you've experienced?*

GB: All the designers here sketch but the sketches are specs, they are scaled, they are not particular freehand, they are like an architect's drawing.

BJ: *But do you do loose sketching, scribbles?*

GB: Yes, that's square 5 (points at the protocol), what we call thumbnail sketches.

BJ: *So there are almost three stages of your conceptualisation?*

GB: There's the thumbnail, then the measured drawing ["spec"] and then the finished, scanned in drawing.

BJ: *What landmark events ("Aha") did you experience while using conceptual tools?*

GB: The real turning point, and although the research was helpful, was when I met with the various private print studios and I found a print that made me think: "Yeas, that's right, that's exactly what I need". And then as soon as I had that, it was easy, it was almost like designing a product around the print I bought and felt suited [the brief]. That was my landmark point.

BJ: *So it was quite a distinct moment?*

GB: Yeah, as soon as I saw it, "that's the one!"

BJ: *What were the benefits of sketching?*

GB: For me personally I find sketching much, much quicker than the computer. If I had to draw everything on the computer it would take me days. So I find it the quickest visual way to see how I want something to look, or could look.

BJ: *Any drawbacks?*

GB: No, for me sketching is really the only way I can design.

BJ: *Spoken and written words?*

GB: I don't know ... it's probably not that essential. In terms of speaking with my colleagues, conferring on ideas, it can be helpful if I'm stuck, or unsure of something, bouncing ideas off each other.

BJ: *Any drawbacks with words?*

GB: You can do something you think is brilliant, you got it, and then you show it to someone else and they can say actually "how about doing it that", and you think "Oh, no – now I have to do it again!" Sometimes it can make you unsure of yourself.

BJ: *And sketch modelling?*

GB: I don't physically model garments myself but when someone makes a pattern from my sketches then they call me and I see it on a person. So there are benefits in that you can instantly see if it needs altering or changes.

BJ: *So on a different project you would engage in modelling?*

GB: Yes, but in this project they were not able to make a model here.

BJ: *And computing?*

GB: On a normal brief I'd say that I wouldn't use a computer at all. For this brief it was obviously helpful because I was using a print and I wanted to get my idea what the print would look like on the finished product, so from that point of view it was good.

BJ: *Any drawbacks with computer?*

GB: For me because it takes quite a while to use the computer because I'm okay but not fantastic on it.

BJ: *Is this because of lack of skills or because you personally don't really like computers?*

GB: I'm learning to like it more, but it's more my skills on it. And also, among us designers here we don't use the computers that much. But if I wanted to that would be fine, but I prefer to sketch.

BJ: *Have your use of conceptual tools changed over time, from college to professional practice?*

GB: I'd say that the importance of sketches have changed. "Spec" sketching wasn't so important at college. Spec is everything here, getting it right and to scale. And although I say I don't like using the computer, I never ever used computer at college at all. Most students in my class didn't use computers at all. But we didn't really have any training on it so I think that's where the fear of computers comes from.

BJ: *So when you look back do you think you should have used computers?*

GB: Yeah, perhaps. I've made up for time by going to training courses.

BJ: *Ho do you see the impact of digital technology on conceptualisation?*

GB: It's difficult here because in this company in the design studio there's not a great deal of emphasis on computers. Everyone freehand sketches and unless we want to colour up a sketch we don't really use the computer at all. We use it for Internet access and research and things like that, but actually design-wise we don't use it that much.

BJ: *Do you think this will change in the near future?*

GB: I think that anyone of us who would like to use it would be welcomed to do so. But among the designers working here it's not a personal preference.

BJ: *So professionally you don't feel pressurised into using the computer?*

GB: No, not at all.

BJ: *Do you use graphics tablets?*

GB: No.

BJ: *If you could do the project again, would your choice and use of conceptual tools differ?*

GB: Probably not, really, because that is generally a standard way that I work on any project, that is, research first, thumbnails, speed sketching and then specs basically. A format set by the company that reflects time and cost pressure as well.

BJ: *Would you have communicated your ideas differently?*

GB: No not really. Everyone's so busy all the time so you tend to just get on with it. Because it was my brief (fashion accessory) and everybody else has so much work to do. But now I've been promoted into designing "jersey wear" so I will be working more with cloth and garments.

BJ: *Will that change the way you work?*

GB: Not really because I was already working with clothing before but now I've got my own department to be responsible for and that will include overseeing modelling.

BJ: *So you go there with a sketch and talk to the cutters?*

GB: Yeah, you have to put all the relevant information on the sketch sheet, and when they made the twill they call you to come and have a look and then you have a fitting.

[GB was running short of time so we had to end the interview rather abruptly. This was the shortest of all the case interviews].

Interview Protocol
Interviewer: Ben Jonson
Interviewee Dominic Harris
Architect (2001 Diploma Bartlett graduate)
Future Systems Architects
08.04.03. @ Future Systems studios 19.00-20.15

Ben Jonson: *In professional practice, as opposed to in college, the cost factor, the client's budget, can be a crucial factor influencing the design, both process and outcome. Did that apply in this retail project [2000 square metre flagship store for fashion retailer "New Look" in London's Oxford Street]?*

Dominic Harris: We were working continuously with project managers and quantitative surveyors, so there was a continuos dialogue with costs.

BJ: *Did that influence your work from the start?*

DH: To a degree. I'd just came off doing another interiors job at Selfridges' [at Birmingham's Bull Ring] and there again the cost was quite a control thing [a developer's budget]. So I've always been used to the mindset of working within a budget.

BJ: *So when generating ideas you were conscious of costs?*

DH: We knew we had a lump sum and in order to get something of very high quality we knew we couldn't do that throughout the entire store. We began by saying, if we take 50 per cent of the lump [sum] into ten per cent of the space what happens then. So we divided at a very early stage the brief into two parts, one which was the more artistic design side, and the other the more efficient backbone which was all about high volume retailing. And that was a move at a very early stage [of conceptualisation].

BJ: *What conceptual tools did you use, and why?*

DH: Meetings have been very important, informally around desks and kind of looking over drawings together, within the office and with the client. There were stages of the project when talking to possible sub-contractors was very important because we began looking at quite special materials. So meetings were certainly quite good for getting ideas going. And those I marked under Words [W in the protocol]. Also the other reason why they [meetings] fall under Words is that you often find yourself writing emails to summarise meetings or requesting information and when you start writing things down it forces you to think what you are asking. And in many cases, the email dialogue that follows is equally valuable, if not more important then the meetings.

Beyond that it was certainly the computer which was used as really a core tool to actually get production information that we can actually show to the client, but also a lot of the work we are doing is modelling on the computer. And it's a very quick tool to build a virtual prototype, you can get something you can use in meeting in the office as well with the client [points at Square 5 in the protocol for first team meeting, and Square 8 for client-meeting, i.e. within first week of project].

BJ: *But when you say using the computer, is that as a conceptual tool?*

DH: Yeah, I would say there're two parts to it. There's the core part of computing which is actually getting the drawings done, and for me this is a tool as a way of working. But lots of the conceptualisation was done in 3D model space using Rhino software program. I just find 3D programs on the computer very natural to work with. Not to say that I keep it just there, I often find myself printing out the views and take them into sketch format and go over it with a pen and work it out.

BJ: *Do you work with a graphics tablet?*

DH: No, just the mouse.

BJ: *So how does your computing compare with sketching? You indicate a lot of sketching [in the protocol], is that the traditional pen and paper sketch?*

DH: It's very much kind of the sketch book [shows at a thick, ring-bound "Filo fax" type of sketchbook which DH brought to the interview, together with loose computer and freehand visuals]. I just sketch bits and things. And then also sketching over printouts of the virtual 3D model. I sort of go backwards and forwards between the two. I always done the 2D related [sketches].

BJ: *Do you go from sketching to computing as well, i.e. do you scan in your freehand sketches?*

DH: Only for presentations. As presentation work I wouldn't put it [sketching] down as a conceptual design tool. For me there's a very clear distinction between what you are actually doing to resolve an idea and develop an idea in the creative aspect, and actually getting it on paper for clients. If you look around [point to rendered presentation drawings pinned onto the studio walls], getting it down on paper, even if it takes a lot of time, it's not conceptualisation.

BJ: *Do you see a distinct conceptualisation stage in the project?*

DH: I think there's a distinction. It comes in spurts, on the back of things, like good meetings; you really get a creative spurt of trying to figure out what your are doing and why. It gets very exciting. Then you've got to document it, make it work, there's a technical side to address. And that's where you'd spend quite a lot of time. It might be creative but you're really trying getting it on paper, getting it real. And as the deadline approaches the more time you'd spend just preparing the computer drawings. Also, as soon as the big deadline passed and you issued a series of drawings and then you get another kind of lax and you'd start looking at next stage where there's a lot more sketching.

BJ: *In this particular project now running for four months, is the conceptual phase over? Or will you go back to it?*

DH: No, I'd say that now we're on production information.

BJ: *So what you recorded in the protocol is the entire conceptual stage?*

DH: Yeah.

BJ: *Would you say that this is roughly the way you work in general? [Looking at the protocol and the wide distribution of tools used as depicted in the Interview protocol diagram].*

DH: I move between different tools quite frequently [points at protocol]. I always recognised that I work best when I move between various mediums, so talking to people is very important in both going through and getting ideas.

BJ: *Where in the design process did you use the tools?*

DH: In the first half, we had a very important meeting with the client, a client presentation, officially called a concept sign-up meeting, the point at which the client agreed [points at Square 52 in the protocol].

BJ: *What kind of conceptual tools were being used?*

DH: It was everything. Everything we had, we had on the table. Really an open discussion. At the meeting there was a strong idea we'd developed in the weeks before that through computer modelling and meetings with technical persons. And the idea was to have a conveyor belt to run throughout the store. And going to that meeting was kind of make-or-break of the project. And during the meeting everything just dropped and everybody was happy with it. A good example of how to work interactively with the client, very good discussion, nobody being too offensive or anything. We were taking drawings and drawing over them and crossing things out, mending your work or design in front of you.

BJ: *Did the client draw as well?*

DH: (Laughs) They tried but then they stopped.

BJ: *So the meeting was mainly in Words [W] and Sketching [S]?*

DH: No, we used sketch models as well [points to sketch models scattered around the table as well as printouts of virtual sketch models].

