CHAPTER 2

REVIEW OF THE RESEARCH CONTEXT

2.1 INVESTIGATIONS

Since the 1950s interest in design research has grown considerably and, in that time, researchers have sought to understand and describe designing, using a variety of investigative approaches and progressing through distinct stages.

2.1.1 Mapping Design

The 1960s has been variously described as the *prescription* stage of design research and the period of *systematic design*, Cross (1984 p.x). It was an exploratory period when, viewed from the present, it is evident that researchers were engaged in mapping activities.

METHODS

A prominent early mapping was L. Bruce Archer's, Systematic Method for Designers, first published in 1965, Archer (1984 p.58). Archer observed that:

> The most fundamental challenge to conventional ideas on design… has been the growing advocacy of systematic methods of problem solving, borrowed from computer techniques and management theory, for the assessment of design problems and the development of design solutions.

Archer set out what he described as one method for organizing the design act systematically. In delineating what a sensible person ought to do, he treated designing generically (with an emphasis on industrial design) and made few claims about how designers actually work or think. Archer gave good value in producing a detailed design manual with numerous graphics and check lists to guide an office manager, but he did not venture far into the central unknowns. The subtleties of conceptual discovery processes, were side-stepped, as follows:

> … there is no escape for the designer from the task of getting his own creative ideas. After all, if the solution to a problem arises automatically and inevitably from the interaction of the data, then the problem is not, by definition, a design problem… An abundance of artists starving in garrets is the surest guarantee of an artistic breakthrough.

Archer emphasises the need for rich, wide, and fruitful experience among designers, as well as the capacity for flexibility and fantasy in thought. He identified issues such as mental fixation, and foreshadowed further stages of design research, but in a few years his systematic design approach was displaced by research that focused more systematically on designing.

PARADIGMS

A more radical analysis of designing than Archer's was put forward by Broadbent (1973, pp. 25-38), who identified four fundamental forms, which he called paradigms of design, including: pragmatic, iconic, canonic and analogical design.

- *Pragmatic*: when the designer employs and manipulates materials directly until a suitable solution is created.
- *Iconic*: which builds upon pragmatic design by treating successful solutions: 1) as templates for new structures and 2) as the generally accepted form for structures of that type.
- *Canonic*: which, like the classical Greek and Roman orders, builds upon iconic design by the provision of rules, or components, as design resources.

- *Analogical,* when an analogue medium, such as a drawing, is used to simulate or represent an invented design.

The first three, *pragmatic*, *iconic* and *canonical* design can be readily associated with pre-modern design, but all describe actions one could see modern architects apply. *Pragmatic* ("try it and see") design commonly occurs on building sites; eg. Where and when inadequacies in documentation become evident and immediate action is necessary to avoid delays and claims. Residential and commercial property developers in my experience, routinely instruct consultants, including architects, to apply *iconic* and *canonic* principles; eg. To match floor areas, standard layouts, fittings and finishes to a target purchaser model identified through market research. *Analogical design*, when the designer shapes and develops a representation of a design, or variations of it in detail, before making a physical embodiment, is the most familiar and dominant paradigm. It is the method student designers are taught to apply, almost universally. The actions of analogical design, such as drawing, model making or using CAD, typify what many people would identify as the outward actions of designing. Recent developments of 2D and 3D design computing software have magnified the power of analogical approaches by enabling almost any aspect of a design to be modelled, throughout its life cycle.

The usefulness of these categories in the present context is reduced by the fact that they do not distinguish cognition processes. *Pragmatic* and *analogical* designing, for example, have similarities to the extent that they both involve production of design concepts. Use of an analogue medium is safer in providing options for a designer to test, review and modify thoughts, than designing as you build, but experienced designers handling multiple projects at different stages, could generate their ideas in a similar way when employing either approach. One distinction between the two categories may be the degree of granularity; ie. The pragmatic design concepts may be more global and the analogical more incremental, but not necessarily. Variations in a designer's cognition may be governed more by time constraints, depth of knowledge of a design type, or familiarity with a particular project, than where a designer happens to be, or what he or she is attempting to resolve. The last two approaches, *iconic* and *canonic*, in contrast are clearly intended to reduce the input of the current designer, in favour of the heritage of the icon, or canon, which further reduces their relevance to this study.

A more process oriented form of classification than Broadbent's, divides designing into *routine*, *innovative* and *creative*. Gero (1990, pp.33-36).

- *Routine* design is applied to designing which proceeds from existing prototypes. This would include *iconic* design. *Innovative* and *creative* design are two forms of non-routine design.
- *Innovative* design refers to designing which also proceeds from existing prototypes, but with the freedom to change the ranges of prototype variables. This could include rule based *canonic* design. Eg. Where a designer adopts traditional forms but changes their proportions. The typical result of *innovative* design, by this definition, has a familiar structure but novel appearance because the values of the defining variables are unfamiliar.
- *Creative* design is distinguished from the first two by the use of new variables, producing new types and providing the capacity to produce a paradigm shift. *Creative* design and *analogical* design can themselves be regarded as analogous when they involve transfer and adaptation of prototypes or an analog medium. Gero suggests that designers typically work within a context of their choosing, defined by available design prototypes, but they will sometimes move outside this context in order to find new variables. Five transfer processes that may produce new variables are nominated by Gero (2002, p.4), namely; *combination, transformation*, *analogy*, *emergence* and *first principles*. Inclusion of *analogy* indicates that *analogical* design can be regarded as a subset of *creative* design.

A further categorisation is the broad distinction between *top-down* and *bottom-up* design, widely used in the context of structured computer programming to describe the strategy of decomposition of a complex procedure (eg. a corporate financial system) into modules, or comprehensible tasks, which can be programmed, or performed by an existing *black box* or program module having the correct inputs and outputs. Use of this terminology has spread informally to other settings. My understanding is that *top-down approaches* simply mean commencing designing at high levels of abstraction. This typically means conjecturing an overall design, or *big picture*, before considering parts and sub-parts. *Iconic* and *canonic* design could be described as forms of top down design. Bottom-up approaches commence with the design of fundamental or foundation parts, individually, which are then linked together to form higher level components, which are in turn linked, ultimately to make a complete design. *Bottom up* design has much in common with *first principles design*. Students learning design

are typically taught to design *from first principles*, or from the *bottom up*, employing an incremental, analogical design approach. Bottom-up design is typically *creative design*, as defined above, by definition, since the term *bottom up* design suggests that variables are identified rather than given.

The above categories of designing can be broadly mapped together to form a single representation as in Figure 2.1.1 below.