BJ: *What "landmark" events ("Aha") did you experience while using conceptual tools?*

DH: There's one which ... number 18 [Square 18 in the protocol]. This was a really funny one, because within the office I tend to look after the IT business, what programs we buy and so on. And I'd been given a couple of days before an evaluation copy of a new program called "Argon", which is a 3D modelling program different to "Rhino" [which is DH main 3D computing tool]. And I'd been playing around with it, and it had an extra little icon on the tool bar with which you could do something special to objects [modifying the object by rounding the corners]. And juts using that became really a key part of the design, which now, months later, is still there. And just seeing that threw up new ideas.

BJ: *New forms?*

DH: No, not so much new forms. It was a shape that had already been sketched out in detail on the computer. I knew in the back of my mind what I wanted to do but it was the ease with which this program let me do it, compared to how difficult it was in the other program. That was really a kind of "Oh, well let's do it this way then".

BJ: *When you say it was difficult could you have done in freehand?*

DH: Yeah, I could have but this was really spot-on. It was great fun. Oddly enough, at the very beginning there was … number 2 (points at protocol), a visit to Tate Britain to see a bar that a guy in the office had worked on; designing a mobile bar for the Tate. We all went down there to see it, it was a one-night event. It was a very elegant way the geometry worked together. It was a very quick project, but the Partners here thought it was good for people to see how quickly something can be conceived. So that was quite a useful thing. It got me thinking about how to fit things together, kind of making snake shapes in one object, the sort of what we were looking for, a kind of modular flexible system.

BJ: *Did you sketch the bar, or take photographs of it?*

DH: It was rapidly sketched and taken into the computer, and that is funnily what actually led to the "Aragon" software.

BJ: *So you did a thumbnail sketch on site [Tate Britain]?*

DH: No I didn't sketch on site, it was Friday so I waited until Monday.

BJ: *So you sketched it from memory?*

DH: Yeah, it got me set on a certain track. I tried to get things to be efficient, it was so beautiful how efficient it was ["Aragon"].

BJ: *So did you go straight to the computer?*

DH: No, always first with sketches.

BJ: *So generally you start with freehand sketching, a thumbnail sketch?*

DH: Yeah, it's because a number of times I've started up something entirely on the computer that I've been quite happy with but when I showed it to other people there was a quite negative response because people aren't as excited by it as you are. It's just another computer model, which is quite generic. I do tend to start with sketches, those doodles you do when you go to a lecture, or see an art show, or whatever, when you sit on the train, the kind of little sketches that get you going.

BJ: *What were the strengths and weaknesses with sketching?*

DH: Sketching is just quick. It's not permanent, it's the easiest thing to kind of throw away. It's quick-on-demand. I would say there are no drawbacks, apart from sketching is not precise.

BJ: *Spoken and written words?*

DH: A key communication tool has to be the benefit. The drawback is that it's not a drawing. But words, spoken especially, sometimes are very quick and informal, the one-minute comment at someone's desk.

BJ: *Modelling?*

DH: Modelling … useful … I don't like it very much.

BJ: *Why?*

DH: Probably to do with patience. I've never been one to do sketch models. If I do models, they are of proper white cards and because of that I'm slow at it. But the benefits are that whenever you've got a physical object like a model everybody gets involved so quickly in it. If you have [something] lying around on your desk everybody stops as they walk down the [studio] aisles and say "Oh", and play with it.

BJ: *Do you substitute the computer model with the sketch model?*

DH: Yeah, but what is interesting, and this is probably very specific to our office, is how every project ends up having a physical model that's being built professionally [the studio space is full of them, in all kind of forms, colours, sizes and materials]. For example, the little model up there [points to a card and plastic model on a shelf], is the project I'm working on. It has probably to do with the fact that the senior partner here doesn't use the computer. He's much older [Jan Kaplicky, 65, founder of Future Systems]. No matter how much we've done virtual modelling and drawing, at the end of the day he always want to have the model made. So a model is always made.

BJ: *Do you feel this is a generational thing, i.e. a younger team would be happy to do it just virtually?*

DH: If you're working with young clients, yes. Or people who are willing to look imaginatively. But the model gives you something very concrete that everybody can look at, and everybody can look back to when they had little play cards. They can understand the scale idea.

BJ: *Do you perceive there's a slow change going on in that a new generation of architects and clients will more readily accept what is screen based and virtual?*

DH: Yeah, but I think sometimes it can be quite dangerous at the early stage of conceptualisation. Because you can end up finding yourself stuck in a corner where you always have to produce photo realistic renderings on the computer, at a stage when you are not ready to do that. And you are trying to address the core ideas of a scheme and you show someone a rendering when they are beginning to judge things by the broader picture. But instead they are honing in on specific details, which is not what you want to talk about.

BJ: *Do you feel clients encourage that? Are they pushing for photo –realistic imagery?*

DH: Yeah, but we try to direct the client in two ways. First, we will show them elements, so if we got a very specific thing we want to show them that is a computer image, but then we stop them from continuously demanding more images by charging for them extra. You don't want to tie up resources. It's a small office, 20 people, and maybe six or seven people working on this project and to allow for computer images to be shown to clients can take two weeks. You don't want to end with having to live up to all the renderings.

BJ: *And benefits and drawbacks with computing?*

DH: One drawback is client expectation of having [computer] images, the other is stability of the computer system. If something crashes, the server goes down, to me that's really, really a severe drawback. And I've seen the effects of data loss. So until we've got more reliable systems that's always going to be a drawback. It's just the uncertainty, for example you come to do some work on a weekend prior to a Monday meeting and you can't log onto a computer. It's terrible…. The benefits are flexibility and speed.

BJ: *Also at the ideation phase?*

DH: Yeah, absolutely. To be able to do a really quick 3D sketch model and send it to an engineer at the most early stage, and say, are we going down the wrong road here, or, with time, do you think we can make this work?

BJ: *So you don't feel the computer constrains your work?*

DH: I know a lot of people do feel constrained but I don't. I'm really comfortable, especially with the 3D modelling environment. Some people get frightened more by 3D because it's more complicated. To me 2D is frightening, to continuously do drawing in diagramming mode rather than doing something more real. AutoCad to me very often seems like an academic exercise. You got a 3D model in your mind and then you go through this dumming-down stage when you got to flatten it and get it onto a series of drawings only to have the contractor, or client or whoever is going to look at it, not understanding it. It's terrible. The work I do is 3D based, how I can do controlled geometry and something that is buildable within a 3D model space. When I think conceptually it's really the natural place to be.

BJ: *Have your use of conceptual tools changed from college to professional practice?*

DH: There's no change. Honestly ... if I look at this diagram here [points to distribution tool diagram in the protocol], I'd say that anything that happened to me is that now there are more Words [W] and more going backwards and forwards between sketching [S] and computing [C]. For my Diploma project I was working mainly on my own, and from home.

BJ: *What has influenced this shift?*

DH: I think the client and office environment.

BJ: *How do you see the impact of digital technology on conceptualisation?*

DH: I think it is very damaging to some people. But I'm very happy with it. If I'm given a conceptualisation task to do, a competition or something to do with a new look, it's natural for me to go backwards and forwards between sketching and computing. They compliment each other. I don't think that's going to change. With more technology, say 3D printers, I think people will take to more modelling with plasticine. I think there's a very positive outlook for using digital technology as well as sketching.

BJ: *If you could do the project again, would your choice and use of conceptual tools differ?*

DH: I wouldn't [laughs]. The one thing I would change for this particular client is more physical modelling because that is what they really responded to. But I tend to fall back on computer modelling whenever I can.

BJ: *Would you have communicated your ideas differently?*

DH: Other than a couple of physical models, no.

BJ: *Do you see yourself as having a fairly well established working pattern?*

DH: Yeah, I can always visualise the way I work. It's always the same pattern. You have a meeting, you discuss or go and see something, and that's where I really get the ideas. But then, in the architecture profession, you have to do something with that. So you have to go into computing using CAD. I wish more people could work 3D, to be the [industry] standard rather than 2D. I don't believe strongly in standards but that would help communication also at the early design phases when we are really throwing ideas around. But you are almost forced to choose one route [2D or 3D].

BJ: Do *many of your office colleagues work similarly to you?*

DH: Many work in a similar way, but probably using less words than I do. I spend a lot of time with clients. Some of my colleagues may prefer more physical modelling as there's a lot of that going on in the office. I think the pattern of going backwards and forwards is very characteristic.

BJ: *What did you learn from taking part in my research project?*

DH: I was surprised to see in the Interview protocol diagram that I didn't indicate more instances of personal preference for using the computer [Reasons why tools were chosen]. Yeah, it's been very useful (DH photocopied both protocols for his own record).

ADDUM:

QUOTES from Interview with Jan Kaplicky and Amanda Levete [Future Systems' partners]; in ICON Issue 1, 2003, pp 58-64.

JK: 'You have this nightmare for three years – will this work? Will that work? You can have millions of drawings and millions of models but the reality is the only thing on which you are judged' [[on seeing the hoarding coming off Selfridges, Birmingham].(Kaplicky 2003:59)

How did you arrive at the form [of Selfridges]?

JK: This is the critical thing [he shows a photograph of a small, crude plasticine model]. Nothing changed between this [model] and that [the building]. Models are very critical. This was done by me physically' (ibid:61).

You make formal decisions on such a complex building based on a little sketch model?

JK: You usually know roughly what it is you want. You have a very strong first idea and it's all there. (ibid:61).

On new work:

JK: 'We are doing coffee sets, cutlery and china and goodness knows what else [for Alessi]. You can say it's less important because it's a smaller scale. But you can get into great difficulties on a smaller scale. ... Small is very difficult – and it can be more important. I mean the most difficult thing in architecture is the chair – and we never tried that! A table is bad enough, but a chair is en times worse. But a coffee cup – you can make a contribution there (ibid:61).

On comparison with Archigram:

JK: 'Their work [Archigram] is still inspirational but there is a fundamental difference that people don't understand. That everything we draw is, from the beginning, buildable' (ibid:62).

On different ways of doing architecture:

AL: 'Having someone [Anish Kapoor] who's outside of you who's such a powerful creative force makes you reassess your methods and your ways of thinking'. ... 'Artists do have a different sensibility. It's a way of working that is much more radical. It's trying to throw out all the pragmatics. It's so easy to get trapped by the functionality, the realisability, the practical aspect of something. What he's really made us do in the projects we've collaborated on is throw that out of the window, forget what the material is, and instead just talk about form, the why, the what.' (ibid:61).