<table>
<tr><td colspan="2">TOP DOWN DESIGN</td></tr>
<tr><td>Iconic design
Treats successful solutions (prototypes) as:
1. Templates for new structures
2. Accepted form for structures of a type.</td><td>Routine design
Proceeds from existing prototypes</td></tr>
<tr><td>Canonic design
Builds upon iconic design by providing rules, or components, as design resources.</td><td>Innovative design
Proceeds from prototypes, with freedom to change the ranges of prototype variables</td></tr>
<tr><td>Analogical design
Analogue medium, such as a drawing, is used to simulate or represent an invented design.</td><td rowspan="2">Creative design
New variables are used, producing new types. Provides capacity to produce a paradigm shift
<table><tr><td>COMBINATION</td></tr><tr><td>TRANSFORMATION</td></tr><tr><td>ANALOGY</td></tr><tr><td>EMERGENCE</td></tr><tr><td>FIRST PRINCIPLES</td></tr></table></td></tr>
<tr><td>Pragmatic design
Designer employs and manipulates materials directly until a suitable solution is created.</td></tr>
<tr><td colspan="2">BOTTOM UP DESIGN</td></tr>
</table>

Figure 2.1.1 Mapping of design paradigms and categories

Models are useful in assisting comprehension and understanding. However the extent to which designers actually employ different processes and the contribution any such process makes in generating, or developing design discoveries and concepts is no less a mystery after creating a model. Knowledge of what designers actually do is not extensive and not easy to acquire. There are so many variables in designing, but the categories discussed so far are broad. It seems likely there are common patterns, or combinations of processes. For example, designing may commence incrementally from first principles, but can deviate markedly during a project, once a designer becomes more aware of the critical aspects of the design. Some respondents in this study view conceptual design as a matter of identifying the best model. Some designs described by respondents display a clarity of vision that seems unlikely to be the outcome of an incremental approach.

PROBLEMS

Archer's earlier reference, to the challenge to conventional ideas of design by systematic methods of problem solving, computer techniques and management theory, was a generalisation. It is probable that when Archer wrote Systematic Method for Designers he was unaware of the (now) classic study of problem solving, by Reitman (1965), published in the same year Archer's work was serialised in DESIGN Magazine. The significance of the (then) emerging field of cognitive psychology would have

been difficult to grasp at that time. As this innovative research became better known, researchers became more conscious of the propositions that design problems are ill-structured, that they are not so amenable to systematization and that design problems themselves, needed to be investigated more deeply. Simon (1984, pp.145-165), Cross (1984, p. ix-x).

An entry point for considering cognitive research on problem solving is terminology and the meanings of terms associated with problems. A basic definition by Karl Duncker (1945, p.2) is that;

> … a problem exists when a living organism has a goal but does not know how this goal is to be reached.

A basic characterisation of a problem by Dominowski and Dallob (1995, p.33) is:

> … there is a goal to be achieved but the means of attaining the goal are not clear or one's initial attempt fails to attain the desired goal.

Mayer (1989, p.39) asks "What is a problem?" and offers a more solver centred, system view:

> A problem solver has a problem when a situation is in one state, the problem solver wants the situation to be in a different state, and the problem solver does not know an obvious way to eliminate obstacles between the two states. In short, a problem consists of three components: the given state, the goal state, and obstacles that block movement from the given to the goal state.

An important implication of the definition, nominated by Mayer, is that the problem (or barrier) always exists relative to the problem solver. Mayer (1989, p.40).

ILL-DEFINED, ILL-STRUCTURED, NOVEL, NON-ROUTINE AND INSIGHT PROBLEMS

One facet of cognitive science research that directly influenced research into design problem solving is the theoretical paradigm of technical rationality associated with the works of Simon. Simon has identified designing as an exemplar of rational problem solving that lies well toward the ill-structured end of the problem continuum. Newell, Simon & Shaw (1958), Simon 1984).

Designing has also been associated with solving problems of a particular status, referred to as *ill-structured*, or *ill-defined* problems. These terms are treated as synonymous in this thesis, as they appear to be more strongly associated with particular researchers than with a difference in meaning. Many computational cognitive researchers like Simon, use ill-structured, while others who are more design oriented tend to use ill-defined. Eg. Rowe (1987, p.40). Any perceived difference between the descriptions can be attributed to the fact that the term *ill-structured* is referentially ambiguous, in that it can be misunderstood as meaning something is wrong with the structure of the problem. That is not the intended meaning. The *illness* of a structure is not an attribute of the problem, like the faulty structure of a collapsed building. On the contrary, Simon (1973 p.146) argues that it is impossible to construct a formal definition of a *well-structured* problem. In fact *ill-structured* refers to the need for structuring, in the same way that *ill-defined* refers to the need for definition.

Simon has written and published extensively on the subject of problems and problem solving. The points summarised below drawn from Simon (1973, 1978 and 1996) are central to his view of problem solving.

- Problems are characterised by a continuum of degrees of definiteness of structure.
- Ill-structured problems are the rule, rather than the exception and are characterised by reference to *residuals*, or what is lacking, compared with a well-structured problem
- A problem can be said to be *well-structured* to the extent that,
  - Aspects of it can be represented and processed in one or more problem spaces, in accordance with certain performance criteria.
  - Knowledge and states of the problem can be represented in a complete, accurate and manageable way.
- Structuring of problems is the main part of solving them. That is, solving a problem is essentially a matter of adequately representing it, so as to make the solution transparent.

Simon's research accommodates and extends findings by Gestalt theorists, nearly half a century earlier. Gestalt researchers also recognised that solving *novel*, or *non-routine* problems, as ill-defined problems were called earlier, was associated with understanding and representation. Dominowski (1995, pp.73-76).

Gestalt psychology is also associated with a class of problems known as *insight problems*, intended specifically for experimental study. Insight problems used in research cover a wide range but three common requirements for solution have been identified by Dominowski (1995 p.75):

- Problems fall within the knowledge and competence of respondents.
- Some form of new response is required.
- A change in view of the problem is required.

The solution requirements of insight problems are not fundamentally different to the solution requirements of ill-structured problems generally. Typically, insight problems require the solver to do more than reproduce a previous solution. They require that the solver grasps, or achieves a new understanding of the problem structure, or the relations of a problem, Dominowski & Dallob (1995, pp.38 & 50). Alternatively, they could be said to require a creative approach. Finke, Ward and Smith (1992, p.169). Generally in this thesis, the term *insight problem* is only used to refer to the particular form of experimental problem just described, not to problems in general that may be thought to require an insightful solution.