Interview Protocol
Interviewer: Ben Jonson
Interviewee: Fabiane Perrella
Designer
Fabiane@ourflour.com
O2.10.03; 14.00-15.00 @ Goldsmiths College

Ben Jonson (BJ): *What conceptualising tools did you use, and why?*

Fabiane Perrella (FP): I used all of them. I don't know, it's how it happens. It's an extension of me. I don't think about it.

BJ: *Where in the design process did you use the tools?*

FP: Speech is the thing that comes to me throughout the design process. It's very important on development of any idea. I most of the time hear myself talking over and over, and to people, listening to myself and how my project is going. Often I think about what I hear from people in questioning my own purpose and motivation.

BJ: *You started with using words (W) in Square One, but also using computing (C)?*

FP: But that's an extension of words. It was Internet research, of the possibility of having it made. Instead of asking someone, you ask the Web.

BJ: *You communicated both in "I" and "We", did that involve other designers?*

FP: Yeah, I talked to people all the time, all day long. Not necessarily designers, just everyone.

BJ: *When you recorded sketching with other people ("We"), how did that happen?*

FP: Whilst I was talking I used sketching, a way to illustrate the words.

BJ: *And the workshop visit (look at Square 13 in the protocol), you used sketching (S), words (W) and computing (C).*

FP: I went to see how metal sheet can be shaped, and also asking the people working there how my idea could be working. To find out whether they know more or less than you. They always have something to add.

BJ: *In Square 16, you recorded computing (C) as a conceptual tool. Was that "thinking with the computer"?*

FP: I was just sketching on the computer and how I could visualise it.

BJ: *What software did you use?*

FP: I was just playing with "Illustrator" creating shapes and trying to make it ... I started to look at how I could present my idea in an image, and I was looking at animals. That it could represent where the idea was coming from. If I had to send a press release about it I didn't have to send the object. So it was a composition of images that could represent what I was trying to talk about.

BJ: *Did the computer help you to conceptualise, to generate ideas?*

FP: Not to generate ideas. The idea was already there. It was how to communicate the idea.

BJ: *Was the computer then a presentation tool?*

FP: No, it was about finding a way of communicating the idea that was difficult to communicate.

BJ: *What "landmark" events ("Aha") did you experience while using conceptual tools?*

FP: Right in the beginning. Even before Square One. It triggered the whole project. The first idea came from the fact that I love diggers. I wanted to create a project with a digger. To shape the metal with brute force, where the arm of the digger was hitting this sheet of metal. How can I bring [the digger] into the design process? And I thought THAT! If I could relate that to a building site, so I could have it engraved on the [metal] bowl. For example, if we had a digger on the "Gherkin" building [Swiss Re by Foster], this digger could engrave the bowl 2003. The line could easily be an object that could be auctioned and collectors could be interested in pieces like this. But why only diggers, I could have people doing this. The visitors of 100% design 2003 jumping on the bowl, and after 1000 people had been jumping on this bowl I could just engrave "visitors of 100% Design of 2003).

BJ: *So how did this idea come about?*

FP: At one dinner.

BJ: *So we should have Square minus One then? What tool did you use?*

FP: (Laughs) Thinking! First on my own and then talking with people who had the same enthusiasm as I. I cooked at my place, and I asked people "what do you think"? And this object could be beautifully finished and showed in a shop window at Liberty's.

BJ: *What are the strengths and benefits of the conceptual tools?*

FP: Sketching is a tool to visualise, because what is otherwise just air, unless it goes to the paper.

BJ: *Are there any drawbacks with sketching?*

FP: I don't think any of them [conceptual tools] have drawbacks.

BJ: *Words?*

FP: Hearing yourself talking. When you don't make sense you can actually hear it. It doesn't have to be pointed out by someone else. I used to record my own conversations and then listen to it. When you tell someone else what you are thinking they will have question about it. And those questions are what you start to work with that is not just talking to yourself.

BJ: *Modelling?*

FP: You just can't from an idea into something without going through an intermediate stage of modelling. The realm of ideas and realm of objects are too far apart. The model is between them.

BJ: *And then Computing?*

FP: The computer is another tool of visualising. Also a tool of research, the Internet is an enormous source of information.

BJ: *Do you see it as an ideation tool?*

FP: The computer doesn't give me any ideas, but neither does drawing, or anything else. Every time you add information to your puzzle it takes a different shape. The computer is a tool to help this idea, or ideas, being formed. They are not originators or ideas, neither are sketches or modelling. They are tools for communicating.

BJ: *Do conceptual tools help communicating a solution to a design problem?*

FP: But then you're talking about a design problem. Design problem, in my opinion, is a very outdated view of generating design motivation. I mean, no one needs a bowl shaped by a digger. No one needs more chairs. We are in some sense eroticised by the creation of new ideas.

BJ: *Have your use of conceptual tools changed since you left college?*

FP: I spend more time on the modelling. It is [The tools] improving all the time. You work a lot more compared with college. At college I could have done a lot more on my own, using the tools more.

BJ: *How do you see the impact of digital technology on conceptualisation?*

FP: I didn't exist before it so I can't see without it. It's not going to be more important but more present. I think it is a good tool to communicate with. It is easy to communicate with, to produce work, to reproduce, to copy.

BJ: *Do you find that you go straight to the computer?*

FP: From where? It depends what I have to do. Perhaps the first thing I do is to talk to someone. But it could happen.

BJ: *If you could do the project again would your choice and use of conceptual tools differ?*

FP: I don't consider it finish. I'd like to take it back. I think I would, at a more early stage, liked to have a digger, and the person who actually operates it. That was what was my motivation.

BJ: *Would you have communicated your ideas differently?*

FP: No!

BJ: *Did you get something out of the protocol?*

FP: In what sense? ... Actually, to be very honest, I felt that when I started I would be very curious about what tools I used the most. But because of this organised way of how the process happens it was difficult for me to conclude going back to it. If you had a frustrating [work] session you don't want to think about it ...grrrr...go away! If you had a very exciting result you wanted to jump, not sitting down filling in squares. Taking those ten minutes reading what the codes mean, it's not part of it. It's too artificial. In that sense, I found it difficult to find the discipline to do it [the protocol] longer than the three weeks I did.

BJ: *Was the protocol difficult to fill in? Did it take too much time?*

FP: No, it was too rigid. And artificial. But understanding of how it works is fine.

BJ: *Could you have improved on the protocol?*

FP: It could have been a more organic format. I don't know what kind of record you want. I wasn't drawn towards it.

BJ: *So it didn't help you, didn't make you aware of conceptual tools?*

FP: No, not really.

BJ: *Is it fair to say that the way you work is very much a personal style?*

FP: Is there anyone who works in a way that is not personal? From what we've been talking about [the protocol], it doesn't reflect my process. It was too rigid.

BJ: *Do you think you have your own one process, or does it change from project to project?*

FP: It changes from each project. It also depends if I'm working on my own or part of a team.

Interview Protocol
Interviewer: Ben Jonson
Interviewee Robert Thake
Product designer (2001 graduate; Leeds University)
Conran Design Group
23.09.03. @ Conran Design Group 14.00-15.00

Ben Jonson: *What conceptualising tools did you use, and why?*

Robert Thake: Mainly discussions or words (W) because we are not at the stage of designing anything. We are just conceptualising and working out why and what approach to take to the project. As a pitch we felt we didn't want to design something. We were trying to convince the [potential] client how our views and ideas would meet their future of the retail environment.

BJ: *So it was purely verbal, no visualisation?*

RT: There's no visualisation with sketches. You can get a feel of what kind of environment we're trying to introduce with me putting three or four images in front of you, and your opinion of that as opposed to me sketching. I mean I could sketch an environment for you but then I think I would consciously putting a mark to paper in my mind I'm designing it, which is not what we want. We want to try to create a feeling, an understanding of where this retail environment is going to go.

BJ: *But you are using the computer as a conceptual tool (looking at the protocol)?*

RT: More as a presentation tool. Conceptually, I mean, there're no computer drawings. It's only used as a tool for communication.

BJ: *Did you use ready-made images?*

RT: Yes.

BJ: *Could you see that as part of conceptualising?*

RT: Absolutely. Conceptually you are using the images to back up your ideas without designing something. Your selection [of images] is critical.

BJ *When you say words, do you mean both written and spoken words?*

RT: Yes, both. In discussions not only with yourself but with other people, within the team and in the office. Generating ideas personally and then in discussion with others. Discussing various outcomes. So even though we haven't designed anything, or put pen to paper in a sketch format, there are a lot of elaboration of ideas what it could be. But you have to hold yourself back, hang on, you are still trying to generate ideas as opposed to designing. That's the approach we think is necessary to take at this stage.

BJ: *Do you make a distinction between conceptualisation and designing?*

RT: Yes, what is conceptual to me is something in your head that you try to communicate. By making mark on a piece of paper I'd be thinking straight away [from the brief] what you think it might be. What format is this store going to take, how is it going to be used by what customers and you start introducing ways of achieving that. So in that respect that's designing it. Conceptualising is understanding why you want to introduce those designs, understanding what the client needs, what the customer needs. Working out the reason behind the project as opposed to just say what we are going to use for materials. It's quite deep, but there's a big distinction between the two.

BJ: *Where in the design process did you use the tools?*

RT: The words are at the start before you turn on the computer just to get ideas flying. The first session (pointing at square one in the protocol) was a review of the existing store and then there was a discussion on how we were going to approach the project, what we actually were trying to achieve by doing this pitch. The in the afternoon [second session} I was writing ideas and routes it could possibly take.

BJ: *Then in the third session you start using the computer (looking at protocol)*

RT: Yes, searching the Internet, image banks.

BJ: *So you were looking for images to match your words?*

RT; Yeah, not the other way round.

BJ: *And that continued throughout the sessions, using words (W) and computing (C)?*

RT: Yeah. I start putting it together on the computer as a form of presentation and then go back to other colleagues to discuss further as a group with those ideas and getting a feeling with the images what sort of environment we were looking at.

BJ: *What "landmark" events ("Aha") did you experience while using conceptual tools?*

RT: I don't think that was relevant to this initial stage. If there was, it probably happened in the early meetings because of the wealth of knowledge and experience. Three directors sat in on the first meeting. The words I wrote in the afternoon from that morning meeting were extremely influenced by what was said in that meeting.

BJ *Did you meet the client?*

RT: No.

BJ: *How big was your brainstorming meeting?*

RT: There were six people at that first meeting, two [of whom] had met the client. It was an audit and a brainstorming at the same time. Using images from the existing store. And then everything else was just words.

BJ: *No flipcharts, scribbling?*

RT: No, just words and personal notes. I think "Aha" moments would be when you come across problems when you start designing. When you start, right, we've come up with this concept. We're still in this pitch, we haven't presented a concept, we just presented the way in which we would work and the way we would approach the project.

BJ: *So you didn't present a number of ideas as such?*

RT: No, it's more about where we think the future of their retail environment is going.
What the business is going to be a year down the line, what the market is going to be in five years' time.

BJ: *What were the strengths and weaknesses of the conceptual tools?*

RT: Weaknesses with words, it can be quite a drawn out process. Personally I find it very easy to write down ideas and you find you end up with three or four pages of writing and a lot of it is irrelevant. It might only be three or four words that you pull out of that. Which may be a good thing. But it's actually having the faith to pick out what is essential. Personally I find myself writing and then re-reading and editing it.

BJ: *What about talking?*

RT: Talking is very good because it's nice because talking come through peoples' experiences. It can soon change someone else's approach to something in an instance and ... when you're stuck all you need to do is a word that might lead you in a different direction. To me that's essential to the way I work. I talk to someone for five minutes to get a different lead of something because you can find yourself going round and round in circles through your own mind with things. And as soon you present problems to someone else they might have a different spin on that. You can spend a lot of time talking and you can find, you get to the point where you stop talking and put pencil to paper. Sometimes I've been siting around the table for a whole day and you think "Oh God, we wasted a day!" But you haven't at all. And the next day you don't realise how many ideas you have generated even just listening and talking amongst yourselves, even over a drink at lunchtime or in the evening. Without scribbling. When you not consciously think about putting things to paper it's quite nice, you are much freer.

BJ: *So in this project you didn't at one moment miss sketching (no sketching activity marked in the protocol)?*

RT: No because you think if the project is going ahead that stage will come. There was an instance when I did think should I sketch what the [[retail] environment might be. But, on reflection, at the time, I don't really know what it's going to be like. I haven't really thought about it enough to sketch.

BJ: *So there was no impulse to sketch?*

RT: I didn't feel I had enough information, enough of the concept to think that I wanted to sketch.

BJ: *Yet you said at the beginning [prior to the audio-aped interview] that you find sketching a core conceptual activity?*

RT: But you have to think this is only a week's work. If we had had a response from the client tomorrow [no feedback at the time of the interview], we'd be spending half a day discussing what to do and I'd probably been sketching straight off in the afternoon. So in this instance sketching was not essential.

BJ: *What about benefits and drawbacks with computing?*

RT: Benefits, it's very quick. Very easy to source images. Again, you have to be very selective, and conscious of what image you're putting down on paper and whether that puts the right message across. It's a very quick method of presenting something, and being able to show both written words neatly and images as well both internally within the company and to clients.

BJ: *So the images were for presentation?*

RT: Yeah.

BJ: *Any drawbacks with computing as a conceptual tool and medium?*

RT: Sometimes you think there are no drawbacks. At the end of the day it's just a tool. And there can be the time when you think your time is being taken up with it.

BJ: *Do you think that the computer can be driving the design process? For example in selecting images?*

RT: Yeah, a lot is determined what is in the database. As opposed to me going out with a camera and taking photos of things I'd find would speak of ideas. It would be a much better result but due to time restrictions and the ease of the computer and the quality of the images [on the database].

BJ: *So if you were to walk about in Clerkenwell [where Conran's offices are located] with your camera for a couple of hours ...*

RT: Probably would have got a different result.

BJ: *So what stopped you from doing that?*

RT: It's a routine I guess. The office environment. Not so much in telling me what to do, it's a lovely idea [to take my own images]. I didn't think about it at the time. On reflection, it would be a lovely way to do it.

BJ: *You may see why I'm asking this question because this is very much the college approach. In college you'd be doing these things.*

RT: Absolutely. You're restricted to the four walls here.

BJ: *Is that imposed by yourself or the office?*

RT: It's imposed by the general environment. It's nice to break the mould to do something like that and get an interesting result. I think people would respect you for doing it. In this office there's nobody who'd be holding you back for doing that. But it's having the foresight to do it. And also the skill to actually pull it off. To snap away an image you wouldn't get the same result, the result you'd require. It's a skill, photography, even with a digital camera. With the images sourced in this presentation are extremely professional. It's about confidence in your own abilities. And you can see straight off that these images are of good quality, in composition and subject matter, extremely interesting, they speak volumes as an image.

BJ: *Have you use of conceptual tools changed over time?*

RT: No, it's always been there. Your confidence in your own words, voice and ideas. Having the confidence to express them.

BJ: *Have your use changed since college days?*

RT: Now I use the computer a lot more. My sketching has suffered, but then my approach to a project might have changed as well. My approach to concepts has matured. I think I'd would have jumped to conclusions at college.

BJ: *Do you feel a distinction between designing for the "real world" when at college and when in professional practice?*

RT: Personally I feel restricted by [business]. You are very conscious of not to let it happen.

BJ: *Do you do any modelling at all?*

RT: Absolutely, we do a lot but for this project we didn't need it.

BJ: *How do you see the impact of digital technology on conceptualisation?*

RT: It's a very difficult one because anything that is digitally created on the computer has been programmed by someone else. If I drew a 3-D object on the computer, the way it appears on my screen has been digitally programmed by someone else. Someone else's decision on colour. It's limiting, that's what I'm saying. It is decided by "Apple" (laughs). In that respect it's disheartening to think that my limitations are the limitations by this tool. The computer is a tool and I always remind myself of that. And as brilliant as it is, if I draw something on the computer as a visual it may visually be impressive and it may be my idea but it is limited by the program itself.

BJ: *How do you see the future use of the technology?*

RT: I think you have to accept it. But there's always be a need for sketching.

BJ: *Yet your project is conceptualised entirely with words and computing? Is this a future thing?*

RT: For the initial stage it could well be. You can achieve a lot with words and computing. I'm happy to run with digital technology but there's a part of me that enjoy drawing and I think that'll never leave.

BJ: *But is the computer not just a tool but also a medium in the sense it affects the ways we look at the world?*

RT: It does, but it's a distorted image. It can be tampered by anyone. The way I draw a box on a page (draws a box on the sketchpad in front of him), is completely different to the way you'd draw a box on the computer. What I drawn on this page is a reflection of myself, someone else could read into that. If you and I were to draw a box each on the page there's something to talk about. If we both draw on the computer it's going to be exactly the same. So there's a lot of feeling, and mistakes. That box I'd drawn there [on the page] I haven't joint up the line, or overlapped that corner. That's something romantic about it as opposed to something on the computer. So there's life in the pen yet! (laughs).

BJ: *If you could do the project again, would your choice and use of conceptual tools differ?*

RT: Yes, simply from this discussion I'd taken the camera out and walked round. As far as sketching, I wouldn't have used it at this stage. We're not designing it yet, just ideas.

BJ: *Would you have communicated your ideas differently?*

RT: No, purely because of the client's needs. There was no presentation, the document was bound [we flip through it, an A4 landscape spiral bound containing some 20 pages of headlines and key words and computer images]. I personally designed, printed and bound it

BJ: *What did you get out of the protocol*

RT: It's nice to see how much I've achieved in a week's work. I feel I could move it on further, and not just using written words and sourcing images. So it's been a useful tool in analysing the way you're working.

BJ: *Did you become more aware of conceptual tools?*

RT: Yeah, you lose track of time when you use computers. How long you actually spent on it.

BJ: *Was it easy to fill in. Or was it time-consuming?*

RT: No, not at all. Very easy.

BJ: *Did you do it at the end of the day?*

RT: End of the day, or every couple of days. Just a reflection of what I'd done.

APPENDIX F4
Interviews Y 2 students

(Interviewees listed in alphabetical order)

Interview Protocol
Interviewer: Ben Jonson
Interviewee: Clare Cunningham
Goldsmiths College
BA Design 2nd Year
13.12.02 11.30-12.30

Ben Jonson (BJ): *What was the design task about?*

Clare Cunningham (CC): To find design solutions for urban cycling. We had to produce 3 concept solutions, so I came up with one for urban commuting, and two for safe school routes.

BJ: *What conceptualising tools did you use, and why?*

CC: (looking at the Protocol chart) I did research into developments already made. There are web sites for encouraging people to cycle. I looked at a few books.

BJ: *Did that come under Words in the Protocol?*

CC: Yeah.

BJ: *So you used the Internet?*

CC: Yeah, I used it quite a lot. Web sites seem to be the big thing in urban cycling.

BJ: *And you treated that as Words, not Computing?*

CC: Yeah. And having group tutorials for the project. They were quite useful for conceptualising.

BJ: *What about Modelling, Sketching and Computing?*

CC: Sketching, well just drawing, trying to understand the way bikes look because the design solutions I decided on were to do with encouraging children to cycle so there are graphic types images that would be attractive to young people. The other one was designing a briefcase that could fit onto the bike so someone who need to bike to work could carry it, and it would detach. So I sketched that out.

Computing was ... I found I couldn't use the computer to draw well so I was looking for doing some Flash animation.

BJ: *So that was using the computer as a conceptual tool?*

CC: Yeah.

BJ: *What kind of applications did you use?*

CC: I used PhotoShop to just import pictures, photographs of people cycling. And then I used Illustrator to make drawings over the top so to try to understand how images of bikes look when you put them into a kind of cartoon look.

BJ: *And that couldn't be done in any other way?*

CC: I could have done it in PhotoShop and just use filters but I liked to draw it myself to try to understand how the dynamics worked.

BJ: *Did you do sketching?*

CC: Yes, I did some sketching as well. It's a kind of three-way thing. I used photographs, and then computer and then sketching.

BJ: *You said that you used the computer because you couldn't do without it (looking at the Protocol chart).*

CC: Yeah, because if I want to make these sorts of images I need to use the computer, to import them and draw over the top.

BJ: *You also indicate in the Protocol that you use both computers and sketching for reasons that you couldn't do without them but also because you liked it? Was there a balance between the two?*

CC: Yeah, I suppose you could say that I like that sort of work. In order to do that I can't do without computers or sketching.

BJ: *Was one more important than the other?*

CC: I think it is more important that you like it.

BJ: *And which tool do you then prefer?*

CC: At the conceptual stage it would be sketching. With the computers it is more doing the donkey work. But sometimes it makes the process quicker, just to change, look at an image and then be able to change it in some way without it taking an hour or so to draw it.

BJ: *And does that help you in conceptualising?*

CC: Yeah, just to look at different colours or lighting effects or different styles of graphics. It is now mainly a graphics project and so to be able to just quickly look at different types of graphic images that I can produce and then see which will fit in best with what I try to put across.