WICKED PROBLEMS AND "SECOND GENERATION" DESIGN METHODS

Problems need not be *ill*-structured or *un*-structured in a particular way, although one class of ill-structured problems, requiring the solver to first pre-suppose a solution, in order to think about, and learn about the problem, have been identified as *wicked* problems. The main characteristics of wicked problems can be grouped systematically into the familiar three part structure of initial state, operations and goal state, as described below. Rittel (1984), Rittel & Webber (1984).

Initial state

- Every problem is a symptom of another problem and is essentially unique, with no definite formulation and many possible interpretations.
- Every formulation or interpretation corresponds to a statement of a solution and determines the resolution.

Operations

- As a result of the initial state, one cannot understand the problem without solving it.
- Each initiative is an irreversible, one-shot operation with an indeterminate range of potential solutions, strategies or moves, with no scope for trial and error and with the problem solver being responsible for the consequences.

Goal state

- There is no definite completion, or ultimate test, or criterion to judge a solution as true or false. Outcomes are merely good or bad, or better or worse and any additional effort may be beneficial.

Rittel and Webber specifically refer to planning problems, however the above conditions may be associated with architectural and other forms of design. With regard to *initial state*, design has been described as a process in which problem and solution emerge together. Lawson (1997b, p.47) observes:

> Often the problem may not even be fully understood without some acceptable solution to illustrate it. In fact, clients often find it easier to describe their problems by referring to existing solutions which they know of.

With regard to *operations*, many designs are the outcome of irreversible, one-shot operations. Indeterminacy too is general to design. Planning like other design fields is substantially based on precedent. The responsibilities of planners and designers are associated more with their professionalism, rather than their particular profession. Both are accountable for errors and sub-standard outcomes. With both, evaluation is a question of degree. There are no particular criteria of definition that exclude one-off design problems from *wicked* problem status. Indeed Rittel makes it clear in his paper that wicked problems are a broad class.

Rittel identified wicked problems, but his intention was not to devise systematic methods of solution, in the manner of Simon and other computational researchers. On the contrary Rittel proposed that there is no definitive formulation of a wicked problem. Rittel & Webber (1984 p.137). Rittel's intention was to make a critical point about the application of the classical paradigm of science and engineering to the

problems of open societal systems. In this critique Rittel refers specifically to architecture. Rittel argues that an error was made by planners and other professionals who were misled by the belief that a wide array of social problems could be solved by mimicking the cognitive style of science and the occupational style of engineering that had conspicuously succeeded in early NASA space missions. He refers to the methods embodied in this approach as first generation methods. Rittel (1984, p318 to 323) advocates, what he describes as, *second generation* design methods. He recommends emphasis on investigations into the understanding of designing, as an *argumentative process*, or a counter-play of raising issues and dealing with them, which in turn raises new issues. Rittel proposes the development of settings and rules and procedures to support an open-ended argumentative process.

One point about wicked problems, that Rittel could have made clearer, is that wicked problems are never single problems. They are problem complexes, or systems of many different problems, with many inter-dependencies. The main impact of this complexity is that the routine structured programming approach of decomposing the problem is both difficult and hazardous, It is difficult because there are many potential components and it is hazardous because: 1) it can only be achieved by interpreting the problem in some reductive manner (ie. proposing a solution) before the components are fully understood, and then 2) any interpretation tends to lead and perhaps mislead the acquisition of further knowledge. This does not prevent algorithms or other applications from being useful, even revolutionary in some way. But the process can be compared with image compression. At certain levels of magnification one may not see a difference between a 16MByte BMP uncompressed image and a 100K JPG conversion, but what has gone will not be retrieved by re-converting the file to its original dimensions. Applying that logic to Rittel's argument, there must be great limitations on upwards extrapolations from computers to the social *argumentative* context of human designers, when so much has been lost in an earlier decomposition process.

A similar critique of computationalism, associated with theories of consciousness and intentionality, has been proposed by John Searle (1980, 1983). Issues at the heart of this critique have been explored in the form of an ongoing public debate with Daniel Dennett, over two decades. Dennett (1993), Searle (1993, 2002). Searle proposes that we should think of consciousness as a biological phenomenon that is part of our ordinary biological history, along with digestion, growth, mitosis and meiosis. He notes that consciousness has important features not present in other biological phenomena. These comprise subjectivity, unity, intentionality, attention, familiarity, mood and boundary conditions, which include situatedness, or the sense of belonging in the here and now. Searle also includes what he refers to as the Gestalt structure of conscious experience, the Gestalt discovery that within the field of consciousness our experiences are structured in a way that goes beyond the structure of the actual stimulus. This relates to unity, that our experiences are unified into a single conscious field, making consciousness more than the sum of the parts. Searle (1993, p.132). This means, in short, that consciousness is a gestalt. It is, both our original and our every day waking, gestalt experience. On that basis, Searle argues, notions of human cognition, simply based on extrapolation from computational behaviour that lack these other dimensions, are deficient.

Another vigorous critic of the computational view, who also conducted a program of design research, has been Donald Schon. Schon (1983). Schon proposed a different understanding of design practice, based on a *constructionist* view of human perception-and thought-processes. Rather than viewing problems as ill-structured Schon viewed each problem as essentially unique. Rather than being an information processor, the designer in Schon's view is an individual constructing an interpretation of reality, not by searching but rather by conducting a *reflective conversation* with the situation. The last phrase is crucial. To Schon, design is not simply a process or an occupation but rather it is experienced as a situation which the designer inhabits. Dorst and Dijkhuis (1995).

2.1.2 Observing designers

During the early 1980s the focus of both computational and non-computationally oriented design research moved towards a closer study of how designers actually work. From simple beginnings, understanding and description of designing progressed from general identification to more precise and detailed analysis, of what have been broadly described as designerly activities. This form of research is easy to describe in broad terms because there are not many ways that designing can be studied directly. One can look, one can listen, and one can analyse and reflect upon what has been seen and heard. As with many scientific and social studies, all studies of designers tend to be constrained by time and budget and influenced by the facts of the research and the observer. This has led to

employment, re-employment and improvement of a small number of methods. While all have limitations, the effects of some limitations can be minimised and others can become better understood with continued development.