BJ: *You also put it in the Protocol graph that you use words because you couldn't do without it and because you like it.*

CC: Yeah, I couldn't do without it for all the research I did, also talking to people, to get ideas of them, and talk about my ideas.

BJ: *When you say people ...*

CC: Tutors and other students.

BJ: *Did the assessment criteria also influence you uses of tools?*

CC: Yeah, because when you get assessed the tutors look at things so you need to have the sketches, you need to have the research, if computing you need to show the printouts.

BJ: *Sketching doesn't seem to be influenced by tutors and peers (looking at Protocol graph)?*

CC: No, because that just working through myself, talking with people with what interests me most.

BJ: *For this project there seems little modelling?*

CC: Yeah, I decided it was going to be mainly graphics.

BJ: *Where in the process did you use conceptual tools? It seems to be fairly spread?*

CC: Yeah, I sort of conceptualised all the time as the projects developed. You just not leave it, you just have to keep trying to find new ideas or new ways of portraying or new solutions to whatever it is you are trying to say. I think conceptual tools are used up to the end, until I present it.

BJ: *What landmark events ("Aha") did you experience while using conceptual tools?*

CC: It was when listening to people talk.

BJ: *Did you pinpoint any particular instances in the grid?*

CC: Yeah (pointing at session 30 marked in the grid and as a footnote). It was Terry (tutor) giving a lecture [group meeting] about design and how it would be looking in the near future, how an object might be in the future, almost working backwards. I thought that was quite relevant in this project because it is quite an organic thing this urban cycling. It's going to spread to other cities, or maybe not. I don't know. So you could look into the future and in 50 years time maybe there will be roads for cyclists.

BJ: *Did that trigger off a change in direction for you?*

CC: Yeah, a little bit because I was still trying to think on a larger scale. That was a Eureka moment but might not have come to anything because I might change it up to the present moment and it was still about encouraging people to cycle. But I suppose when I came up with the idea for the briefcase, I was looking into the future.

BJ: *And footnote 39 seems to be another "Aha" moment?*

CC: That was when we also sat around as a group talking to the tutors and just looking at other people's work what they've been doing the way they've been going about it. It just inspired me because just seeing other people's solutions or ideas how to cycle.

BJ: *Did that influence your own work?*

CC: I don't know if it changed it, but it gave it a bit more structure so I could draw other ideas or concepts.

BJ: *Then there is a third instance you marked?*

CC: Yeah, number 45 (in grid). That was again when we spoke to Kate (tutor) and she gave us each a small assessment. She told me I needed to be a bit more focused with the kind of images I was portraying and make sure they were right for the age group I was looking at or was trying to promote. And that gave me a bit more structure to my ideas and I thought, oh yeas, I could do this way and do that.

BJ: *So all those instances took place when you were talking?*

CC: Yeah, and listening.

BJ: *So when you were working on your own you didn't come across any particular moment where there was a breakthrough?*

CC: No, not particularly. It was one of those projects that was difficult to come up with some really innovative ideas just because the fact that so much has been done on urban cycling already and that doing research confirmed that. So it was more from talking to people, maybe this, maybe that, that I could that.

BJ: *What were the strengths and weaknesses of the conceptual tools you used?*

CC: The benefit of sketching is just putting on paper what is in your head, in an image, a picture. The drawback is if you don't have much drawing skills, if you can't draw something out of your head, which is something I can' do, I have to get lots of pictures to reference from

BJ: *And Words?*

CC: The benefits are there is an infinite amount of things you can say or read about.

BJ: *Any drawbacks?*

CC: You can't read everything!

BJ: *What about modelling?*

CC: The benefits are you can understand and it can help get a better perspective of things in three dimensions. The drawbacks are skills and materials available.

BJ: *And Computing?*

CC: The benefit with computing is that you can cut corners in terms of it might take you a long time to sketch. The drawback is that computers crash, and you can't get on them on the course. The facilities on the course are crap.

BJ: *Did you use any other conceptual tools?... Photography?...*

CC: No, I didn't.

BJ: *Have your use of conceptual tools changed between the first and the second year of the course?*

CC: I don't think so. Maybe I'm doing a bit more research than I've done before. But I'm trying to change it because I need to do a lot more sketching.

BJ *How are you going to go about that?*

CC: I started a small sketchbook, just sketching any idea I have, and that's kind of helped.

BJ: *Is that on your own initiative, or you've been told ...?*

CC: No, no, I just decided to do it.

BJ: *How do you see the impact of digitisation of conceptualisation?*

CC: Well, that's quite a big question (laughter). I think it can open a lot of doors to information your might not have been able to access before. And I think it can cut a lot of corners.

BJ: *If you could do the project again would your choice of conceptual tools differ?*

CC: I might have used photography a bit more, but otherwise, no.

BJ: *Would you have communicated your ideas differently?*

CC: No.

BJ: *Anything else you'd like to add about your use of conceptual tools for this project?*

CC: I suppose it has made me a bit more aware of my conceptualisation, which is a good thing because it is good to distinguish between conceptualisation and then actual production.

BJ: *You said earlier that you didn't draw a strong line between conceptualisation and finalisation?*

CC: I think you have to conceptualise continuously to make a rounded design idea. If you stop conceptualising too early you might stunt ideas that could be developed.

Interview Protocol
Interviewer: Ben Jonson
Interviewee: Edward Finney
Central Saint Martins College of Art & Design
BA Fashion 2nd Year
Etwfinney@hotmail.com
@ CSM CXR
December 12, 2002; 4-5 pm.

Ben Jonson (BJ): *What conceptualising tools did you use, and why?*

Edward Finney (EF): Tools used were mainly pencils, pens. I used cameras, photocopiers (indicated as C = Computing in the Self-analysis protocol). When I first started my research I took photos of machinery, and by the end I took photos of my model wearing my print.

BJ: *And why?*

EF: Out of necessity. And because I prefer them (marked "a" and "b" in the protocol grid), and, towards the end, because of the assessment criteria (marked "d") because I went back to the brief by the end rather than looking at it all the time just to make sure it was fine. I couldn't do without taking the pictures because I couldn't make a print of them out of my head. So I needed some source. And because I like it is the reason why.

BJ: *Where in the design process did you use the tools?*

EF: A little in the middle with a lot at the end and at the beginning (see grids).

BJ: *So you did conceptualise to the very end?*

EF: True.

BJ: *So how did you find time for the final artefact?*

EF: It wasn't a rush because I had it all planned out. I knew was I was going to do, I knew there was a times schedule how it was going to work out. Some mad ideas right at the end. But it all worked out fine.

BJ: *What landmarks events ("Aha") did you experience while you used conceptual tools?*

EF: Sessions 20-24 (points at grid references in the protocol) were quite interesting because the whole brief was based on a repeat print. And because my images were symmetrical anyway I didn't do a cut-through, which is a process cutting with paper and making sure that when you repeat the patterns go together. I didn't do that. I just pulled it off. It just worked.

BJ: *What tools did you use there?*

EF: Experimentation with prints, so it was all modelling. It was working hands-on all the time. Nothing else.

Another ["Aha"] one was 43 to 44 (points at Square 43 and 44 in the protocol), where it wasn't a [brief] requirement, but I cut a shirt. I had a lot of material left over to use, so I did that. It was just an idea I thought of.

BJ: *So by actually engaging with the material helped you?*

EF: Yeah. Also, financially because you spend a lot of money on material. And why not making something out of it instead of it just lying on the bedroom floor.

BJ: *So you wanted to make the most of the material you had?*

EF: Definitely.

BJ: *Any other special events?*

EF: The last, you can see [on the grid] it is all in pencil.[points at Square 86 in the protocol]. The day before the crit.

BJ: *Yesterday! [the interview took place in the afternoon on the day of the crit]. What happened there? A "Eureka" moment, in the bath?*

EF: [laughs] I wish I had a bath, didn't have the time. Because you are constantly working finishing things off you start generating more ideas that's why I decided to suddenly make some trousers. And I made it that day [yesterday].

BJ: *What triggered off that "Aha"?*

EF: It was in my design because during the day I'd been sketching and doing up my whole book [for the presentation]. I did about 45 [sketch] designs and then suddenly thought trousers can't be too hard to make. So let's just make the trousers. So I came here [to College] and made some trousers.

BJ: *And that came out of actually being engaged in sketching?*

EF: Yeah, definitely. It was tough because I had a lot more to do ... Six illustrations ... finishing off some samples. And I thought why not make some trousers. I love making, as much as I love printing.

BJ: *What were the strengths and weaknesses of the tools?*

EF: Benefits of sketching is that it is quick, you jot down your ideas. Drawbacks might be it is not as neat as some people would think. Especially if it is a quick process it is not going to be to a standard.

BJ: *What about spoken and written words?*

EF: Other than today, I don't really talk about my work in general. The only time I do it is to sum it up in a page. But not in this project though. I think pictures can tell you more than words do. And it's not for me to decide, it's for other people as well. But I talk a lot to my tutors. But in this project I didn't talk to the tutors until today [in the crit]. At the beginning she [the tutor] gave us the brief and told us you didn't have to communicate with her. So she was only in twice, today, and at the beginning.

BJ: *So you've been running with the ball on your own throughout?*

EF: Yeah, of course.

BJ: *Why of course?*

EF: Yeah, I'm used to it. I don't really bother to speak to tutors all the time. In the first year we were more nurtured, there were a lot more teachers around to help you. Now you just get on with it.

BJ: *Is that part of the curriculum?*

EF: I should think so. But I don't know. This is only my first term.

BJ: *And modelling?*

EF: The benefits are that you can see it. You can't design something without modelling it. You can design something and leave it, or you can model something and see it for real. And there is much satisfaction for making.

BJ: *And computing? The brief specifies that you should refrain for using computer generated images.*

EF: I didn't use any computing but I use photocopier, which I marked with C in the protocol. Benefits are the same as with sketching: Quick. But you can also get some really nice results, and effects. And it can look a lot slicker as well.

BJ: *So you use the photocopier as a conceptual tool?*

EF: Yeah, for illustrations.

BJ: *So you photocopy your own sketches?*

EF: Yeah

BJ: *And scribble on top of the copies?*

EF: Yeah, sometimes, but not for this project. I was going to but I didn't. For this one I basically made up a collage, photocopied all my fabrics so it looked nice for my presentation.

BJ: *So it was more like a presentation tool?*

EF: Yeah.

BJ: *And the use of cameras?*

EF: That was a development tool, and presentation. Development and research at the beginning, presentation at the end.

BJ: *Have your use of conceptual tools changed over time from first to second year?*

EF: No, it's the same. I don't think it ever will.

BJ: *How do you see the impact of digital technology on conceptualisation?*

EF: It doesn't pose a threat to me at all - at the moment. Because I think I know I'm capable of using a computer. I know how a computer works. So now I'm getting rid of computers.

BJ: *So you don't see the computer as a conceptual tool?*

EF: It's an aid I suppose. That's a kind of tool. Computers are made up of a lot of tools. But not for my work.

BJ: *If you could do the project again, would your choice of conceptual tools differ?*

EF: Maybe, I might use … more sketching, more research, more development of ideas.

BJ: *Was this because of time?*

EF: Yeah, I just quickly wanted to get some print ideas.

BJ: *Would you have communicated your ideas differently?*

EF: No. They don't talk to you but they still see your work. So they know what's going on. They just leave it to me.

BJ: *So you've worked very much in the "I" mode ["Inner-personal communication"] throughout this project.*

EF: Yeah, all the way throughout this project.

BJ: *Did you talk to peers?*

EF: No, not until today. I mean they see the work when you are working but they don't really say anything. I don't talk to them. They might say "ummmh" or something like that.

BJ: *Was this particular for this project?*

EF: I think they really did try to leave us alone on this one, to get us really experimenting. There's still a lot to learn.

BJ: *What about between students?* [I asked this question because I suspected that EF is mixing up peers with tutors].

EF: No, we don't really talk much. I mean, we are all quite busy so we're all getting on with our own stuff, you know, there might be a passing comment but that's all there is really.

BJ: *It sounds highly self-centred? Rather than collaborative as might be the case in some other design domains*

EF: Oh yeah, definitely.

BJ: *So it's almost like an artist's pursuit working on your own?*

EF: I like both though. In the other project [running parallel with this project], it was just the opposite. It was working with different design students doing different things, knitwear, everyone doing different courses but together. So it was quite a contrast to this. I quite enjoyed it. But I also [like] working on my own.

BJ: *And conceptually?*

EF: The two are different. This [project] was very self-employing.

Interview Protocol
Interviewer: Ben Jonson
Interviewee: Thomas Grimer
2nd Year Product Design Student
Central St Martins
09.06.03
15.00-16.00 @ CSM

Ben Jonson: *What conceptualising tools did you use, and why?*

Thomas Grimer: Sketching is the most important tool because it's the quickest way of getting what is on one's mind on paper. So even yourself can what your thinking, and to gather a logical order of your thoughts. So sketching is definitely the first one. Model making is secondary, to me anyway, because I make models with regard to my sketches. I know other people make models from the outset. But that's not the way I work. Model making I find is a much better way of showing other people your concept but not when you use it for your own means, or my means anyway. The written word is, obviously, eh, probably the least important but sometimes you just have to submit it because of course requirements, or for the ease of modern communications, like email. And it is the easiest way to communicate. In certain projects the computer is really indispensable but if there's one thing you could do away with it's the computer. Sketching is the foremost tool because you can't progress anywhere without the sketches to begin with.

BJ: *For this project, would you say you used all tools with equal weight?*

TG: No, definitely not equal weight. The prime tool for this particular project was sketching, and model making, and then for all presentations, and only in the final stages of the project and because of the nature set by the staff.

BJ: *Did you brainstorm or talk to peers, or people outside College?*

TG: Outside College, no. Obviously discussions are going on about projects more often than not, in comparing them to other people's projects.

BJ: *When you say sketching is that just sketching or annotated sketching?*

TG: For my private use, my personal way I work is very messy. I work with scraps of paper. If I look through my sketches, sketches with any annotations are sketches I've done in front of somebody else in showing them what I'm trying to achieve. Frequently sketching and talking, if I'm going to show it to someone and it's not a final presentation. Annotated sketches come later, nearer to the point where I begin to make models.

BJ: *Where in the design process did you use the tools?*

TG: I kind of answered that just now. In the initial stages and where it's coming from the mind, it's sketching. Model making (looking at the Self-report data transferred to the chart in the Interview protocol) is because of the criteria in the project. In a normal project I would go from sketching to model making, to and through for some time, and then computer-aided design and then finish off with photography, and for the final presentation, written words. This project was a little bit different because of the criteria set. So normally I would work between sketching and modelling to and through for a long period of time.

BJ: *What "landmark" events ("Aha!") did you experience while using conceptual tools?*

TG: None, not in this project. I appreciate in other projects I have them. In this project it was more a case of I'd written a brief that was ambiguous and perhaps a bit too far fetched for the time I had. So my "Aha" moments were when I kept reducing my brief.

BJ: *The fact that you were writing your own brief ...*

TG: I consider that to be my "Aha!" moment because I think I found a hole in the market, a potential for the design.

BJ: *So does it mean that writing the brief was part of the ideation?*

TG: Yeah, which is quite different because we rarely get that chance. Normally you'd have to manipulate within the brief. Yes, I suppose you could say that the "Aha" moment was the way I decided to write my brief.

BJ *So what happened before then? [Jocular] Did you walk around in the street talking to yourself, or did you have a great idea in the bath?*

TG: I keep a small book. If I have a random idea, normally when I'm working on something else, I jot it down. I probably got 50-60 ideas in that book. So it was a re-cycled "Aha" moment.

BJ: *What were the strengths and weaknesses of the conceptual tools?*

TG: The benefits of sketching are the speed and the ease of sketching. And also it is a pretty medium in itself. And also that sketching backs up what you are doing because I find it much easier because while sketching you can build up layers, sketching on top of your drawings. So it's a verbally annotated drawing. Almost like an animation done in front of someone's eye which leads them to understand what you are thinking.

The drawbacks are they depend on your skills. Obviously you are limited to two-dimensions so you have to have good visual skills in your own mind to be able to work with sketching purely.

BJ: *But you said earlier that your sketching skills are pretty basic (see remarks made in the Interview protocol)?*

TG: I compare myself to people who are "very good", but compared to my classmates I'd say "good".

BJ: *Is it essential to have good drawing skills, in the conventional sense, say to draw a perspective. Or is sketching something different, does it have to be good in that sense?*

TG: In terms of design in the early stages it only has to make others understand what you are saying If you can sketch with a blunt toothbrush then that's fine if you can understand that. In the later stages, when you're not there to back up your sketches, a good clout with sketching is essential. Because even if someone is able to understand you they are not going to give you the time of day unless it is visually attractive in its own right.

BJ: *And that is more at the presentation stages?*

TG: I think when you show anybody you are presenting. I think everything you do is presentation.

BJ: *Spoken and written word?*

TG: They are very useful. You get an immediate response. And a sketch can't do all that while you might see the visual problems you might not appreciate the social ones or whatever.

BJ: *And drawbacks with words?*

TG: At the conceptual stage I think you can be swayed, and that's not necessarily a good thing. But that's as much a positive as it is a drawback.

BJ *And modelling?*

TG: Modelling definitely helps in the realisation of concepts, it helps to have it in a solid form. The drawbacks are that it takes time to create that concept.

BJ: *So even sketch modelling takes time?*

TG: Yes, they take an irritating long time. But normally I just sketch and sketch and make a model at the end. That's the way I would work.

BJ: *And computing?*

TG: In this particular project not very much help at all. Because when the concept is intertwined with other issues then the computer is useful to relay my concepts. But in the actual conceptualisation process it wasn't particular useful. The drawbacks are it is too slow and you'd need a degree of skill to be able to use it in the beginning and I just found it stifles the creative process battling with the working knowledge of the machine as opposed to your idea.

BJ: *Does it mean that if you had greater computing skills you'd use it as an ideation tool?*

TG: Not at the very beginning. No, not in the initial stages. If my skills were excellent, if I could use the mouse like I can manipulate s pencil, yeah, then I'd use it. But I think that'll never be the case. So seeing it as [it will] never going to be the case it will never be at the beginning of my conceptualisations.

BJ *You mentioned earlier photography. Do you see that as a conceptual tool?*

TG: Yeah, because you can just very quickly take photos of found objects, manipulate them, collage them. And for digital images I'd use the computer in the initial stages for images I already have. For instance, I can easily stretch or skew the size of an object. The computers are invaluable for that work. But to initiate something that in my mind is invented then I still wouldn't use computers. I find that if I'm trying to use a computer it limits me to what I know. And even perhaps stupidly enough stop me from doing what I want because I know I'm not able to realise it on a computer. So I limit my own design because I know what my real skills are in a computer. Whereas sketching in a way is limitless. In one way or the other I can make it work.

BJ: *Do you use a graphics tablet as a drawing tool?*

TG: But that's almost like trying to imitate sketching. So I'd still qualify that as sketching. I have a tablet but in the same way a laptop screen or a palmtop is never going to be as good as a book, a tablet at the moment is not as good as pencil and paper. For all those reasons I don't use them [tablets].

BJ: *Have your uses of conceptual tools changed over time, from the first to the second year in college?*

TG: I do more model making and that's mainly because the School is pushing it, and I'm quite glad that they are.

BJ: *And more computing?*

TG: Yeah, but that's not because of the School but because of the realisation for which computers are being used. Everyone individually is learning, one of the pressures is pushing computers. Yes, I increased those two things [model making and computing].

BJ: *And sketching?*

TG: Probably about the same as I ever did.

BJ: *Do you have any formal drawing classes on the course?*

TG: I've done life-drawing classes before. But here [in College] no formal [drawing] tuition as such. But we had a slight tuition in model making in the first year.

BJ: *How do you see the impact of digital technology on conceptualisation?*
You've already said that the computer will never be an ideation tool.

TG: I can't really say that. It's not good enough yet.

BJ: *But the impact on your work?*

TG: In terms of conceptualisation it's relatively small. I'm still more influenced by paper and pencil. But if a tablet became as quick or as smooth as pencil and paper and was accessible I'd use it tomorrow. Because it would be so more accessible in the computer I wouldn't have to scan it and manipulate in any other way. And it can be reproduced as many times I'd want.

But I get the impression that majority of tutors are in favour of the old school of pencil and paper approach and are scared of the computer. Because there's also this social aspect of design and all "big" designers are using pencil and paper: "I scribbled with a bit of charcoal on the toilet wall" kind of thing. You feel that if you want to be a big deal in design you are going to shoot yourself in the foot if you are using the computer all the way. So the social impact will want me to stay with paper and pencil. Compare it with the book that you can access immediately and close immediately. I don't think in my life time it will be able to compete with all aspects of the way we work [Thomas is 21 years old!]. Just little things like the boot-up time of a laptop a tablet and if it's just a fraction slow it will just change the way people act. I think these machines will change the way people work for the worse. People will be able to cope but to cope is not such a good thing.