Two broad research approaches predominate, observation studies of designers at work and interview studies of designers talking about their work. There are a variety of ways of observing designers working, but the most direct method, in-situ observation, where the observer follows the designer throughout a project, or becomes a participating member of a design team, is too labour intensive to be a practical option for many researchers. A far more commonly chosen option is the application of a protocol consisting of a set task, time and place in which the designer works in a controlled, concentrated fashion and the process can be efficiently recorded. An alternative to observing the designer at work is to ask the designer questions. Interviewing may be combined with protocol sessions or undertaken as a different form of study. Interview studies are less common than protocol studies but are effective means of acquiring information that is difficult to obtain from a protocol session. Both forms of study are reviewed briefly, below.

PROTOCOL STUDIES

Experimental design protocol sessions typically incorporate the following features: 1) One or more individuals are given instructions for a particular artefact that must be designed. Depending on the research, various media (eg. pens and paper) are typically provided to facilitate designing. 2) Participant(s) then perform the designing until the design is complete, or the scheduled completion time is reached. During the session participants communicate their actions according to the rules of the protocol. 3) The sessions are recorded, typically by video, so that session actions and events can be viewed and heard. 4) After the session participants are de-briefed according to the rules of the protocol. Eg. Subject(s) may watch the video with the experimenter and describe what they were thinking at crucial times during the recording. 5) Subsequently the experimenters analyse sequences of activities, with the aim of detecting consistencies that may be instrumental in the development of theory.

Protocol analysis methods focus on detection and coding of regularities of process, or content, with the aim of developing theory that can be applied to design thinking in general. Process-oriented descriptions, or coding, focus on the designers' actions, or moves. Content-oriented descriptions, or coding focus on the statements, sketches and other products of the protocol and what they mean. A number of researchers have identified factors in the activities of the subjects that appear to contribute to their making unexpected discoveries.

The following precis outlines different approaches.

SKETCHING STUDIES

Designers typically produce drawings of different types to represent and convey information about their designing to themselves and to a variety of audiences for a variety of reasons. Of particular interest to design researchers are the sketches and drawings created during the process of designing and considered to be an important component of the intra-personal communication that supports design thinking.

Schon and Wiggins (1992, p.154) describe processes of design reasoning associated with sketching which they characterise as:

> … a reflective conversation between materials, whose basic structure -- seeing - moving - seeing -- is an interaction of designing and discovering.

Goldschmidt (1991, p.125) also describes a process of design reasoning, called *interactive imagery* associated with sketching, consisting of *moves* (the basic detectable operations of designing) and *arguments* (or statements related to a move), which may be figural or non-figural. Goldschmidt proposes that exchanges between *seeing as* (meaning figural or gestalt argumentation*)* and *seeing that* (meaning non-figural argumentation) enable designers to bridge between physical (figural) and conceptual (non-figural) aspects of designing. Goel (1995, p.120) characterises the progression of a design as a series of lateral transformations, as one idea replaces another and vertical transformations, as ideas are developed. Goel proposes that the density and ambiguity of sketches facilitates lateral transformations that are an essential aspect of conceptual design. Goel (1995, p.194). Suwa, Gero & Purcell (1998) examined the design thoughts of an architect, considering how he drew depictions, inspected depicted elements, perceived visuo-spatial features, and thought of

non-visual functional or conceptual information. They propose that design sketches serve not only as external memory, or as a provider of visual cues for association of non-visual information, but also as a physical setting, in which design thoughts are constructed on the fly.

Akin & Lin (1996, p.59) have observed that design decision making tends to peak when a subject alternates between three activity modes: *examining-drawing-thinking*, in rapid succession. Suwa, Gero & Purcell (1999) have also observed that designers sometimes cycle rapidly (almost simultaneously) between cognitive modes, which they identify as *analysis*, *synthesis* and *evaluation*. Suwa, et al propose a dialectic, described as *bi-directional causality*, between a form of interpretation (referred to as *invention* of issues or requirements) and unexpected discoveries, such that invention leads to discovery and discovery leads to invention. They propose that the act of externalisation and the simultaneity that diagrammatic representations such as design sketches offer, improves the likelihood that the designer will discover new features of the elements. Suwa, Gero & Purcell (1999, p.297-298).

One implication of these findings, for this study, is that there appears to be an association between rapid alternating design activities and decision making or discovery during design sessions. For the purposes of this study, such discoveries, occurring *in the heat* of intense design activity, will be referred to as *hot* discoveries.

BLINDFOLD STUDIES

Protocol research of a different kind, on blindfolded designers, by Athavankar (1999) and Garde Kuthiala and Athavankar (2001) suggests that relationships between different mental representations, words and hand gestures, can also increase the likelihood of discovery, without external representation at all. It is proposed by these researchers that designers use their *mind's eye* as a virtual space to model their spatial ideas and to make visuo-spatial decisions, when prevented from sketching. Support for Athavankar and Garde's studies has been found in blindfold studies of architects by Bilda and Purcell (2003). In subsequent sketching versus non-sketching experiments it has been observed that, for some designers, constructing internal design representations was sufficient for them to design without sketching, or other externalisations. Bilda & Gero (2005).

COMMENTS ON PROTOCOL STUDIES

The great strength of protocol studies is that the conditions of the experiment can be controlled, ensuring that specific activities of designing, design reasoning and associated activities such as sketching performed in a problem solving setting. This enables design related events to be investigated closely and associated data to be generated and gathered quickly. However there are also limitations to protocol approaches, as described below, and these necessitate the adoption of complementary forms of study.

- Protocol sessions reflect what people actually do in one situation, but they can not replicate the conditions of day to day professional practice, as they are not situated in the changing context of the designer's life. In addition to the constrained problem scope and time, the situation of the session being recorded and observed may influence a designer to act differently to his, or her, normal way of working.
- Coded protocol data is typically abstracted and difficult for anyone but the researcher to comprehend and utilise. In addition the degree of coding abstraction may omit or hide as much as it reveals of the way different people design.
- Much of the protocol research is relatively fragmented. Many studies employ different highly structured design problems, different methodological approaches, different protocols, different coding systems, different forms of analysis and they tend to have small numbers of experimental subjects; some as few as one individual. Development and convergence of methods over time will lead to greater consistency, but at present there are difficulties in equating different studies and in identifying trends and individual variations, that may only become evident when significant numbers of respondents are observed.

The combination of these factors must influence both the validity and generality of protocol study findings. Utility in other settings, such as education and training is lessened while the findings are unsupported by evidence from other forms of research.

The findings from the blindfold experiments are of particular interest in relation to this study. The fact that some designers can operate blindfolded, is no cause to doubt the usefulness of sketching in designing generally. However the evidence of the blindfold experiments suggests that some cognitive processes, currently associated with sketching, and thought to be necessary for discovery, or effective

alternative processes, may be managed internally by some designers. The blindfold evidence also raises the prospect that, if designers can design using only their *mind's eye* in protocol sessions, they should be able to do this at other times. A further implication from this is that mental activity, when designers are not sketching, that is currently disregarded, may make a significant contribution to designing.

INTERVIEW STUDIES

Many design journals and other print and electronic media regularly include interviews with designers. More often than not such interviews are interesting and informative, but it is unusual for them to be analytic in a way that facilitates comparison, or learning about skills and ways of designing. Writers are often inclined towards hagiography and many focus on features of a designer's work, rather than the genesis of the work. Perhaps for these reasons the small numbers of interview studies that offer more inquisitive and comparative treatments of designerly activities, such as the following works by Darke and Lawson, have become well known references.

JANE DARKE

During the 1970s Jane Darke re-analysed a series of earlier recorded interviews. These were originally intended to evaluate designs, design assumptions and intentions associated with recent local authority housing schemes. The respondents were a group of well known British architects. A published paper by Darke reporting on this re-analysis, titled The Primary Generator and the Design Process, has become influential within the architectural profession and design research community. Darke (1979). Darke's study is most interesting, for a particular finding in the re-examination of the respondent's statements. It was evident that the architects' tasks had been complex, due to both demanding requirements and highly constrained situations. However, in the re-examination Darke noticed that, faced with this complexity, the architects tended to latch onto a relatively simple idea very early in the design process. Lawson (1997b, p.44). Darke proposed that by narrowing the range of possible solutions, some designers were able to construct and analyse a scheme rapidly. Darke (1979, p.38). The process and rationale are summarised by Lawson as follows. Lawson (1997b, p.45):

> …first decide what you think might be an important aspect of the problem, develop a crude design on this basis and then examine it to see what else you can discover about the problem.

The following statement of a respondent, Richard MacCormac is remarkable in being a clear articulation of what is now recognised as a key feature of how designers actually work. Darke (1979, p.42), Lawson (1997b, p.46).

> A brief comes about through essentially an ongoing relationship between what is possible in architecture and what you want to do, and everything you do modifies your idea of what is possible . . . you can't start with a brief and (then) design, you have to start designing and briefing simultaneously, because the two activities are completely interrelated.

This statement also provides grounding, within the context of architectural designing, of observations made by Rittel in the early 1970s about wicked problems: ie. That one cannot understand the problem without having a concept of the solution in mind. Rittel (1984, p.321).

Generalising from her observations Darke makes a case for the use of subjective rather than scientific methods of design analysis and of designing. Like Rittel, (1984) Darke is strongly critical of interpretations of the design process based on inappropriate prescriptive models, in this case, an *analysis-synthesis* model which, as she puts it, does not correspond to the design process as seen in practice. Instead, Darke proposes a development of the *conjecture-analysis* model of Hillier, Musgrove and O'Sullivan (1972, p.29-3-3) consisting of *generator-conjecture-analysis*.

Darke notes Hillier *et al's* observation that design is *essentially* a matter of prestructuring problems, based on the designer's knowledge, which is why the process of design is resistant to *inductive-empiricist rationality*. Hillier *et al* propose, supported by Darke, that design is more appropriately viewed as a process of variety reduction, whereby the multitude of potential solutions are reduced by the designer's knowledge of external constraints and ability to structure the problem in solveable terms. Conjectures of approximate solutions need to be proposed early in the process as many design decisions cannot be taken before the solution in principle is known. Therefore conjecture and problem specification proceed side-by-side rather than in sequence.

The proposed new element and principle idea in Darke's paper is the *primary generator*. Darke describes this as a value judgement rather than the product of rationality. The body of Darke's paper contains case material which supports the idea of the primary generator and the generator-conjecture-analysis model.

One aspect of Darke's paper, of particular interest to this study, is the relationship between conjecture and discovery. Key observations from the interviews made by Darke about the conjectural process are:

- The idea of a primary generator is found to be a useful way of conceptualizing a particular stage in the design process.
- The use of a few simple objectives to reach an initial concept is characteristic of these architects' approaches in design.
- The greatest variety reduction or narrowing down of the range of solutions occurs early in the process, with a conjecture or conceptualization of a possible solution.
- The concept which is typically visual may emerge before or after preliminary analysis. In either event there exists a 'rationality gap' whereby the concept springs to mind, either *before* rational justification for such a form, or without the analysis dictating *this particular* concept rather than others.
- The concept of the primary generator can be seen as a conjecture, which is then tested against, and supported by, the case material.
- Any primary generator may be *capable* of justification on rational grounds, but when it enters the design process it is usually more of an article of faith on the part of the architect.
- Further understanding of the problem is gained by testing this conjectured solution against the case material.
- The term 'primary generator' does not refer to that first conceptualized image or 'conjecture' but to the ideas that generated it. Darke explains:

> The primary generator will be a component of the designer's 'cognitive structures' ... By becoming aware of ideas that are acting as generators, the designer may be able to evaluate them and widen their range if necessary.

Statements in Darke's paper, about generating concepts, by the interviewed architects, are more informative about development of intentions than of design embodiments. The statements support Darke's view, of the realisation of primary generators being a process of variety reduction, based on the designer's knowledge ability to structure the problem in solveable terms. However, this view gives an impression of matter-of-fact decision making rather than discovery, which I would consider open to question. Looking for a generator is a strategy. The iterative process of stepping between consideration of objectives and solutions is too. But is the process of *drawing out* solutions simply a matter of knowledge?

This, briefly, is what the architects said.

- Kate Macintosh, in describing the Dawson's Heights scheme, cited a number of objectives. A wish to respect the scale of the neighbourhood, she affirmed, prompted the use of a stepping-down profile. Another, to make best use of sun and views, suggested the staggering of the highest points in each block, 'as each "Leviathan" looks across the tail of its brother'.
- Michael Neyland, describing Linden Grove, refers to the site as being important in modern architecture because, 'it's one of the only subjective non-measurable things.' He appears to be conscious of an ongoing design dichotomy between inward looking and outward looking schemes. In this case he opted for the latter because of the presence of good trees around the edge of the site.
- Darbourne and Darke's Marquess Road scheme appears to embody ideas of low rise high density giving a traditional townscape of streets and squares, pioneered in an earlier scheme, extended to include the social objective of providing an atmosphere of 'house-dwelling for everyone', with a small private garden for family dwellings.