BJ: *If you could do the project again, would your choice of and use of conceptual tools differ?*

TG: No, predominantly it would still be the same. If I had a little more time I probably finished my conceptualisation with computer editing software. But that's mainly with presentation in mind.

BJ *Would you have communicated your ideas differently?*

TG: In this case, no.

BJ: *Finally, what did you get out of this protocol, of taking part in my research?*

TG: My main concern it would be hard for you to read my scribbles. Yes, it was easy to use. First, when you are not familiar with it, you are constantly referring back to the guidelines. Maybe it could have been a bit bigger (size of squares for marking}. I had a feeling of cramming in things.

BJ: *Did you become aware of your ways of conceptualising that you weren't before?*

TG: I became aware of that I use computer less than I thought I did. Also, how much time was spent on model making when I could be doing something else. Because you use computers it makes model-making seem even slower. But it doesn't mean I'd look back on it [the protocol] and think I should have done more of this or that. But I think it is useful because industry is pushing the text side of things and pushing towards computers because of economics and gains of speed. But I think it might be damaging how traditional design works. So I think it's good to have proof of paper and pencil.

But I also think computers are inevitable and people need to know how to use them a lot more. The reason why students are irritated by schools is because they seem painfully ignorant of technology and it makes students have this feeling that if they didn't sketch they wouldn't understand about technology. So you get this media backlash: if they [students] don't understand it's because they don't sketch. In fact I think if they gave us more education in computing, which would be useful, people would automatically do sketching because it is the logical choice. People would do it without being told. You better let them do it themselves because predominantly people will go back to sketching because, in my view, it is the most efficient way of starting the conceptual process.

BJ: *So what you are saying is that by pushing the computing medium students generally would recognise the importance of sketching?*

TG: Yeah, and I think you can see it to some extent now where a small majority in the class is annoyed that sketching skills are ignored. And if they hand in a freehand sketch it is frowned on, for not being done in PhotoShop. If people did more computing there would be a demand for more sketching. You give them sketching time they demand computing time, you give them computing time and they demand sketching time.

The problem with computer graphics is that it is too easy to reproduce, anyone can do it. And that's a difficulty because you don't need to be that skilful to make a computer piece look impressive, especially to people who are unaware, who aren't in the industry all the time. And as a result people getting jobs are those who are particularly well trained in that computerised field. And people with real skills and talents are being left behind. I think that's a worry for most people. So people are competing unfairly.

Interview Protocol
Interviewer: Ben Jonson
Interviewee: James King
2nd Year Graphic Design Student
Central Saint Martins College
27.02.03; 15.00-1615 @CSM

Ben Jonson: *What conceptualising tools did you use, and why?*

James King: I used sketching [points to the protocol; S] to generate my ideas as quickly as possible and to make plans for what I was going to with the computer. I used computing [C] to try to make the conceptual visual, to try to make ideas into a sort of visual things to respond to and maybe have more ideas, and to see what the aesthetics would look like. I used words [W] because I had a crit every single week talking to the tutor about it. It wasn't a tool but it was useful.

BJ: *So what was the difference between visualising with sketching and computing?*

JK: I see the computer as time based so at every one point you can see how things are moving which is impossible to convey in a sketch. And my visualising in sketching is not that strong, it's more like taking down ideas in a visual ways as supposed to creating something that would look like the final thing. So the computers are better visualisation tools for looking at how it might end up basically.

BJ; *Was that in your mind to convey the final outcome, although still at the conceptual stage?*

JK: Yeah.

BJ: *Where in the design process did you use the tools?*

JK: (looking at the protocol). At the start point, which was the briefing, it was words. Every time I met the tutor we were going through ideas verbally, and at one point we used sketching as well. We sketched together ...The tutor was drawing up this ... "Do you think this would be right"? "Yes" ...

BJ: *Did <u>you</u> do the sketching?*

JK: No, the tutor did that actually

BJ: *So the tutor was showing you his ideas? Giving you examples how it could be done? A kind of instruction?*

JK: Yeah

BJ: *How did you find that?*

JK: It was useful because it is obviously difficult to convey something like that verbally, so a sketch helps.

BJ: *But it wasn't interactive?*

JK: No, in the sense that it would just showing how it might be.

BJ: *Were you tempted to interact by showing your way of sketching?*

JK: No, I think it was just easy to draw it over. And then at the beginning of the project as well, it was very much sketching, kind of staying away from the computer as long as possible. Although part of the criteria was that we would start experimenting on the computer. But I used sketching to have a clear idea what I wanted to achieve before I sat at the computer.

BJ: *So the tutor actually encouraged you to use the computer as a conceptual tool?*

JK: Yeah.

BJ: *But you didn't actually do that because your use of the computer as a conceptual tool came quite late [looking at the protocol].*

JK: Yeah.

BJ: *Did this reflect your own working habits?*

JK: Yeah.

BJ: *You wanted to do it your way?*

JK: It was just how I work. Sketching was much faster. Also we were learning the software program [Director] from the start, so it was quite clumsy, so you were not quite sure how to make it happen, so it was pretty slow from that point of view.

BJ: *As for the reasons you used computing as conceptual tools you put most often down "because of assessment criteria"?*

JK: Yeah

BJ: *Where in the design process did you use the tools?*

JK: Towards the end it was much more computing driven because of the assessment criteria. We had to be on the computer, we had to be on this program [Director].

BJ: *So the concepts had to be shown on the computer?*

JK: Yeah.

BJ: *Were there any landmark events ("Aha") that you experienced?*

JK: There was a slight "Aha" moment nearly the end. In box 139 (points at Square 139) where I went back to sketching again, I did realise that there was something I could use in the project but for me this project didn't have a great deal of inspiration.

BJ: *When you say "slight" what did happen though?*

JK: I just realised what I could with the project to fulfil the brief.

BJ: *More specifically?*

JK: It was relating to something that we talked about in the briefing.

BJ: *How did that effect your project because it came so late in the assignment?*

JK: It sort of bound everything together.

BJ: *And that actually happened when you did sketching?*

JK: Yeah.

BJ: *So you were sitting there with the sketchbook?*

JK: Yeah.

BJ: *And something happened?*

JK: Yeah.

BJ: *What, an annotated sketch?*

JK: Can I show it to you [opens sketchbook and shows the sketch]. This basically is a page of visual thinking about concepts of space for different people.

BJ: *So you were pulling things together?*

JK: Yeah, because I'd been struggling with what my conception of space was and what to do. Just taking down what I thought about.

BJ: *So this was a kind of ad-libbing with a pen?*

JK: Yeah.

BJ: *And this didn't happen when using words or the computer?*

JK: The idea for using the sketch came out of a conversation I had in an interim crit with the tutor when we were talking about how we in the West have different concepts about thinking in trajectories. It was very much about Cartesian grid in space that formed the basis for the project.

BJ: *So it was a previous tutorial that ...*

JK: ... that germinated a seed.

BJ: *What are the benefits and drawbacks of sketching?*

JK: Very quick, it happens at idea speed. The drawback maybe is that my skills limit myself to quite basic aesthetic visualisation.

BJ: *When you say skill, is that in the technical sense?*

JK: Yeah.

BJ: *Is this your own opinion about yourself or is it something you've been told?*

JK: No it's probably my own opinion. If you try to visualise an idea and the end result depends on how it looks I think my sketches are not suited to that. It's very much noting ideas, drawing them out.

BJ:? *Dou you equal skills with presentation drawing?*

JK: No because I don't do presentation drawings. Basically, if your sketches are not aesthetically pleasing they may hold you back conceptually what you are trying to do. For me, whatever I'm creating it has to be appealing. Conceptually obviously that's important but it can be quite frustrating if you sketches are just scribbles.

BJ: *Benefits or drawbacks with spoken and written words?*

JK: The ambiguity of words means that in translation it could be any idea and you can't understand it. To do something visual is very useful. But there are little things you can explain with words.

BJ: *And computing?*

JK: It can be like a time based sketch but I think there are more drawbacks with computing for ideation compared with old-fashioned sketching. I think it is too slow and also the tools themselves really dictate what you can and can't do with them so if you w4ere to use PhotoShop or something like that you only have the functions and features that predefine what you can manipulate or draw with. So it's better to use a pencil if it's for conception.

BJ: *Do you think there's a risk of being driven by the computer at the ideation stage?*

JK: Yeah, because there are things that the computer does very well and things it doesn't do. With the computer you often go down the route of what the computer can do not necessarily how you arrived at it yourself.

BJ: *Do you think you can cut corners with the computer?*

JK: As long as you have an idea what you want to do. Also it depends on what kind of program you are using. For example, "Director" is quite a complex tool. Because you can actually use a programming language inside so it is more conceptualising than drag-and-click with PhotoShop. Computing is good for finishing pieces but for ideas it is not for me personally that good. But there are some programs that are better for ideation. For example "Design-by-numbers" which is a teaching tool to teach programming at basic level and at the left-hand side [of the screen] it's visual presentation but which you can't alter visually or click-and-drag-and-drop. The only way you can make a change is to write a program. So conceptually that's very much better and interesting than something like PhotoShop.

BJ: *Have your use of conceptual tools over time, from first to second year of college?*

JK: No, I think it's been sketching the whole time, apart from assessment criteria, which demand something else.

BJ: *How do you see the impact of digital technology of conceptualisation?*

JK: I think it depends on the individual using it [computer]. Some programs are designed to produce finished products, very smooth and clean, not necessarily bad but very slick which is what some people would like. But having said that I also know people who got practised to use computers and they would use it as a sort of cut-and-paste and make quick visual ideas what things would look like together, using it as a typographical means, and a lot quicker than drawing out the lettering by hand. But it depends what the end is all for. Conceptually, if it's going to be viewed on screen I think conceptually they [computers] are better.

BJ: *Would that be Web design?*

JK: Yeah, exactly. Or something that relied on coding, anything that would have to do with programming as opposed to programs which are based on the real world of paper and pens.

BJ: *Simulating the real world?*

JK: Yeah, basically.

BJ: *If you could do the project again, would your choice and use of conceptual tools differ?*

JK: I think I'd probably use more sketching, just trying to push that. I was tempted to start on the computer straight away as it was part of the assessment criteria. But I ignored that. Also, I'd done more work [looking at the protocol graph in which there are big gaps between "conceptual activities" over the 8-week assignment period].

BJ: *Is this a post-rationalisation or were you aware of it during the assignment?*

JK: I don't know. I had to do a lot of things outside the assignment. Also, I didn't enjoy the brief so much.

BJ: *And why did you not enjoy the brief?*

JK: It was just block. I found it difficult to come up with an idea that would fulfil everything I wanted.

BJ: *And do you think that the prescription to use the computer held you back?*

JK: Absolutely. The fact we had to use a certain program. The idea of the brief was that it would teach us to use it. We had to use it therefore we would be able to use it in the future, once we got to grips with it.

BJ: *So you felt constraint, not enough freedom?*

JK: Perhaps the grass is always greener, to put it that way.

BJ: *Would you have communicated your ideas differently?*

JK: No, I think that would have been the same. I've got very clear ideas of how I think conceptually, of how I work best, with my hands as opposed to on a keyboard.

BJ: *Do you use 3-D modelling at all?*

JK: No, we are not taught to do paste-ups. Perhaps it would be accepted although it wasn't mentioned in the brief. I just didn't think a bout it.

Interview Protocol
Interviewer: Ben Jonson
Interviewee Thomas Wood
2nd Year Architect Student
The Bartlett
17.03.03.02
13.00-14.10 @ Bartlett seminar room and Y2 studio

Ben Jonson: *What conceptualising tools did you use, and why?*

Thomas Wood: I'd say mainly I used computing and modelling. The sketching was intermediate, it did feature but not as important.

BJ: *When you say sketching, do you mean traditional sketchbook?*

TW: No just loose sketching ideas, maybe scribbles.

BJ: *And modelling? What did you do, for example?*

TW: A variety of mediums, card, wood, metal. We've got a workshop downstairs which we are allowed to go into to start with. Maybe a grey card model to go onto using other materials.

BJ: *Because the brief was about ideas for a building you started with knocking up models that looked like buildings?*

TW: Yes, I did a series of these grey card models and which were later translated into metal to be specific to the materials we were going to use in the construction of the building. Obviously the grey card model doesn't show the materiality of the project so once a series of these [models] were made the materials were more considered in the final model I was making.

BJ: *Was the brief particularly about the articulation of space or the exterior?*

TW: It was both really. The form was generated with these grey card models and then the interiors were dealt with, well, I'm only a second year student so I didn't explore the interior as well as I could.

BJ: *The brief was only for three weeks, so the nature of the project was perhaps sketchy rather than final?*

TW: There was nothing that was totally resolved. Although towards the end of the [academic] year we will have to have this resolved. So the final drawings will be produced at the end of the [academic] year.

The spoken words, tutorials, were really sparse. We have two [studio] days a week and only half an hour of each days did we speak to a tutor about the work. So the rest of the time you're on your own, unless you spent five minutes talking to a friend. You get bored hearing about other people's projects. So most of the time is working on your own with these [conceptual] tools.

BJ: *So quite self-directed studies?*

TW: Yeah, yeah, it's quite lonely as well as a profession.

BJ: *Where in the design process did you use the tools?*

TW: The unit I'm in is a modelling one, that is, they encourage you to design through making, the act of making, so really there's a mix of computing and modelling. So in the second week there's quite an important involvement with computers where the tutor tells you have to go down this route so there's where you can see a lot of "C's" circled (points to the protocol).

BJ: *What software did you use?*

TW: Mainly CAD and PhotoShop, and I used Adobe Premier and video too taking stills from the video to put into the project.

BJ: *What you did on the computer, did you see that as conceptualising?*

TW: As I said, you start with a card model, or a series of sketches. I prefer to model it our rather than to sketch to start conceptualising the idea. And once you got the form and the tutor is happy then you can take on step further putting the model into an Auto Cad drawing. So you can get the specifics of the dimensions, the spatial conditions. And then you transfer it, like I did, into a final [sketch] model, which is more considerate of the materials you used in the construction of the building.

BJ: *So the model came first in terms of conceptualisation?*

TW: Yeah.

BJ: *What "landmarks" events ("Aha") did you experience while using conceptual tools?*

TW: Yeah, there were but I didn't make a note of it, which I should. But I think they largely came after the tutorials when they helped me going down one route because of what they said. So it was perhaps more the tutors ... like a guide. You are made to reflect on the progress you've made in the tutorials.

BJ: *So you couldn't really pinpoint any "Aha" moments?*

TW: It was more gradual as I put the models together. Although when I experience such moments they tend to come when I'm not involved in the work, when you have more distance from your work. I go the gym in the morning, so for instance when I'm on the bike cycling and suddenly these things come together because you are relaxed enough to let that happen.

BJ: *What benefits and drawbacks would you see with sketching?*

TW: The benefits are the quickness of generating ideas. The drawbacks are if you are not so talented regarding drawing. It then can be limiting.

BJ: *You said you drawing skills were "basic to poor", so you mean that skill are holding you back, you would use more sketching if you felt more confident?*

TW: Oh yeah, for certain. If the confidence was there and if I felt I had the talent for sketching then sketching would be more important to me than modelling because model-making is a lot slower.

BJ: *So you see sketching as a talent?*

TW: I think it's something you're naturally gifted with.

BJ: *Do you think you could improve on the skill by working harder at it?*

TW: Oh yeah, I think people do. But when there are deadlines you do what you are comfortable with. And what I'm comfortable with is model-making. It serves the same sort of purpose.

BJ: *Spoken and written words?*

TW: Well, as you can see I'm not the most articulate ("basic-to-poor"), the benefits are you allow the ideas to flourish in another area, so that's good. The drawbacks are we are just talking about it, we are not actually seeing it. Because designing is largely about visual so there needs to be a visual subject matter.

BJ: *Modelling?*

TW: I think people can understand a model a lot easier than a sketch in many cases. During the project, we went to visit Foster's [the architects] model workshop. And one thing they said was that most of the customers, if there is a model and a drawing presented, they go straight to the model to get the idea of what they are going to buy. So generally people can understand models a lot easier. The other benefit is that you can, if you are using specific materials, the model can be a lot more evocative. The drawback is the time it takes to make.

BJ: *And computing?*

TW: The benefit is the accuracy. And the speed as well. A final drawing can be generated a lot quicker than by hand.

BJ: *When you say accuracy, is that sketching?*

TW: No. I don't use it for conceptualising although one thing you can do, and it's being pushed a lot in this unit, is that you photograph your model and then you sketch on top of it. So you produce those photos in PhotoShop and manipulate them in some way, stretching them or that sort of thing. And then you print out the photograph and sketch on top of it. So it's this backwards and forwards. You may put it into a CAD package too. But then it's more of an informed tool than conceptualising. The drawback is that it [CAD] is very limiting for conceptualising, it's more engineering.

BJ: *Do you use a graphics tablet?*

TW: No, I've never seen one here.

BJ: *Did you use any other conceptual tools?*

TW: Yes, video and photography, but not really in a conceptualising sense.

BJ: *Have your use of conceptual tools changed from your first year to the second at college?*

TW: There are more computers being used in the second year. That's to do with the nature of the course, although the Y2 head of tutors is very much against computers.

BJ: *Against computers?*

TW: Yeah, he actually marks you down if you overuse the computer. I think he's happy with PhotoShop but not CAD packages. He wants to see hand-drawn stuff.

BJ: *Do you have formal drawing classes here?*

TW: No, we've had a tutor coming in giving us an hour of a lecture, but that's it.

BJ: *As for the use of conceptual tools, have you changed?*

TW: I think it's the same. I tried to bring in more sketching to the project, but I didn't.

BJ: *How do you see the impact of digital technology on conceptualisation?*

TW: The more informed elements, like photographs, CAD packages, the way you pass on what is already conceptualised, the notion of the project, backwards and forwards. You are not actually creating more ideas when you draw with a CAD package.

BJ: *Do you think the conceptual phase is being cut short because of the computer?*

TW: I'd say it is. Whether it's a good or bad thing I don't know.

BJ: *Do you feel pressured into using the computer too early in the process?*

TW: No, not pressure, it's just accepted in a degree like this that the computer is going to be used all through the project. But I think if you'd asked an average student here they'd say that they generated ideas either through modelling or sketching, apart form searching the Web.

BJ: *If you could do the project again, would your choice and use of conceptual tools differ?*

TW: I'd probably try to do more sketching. But that's what I'm always saying. Because I rely to heavily on model-making.

BJ: *Do you think you should work harder at getting better at sketching?*

TW: Oh yeah, I always think I should do.

BJ: *What then would be the benefit?*

TW: Because it's quicker. And sketching and modelling complement each other, like computers compliment conceptualisation.

BJ: *So is it the confidence of walking up to a flipchart and dazzle with a sketch?*

TW: Yeah, exactly. And that's another advantage with sketching because for model-making you'd have to do it in a workshop at a desk but for a sketch you can use any old bit of paper to work out an idea.

BJ: *And you maintain that sketching is a talent?*

TW: Yeah. I've been in design for ten years now through education [since B-tech and work experience] I never felt I was adequate in sketching. I've seen other people being good at it from the start.

BJ: *But does the sketch have to be "pretty" or "well-drawn"?*

TW: Well, you could say the same about a model-making. A model can be anything.

BJ: *If you could do the project again, would you have communicated your ideas differently?*

TW: It's funny, because I'm a student. It's different from being in practice. I feel two half-hours a week of tutorials is both too much and too little. It would be a lot better to have a week preparing the material to present in a tutorial because the tutors get involved quite heavily. The other half an hour I'd prefer the tutor just walking around giving people for five minutes or so. So that's the way I'd like to communicate with tutors.

BJ: *What about peers?*

TW: I think the people who succeed in the Bartlett are the ones who are able to go up to anybody and talk about their ideas and make it sound exciting. If someone feels excited about your ideas then you get that. I'll like to that a bit more. It's also about learning to do things in different ways.

BJ: *Would this apply using sketches and models too?*

TW: It depends. People generally go up to another person in the unit and ask them what they think if they got a problem. But if you just want a break or a bit of relaxing you can also talk to a mate about the project just to take your mind off.

There's also the inspiration you get form leaving the studio and go outside. For example, I went to the Wapping pump house [site visit].

BJ: *Did you have lots of ideas or did you hone in on one idea pretty soon?*

TW: Yes, because it was such a short project I did. Also, that was encouraged by the tutors, and which I did through modelling.