These three examples might well have been simple ideas that were not difficult to embody in a design, although I believe they are more than that. However other examples referred to by Darke were undoubtedly complex and problematic, in that design solutions, after the primary generator was identified, were not simply a matter of following through from one decision.

- Describing Kedleston Walk, Bethnal Green, Douglas Stephen refers to an intention to create a low rise high density scheme of 58 units in an area that was deprived of open space, particularly *private* open space. Rather than slabs, or towers, Douglas Stephen opted:

  > … to try and do a sort of funny section, to spread the building as much as I could over the whole of the site.

  From other comments made by Stephens it appears the design incorporates features of Bethnal Green, including dwelling types and the use of pedestrian streets to form communal recreation spaces. These ideas appear to have sprung from observations of Bethnal Green Stephens has made, as a result of wandering the area extensively.

- Pollards Hill, Merton, by Richard MacCormac is a development of over 4000 units. The scheme involves an almost continuous three-storey terrace of housing folded round the outside of the site, described as 'a sort of intestinal geometry' by MacCormac. The design incorporates series of courtyards on both sides of the block, for parking on the outside and for recreational uses on the inside. The inner courtyards lead to a large central green space. It is clear from Darke's description that the genesis of this design involved complications with local authorities and testing of a variety of housing forms before arriving at the terrace concept. In this case in particular Darke observed there was a process of developing design and brief at the same time, with each informing the other. Clearly, in this case, while the designers are undoubtedly knowledgeable, Darke observes they were also learning about the problem by trying to produce a solution,

The descriptions above give an indication of the sources of primary generators and ultimately the designs. The last example, Pollards Hill, more clearly than the others brings two sets of ideas together, that of developing design and brief at the same time and the combination of knowledge and learning in producing solutions. However, questions of where, when and how the ideas materialised remain out of reach.

That last qualification aside, Darke's paper is undoubtedly important in relation to this study, both for its content and as an example of method. It provides a compelling demonstration of the value of interview studies as a medium for capturing the essence of designing as it is done.

OTHER INTERVIEW STUDIES

Significant interview studies have been conducted by Lawson (1997a & b) and Robbins (1994)

In her paper, Darke refers to observations by Lawson about development of design briefs occurring through interaction between the possible and what is wanted. Lawson had proposed that the design process can be seen as a negotiation between problem and solution in which problem and solution emerge together. Following an interview study of ten prominent architects, in two books, Lawson (1997a & b) reiterates and expands on the above ideas and adds a range of general and specific observations about designing. Lawson provides two main explanations for the negotiation process and why design involves finding and identifying problems as much as solving them, namely learning and communication. First, designers tend to learn about their problems through attempts to solve them rather than through abstract study and analysis. Lawson also suggests this interactive process is so widespread for the simple and practical reason that the presence of an illustrating solution facilitates communication, for the purposes of: 1) Understanding problems, including both intra-personal (self to self) and inter-personal communication (self to other) and 2) Describing problems, generally, or inter-personal communication.

A number of observations about the genesis and functions of generators are also made by Lawson. He states that rather than being fully developed designs, primary generators may simply be the result of studying only a few aspects of the problem. They are, in effect, working hypotheses, or “what if?” propositions that allow aspects of a design to be temporarily fixed (ie. treated as a given) in order (putting it simply) to see what happens and thereby learn more about the problem. Lawson (1997b, p.194) notes that:

> … good designs often seem to have only a very few major dominating ideas which structure the scheme and around which other relatively minor considerations are organized… Such 'central ideas' inevitably emerge from early explorations through 'primary generators'. However, it is interesting to note how little

> some of these ideas may be understood until later in the process.

A further proposition Lawson makes, about the origin of primary generators for a particular project, is that they are unlikely to spring from nowhere, or to simply originate from the characteristics of the project alone. Lawson refers to a group of respondent statements, which he describes as *guiding principles.* Lawson (1997b, p.200). These, he proposes are important as origins of concepts that form primary generators. A variety of statements that Lawson has highlighted under different sub-headings could support his observation. For instance, more than one respondent notes that designers bring their own continuing programme with them into each design project and that projects allow designers to explore and develop this programme. One proposed that, in this sense, the design process can itself be seen as a form of research. Another (Calatrava) went further, in effect proposing the superiority of design as a place of research and innovation, on the grounds that technical innovation more often arises out of solving problems in a particular design situation rather than thinking about the technology in a purely abstract way. Lawson (1997a, p.34).

Several respondents affirmed the value of a primary generator, using the term *big idea*. Particular reference was made to the context of larger projects where people are working together. The valuable role of a *big idea* in providing a common understanding, or sustenance, or acting as a *distant light* to work towards, was affirmed. Other items of significance were also raised. It was evident that designers vary significantly, in their attitude to the generation of alternative design solutions. Lawson suggests this may be attributed to both cognitive style and work context. Another attribute is the ability to develop and sustain parallel lines of thought. Examples include; a) maintaining consistencies, or developing detail and big picture at the same time. b) issue management, which effectively means recognising the best time to reconcile different lines of thought - if this occurs too early, Lawson suggests, ideas which are still poorly understood may get lost, while if left too late, the design may become too rigid to accommodate new thinking. Lawson also comments on the importance of drawing to many designers, noting the common observations of designers that they find it hard to think without a pencil in their hand. Lawson (1997b).

ROBBINS - WHY ARCHITECTS DRAW

Why Architects Draw is a record of interviews with eleven internationally prominent architects with a somewhat abstract stated intention to address cultural and social questions about the role, uses and limitations of drawing in conceptual and social practice. Robbins (1994). The questions asked are of two types, first a series about the roles and uses of drawings with regard to different aspects of professional practice and different users of drawings. The second focus is on the individuals, their understanding of how they use drawing in their own practice and the actual drawings used in a design of their making.

Robbins observes that different architects draw differently and use different types of drawing, in creating a design and communicating it to others. He concludes that it is no surprise that architects use drawing differently. Why Architects Draw contains a useful treatment of the history and development of drawing and an interesting series of interviews. Robbins has presented the interviews with a minimum of interpretation or analysis, leaving that to the reader. The concluding analysis is more focused on the broader role of drawings, in relation to different audiences. A weakness in this book is that it contains no quoted passages from the interviews and, with the exception of a few words, could have been written prior to, or perhaps without interviews.

Deeper analysis of these, and other published interviews, to uncover clues and implications about discovery, could be a worthwhile adjunct to this research. However this has not been attempted in the present study.

COMMENTS ON INTERVIEW STUDIES

Interview studies are a blunt instrument in comparison with protocol studies. Statements by designers gathered during unstructured or structured interviews, are often wide ranging and difficult to verify and therefore are not always relevant, accurate or true. However, possible problems of respondent unreliability can be offset by utilising significantly larger groups of respondents than would be manageable with protocol studies. In their favour interviews are easier to schedule and administer and they require less commitment of time and effort from the respondents than protocol studies. The latter feature is significant because it influences respondent quality. Lawson (1997b, p.44), observes:

> One of the advantages of the interview is that we can sometimes persuade very good designers to allow us to interview them whereas, sadly, many of the laboratory experiments are carried out on students who are easily accessible to research workers!

For the research of this thesis either protocol or interview options could have been chosen, but ultimately a clear preference for interviewing eventuated. It would be possible to assemble a list of reasons for this decision but two critical factors, 1) the relative generality and explorative nature of the study and 2) the need to consider multiple designers in their professional setting, led planning towards an interview based study.

2.1.3 Cognitive research

Since the 1960s design research has been stimulated by and, to a growing extent, has embodied aspects of cognitive psychology. It is customary to think of cognitive psychology as a recent field and, of course, the field owes much, to recent research, associated with the information sciences. But while a great deal of cognitive research is recent, interest in the psychology of cognition is not new. The rapid development of cognitive psychology in the latter part of the twentieth century is substantially a revival of interest, ending a hiatus of about three decades.

EARLY PSYCHOLOGICAL RESEARCH

In the following summary of developments, from vigorous nineteenth century activity to the mid twentieth century resumption of cognitive research I have drawn extensively from Sternberg (1995, pp. 45-60).

Sternberg notes, that in the nineteenth century a series of conceptual approaches to psychology achieved prominence, sometimes in parallel with contemporary activities in other fields. A movement called *Structuralism*, can be regarded as a starting point. It became dominant while other scientists were identifying chemical elements, biochemical constituents of cells and physiological structures. German structuralist psychologist, William Wundt (1832-1920) proposed that psychology should focus on direct, as opposed to mediated (or interpreted) experience. Edward Titchener (1967-1927), a student of Wundt was also a structuralist for much of his career but was influenced by an American counter-movement, *Functionalism.* To illustrate the distinguishing features of structuralism and functionalism, Sternberg observes that structuralists asked "what are the [structures] of the human mind?" while functionalists asked, "What do people do and why do they do it?" Under the strong influence of William James (1842-1910), and later John Dewey (1859-1952), functionalism evolved into another movement, *Pragmatism*, which proposed that knowledge is validated by its usefulness. These developments have a special relevance to designing because of their association in time and place with *modernism* and Chicago, where Louis Sullivan, was invigorating architecture with similar ideas. Sullivan (1896).

Later in his career, Sternberg recounts, Titchener proposed that psychology should study not only sensation, but also the categories into which sensations can be grouped. Another movement, *associationism* was emerging. In contrast to Wundt's interest in elementary sensation, *associationists* studied higher-level mental processes, such as how experiences become associated to bring about learning. Hermann Ebbingaus, (1850-1909) a prominent associationist, developed more rigorous introspection and self observation techniques than Wundt had employed. Another associationist, Edwin Guthrie (1896-1959) developed these techniques further, observing animals, rather than himself. Guthrie studied stimuli and responses and proposed that the two events, when occurring at about the same time, repeatedly, become associated because of their *temporal contiguity*. Edward Thorndike (1874-1949) also studied animals. Thorndike was an associationist too, but he observed that formation of associations was related to *satisfaction*, not just *contiguity*. Thorndike's law of effect states that a *stimulus* will tend to produce a certain response (an *effect*) over time if an organism is rewarded (the *satisfaction*) for that response. Sternberg (1995, pp. 45-60)

The developments, described by Sternberg, are related to psychology in general and not directly aimed at revealing how people make discoveries. However they were heading in the direction of greater understanding of cognitive processes. Thorndike's discovery of the association between cause and effect was also a profound breakthrough. But unfortunately, in becoming influential, the law of effect had a stifling effect on cognitive research. Behaviourist researchers proposed that it was unnecessary to hypothesise complex mental mechanisms, if behaviour could be explained by simpler ones. Declining to acknowledge the human ability to think at a high level, behaviourists described thinking purely in terms of direct associative links between stimuli and responses. Behaviorists

attempted to explain problem-solving or goal-directed thinking, in terms of successive mental trial and error. No distinctions were made between processes involved in solving routine and nonroutine problems. Instead behaviorists proposed that a problem solver either generalizes from a similar problem, or engages in random solution attempts. Lawson (1997, p.134), Mayer (1989, p.51-52).

EARLY GESTALT RESEARCH

While the simple behaviourist view of human behaviour began to predominate, early in the twentieth century, it did not extinguish humanistic approaches. The associationist and behaviourist *elementistic* view was strongly rejected by *Gestalt* psychologists.

The term *Gestalt* originates from the German word *gestalten* (wholes). Use of this term to represent a theory is widely attributed to three German psychologists, Max Wertheimer (1880-1943) Kurt Koffka (1886-1941) and Wolfgang Köhler (1887-1967). Behrens (2004). Gestalt theory was applied to a range of behaviours including problem solving. Gestaltists made a point of studying non-routine or novel problems which, unlike routine problems, required qualitatively different thinking to produce a fresh or novel solution. Such solutions, they argued, would be unlikely to arise from random solution attempts, proposed by behaviourist explanations. Mayer (1989, p.51).

Max Wertheimer proposed that grasping the internal structure of a problem situation is the central component of what he called *productive* thinking, as distinct from normal *reproductive* thinking. Wertheimer advocated greater emphasis on the study of productive thinking, which he associated with structural understanding. Key notions in Wertheimer's perspective were that a problem must be viewed as a structured whole, rather than piecemeal. From this, it followed that internal structural relations were important and needed to be identified. Gaps or disturbances must be dealt with structurally. Operations must be considered in relation to their role in overall structural change. Wertheimer further noted that an initial, incorrect view of a situation can prevent a person from seeing its real structure and recognising what must be done to close the gaps in the structure. An initial view, he noted, might be vague; in that case, solution would require mainly that the situation be clarified. The transition from an inadequate view to a fundamentally different, more appropriate structural view, Wertheimer associated with insight. To solve a novel or non-routine problem, the solver must have *insight into the problem*, which typically means recognising how the parts of the problem fit together in new ways. Wertheimer (1959, pp.210-212) Dominowski (1995, pp.74-75), Mayer (1989, p.51).

Like Wertheimer, Wolfgang Kohler is also acknowledged for classic research on insight (Mayer, 1995, pp.10-12), and for initiating the development of a general system theory. Kramer & de Smit (1974, p.3). Kohler also distinguished productive thinking, involving a change in mental representation, from ordinary thinking. He noted that prior learning is required, not only to solve problems, but also to understand the nature of problems that one confronts. Although some problems might be solved by nothing more than recall and application of prior learning, other instances of problem solving require something more. Kohler argued that all problem solving concerns awareness of relations and that productive problem solving involves awareness of new relations among problem components, and that understanding these new relations, is what is meant by insight. Dominowski (1995, p.74). Dominowski also cites Maier (1940) who contrasted *habitual directions*, which result in reproducing old solutions, with *new directions*, which give rise to new combinations of experiences. The experiences may well be familiar, but the combination is new. Dominowski cites Maier's argument that reproducing old solutions could be accounted for by memory and associative processes, but that producing new combinations required an additional factor, a direction that is established in the problem situation and controls memory integration. Dominowski (1995, p.73). Direction, as Maier used the term, meant a *new direction*, or *re-direction*, in contrast to *habitual direction*, so that the concept of direction is related to restructuring. Mayer (1995, p.16), cites an observation to this effect made by another Gestaltist, Karl Duncker (1945, p.16), who states:

> What Maier calls direction... is nothing but the ... reformulation of the problem as it initiates the solution process.

Duncker's observation highlights a problem of lack of clarity and uniformity in early Gestalt theoretical writing and terminology that has, arguably, inhibited recognition of Gestalt theoretical ideas.

COGNITIVE VIEWS OF DISCOVERY

Cognitive views of ill-defined and ill-structured problems have already been reviewed earlier, in the context of Design Problems. However the theoretical bases and issues of cognitive psychology were not described. While it is not practical to attempt a comprehensive description in this thesis, it is necessary to identify important cognitive views and issues of discovery that are relevant to this study.

Cognitive psychological research, which became identifiable in the 1950s, was based on a fundamentally different premise to the behaviorist view, the assumption that humans are active, information-seeking and information-using organisms, rather than passive receivers of stimulation. Cognitive psychology combined elements from different sources. The new field maintained the methodology of experimental research, developed by neo-behaviorist psychologists during the twentieth century and continued to acknowledge the roles of learning and memory as keys to cognitive processes. Cognitive psychology also incorporated new concepts and techniques from computer science, information theory and linguistics. Reynolds & Flagg (1983, pp.8-13). Earlier investigations of mental structures and processes, and the experimental methods of German Gestalt and Wurzburg theorists, including think-aloud protocol study techniques were also influential. Mayer (1995, p.13), Simon (1999). Figure 2.1.3, copied from Simon (1999. p.7) summarises the chief European influences on the Carnegie-Rand group which included Newell, Shaw and Simon. Simon describes the European influences at length in this paper.

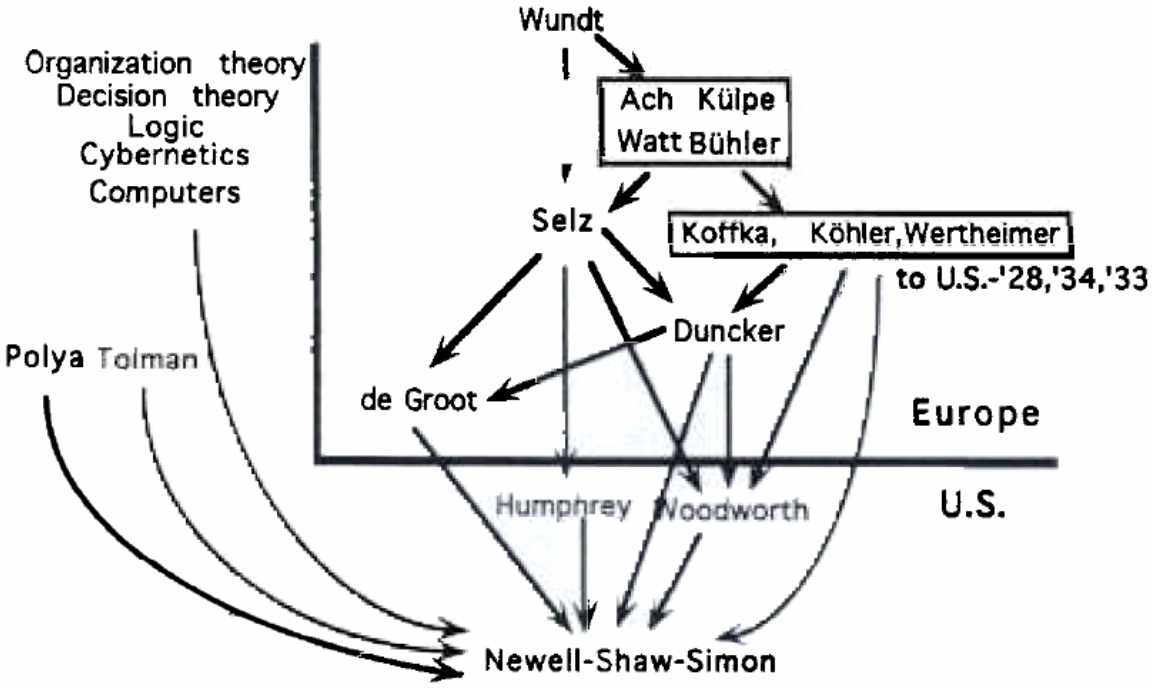


Fig. 2.1.3 - European and American Influences on Early Cognitive Simulation by the Carnegie-Rand Group. Copied (with minor print defects) from Simon (1999)

RATIONAL PROBLEM SOLVING

Many writers have referred to analogies between information processing in a computer and human thinking. Influences of both the theory and methods of cognitive science contributed to a shift in design research attention beyond foundation activities of defining idealised and generic methods, to more specific considerations of design problems and the direct observation of the minutiae of how people design. Simon's information-processing theory of human problem solving was developed in the first instance as a computer program in which the problem-solving behaviour is produced by a small set of elementary information processes, organized into strategies or programs. Simon (1978, p.279). His intention was to demonstrate that a system that performed such processes can solve problems, and produce behaviour that closely resembles human behaviour in the same problem-solving situations. It

is now a historical fact that work by Simon and others has achieved impressive successes. Elementary information processes for problem solving have been combined in experimental computer programs that simulate many forms of human behaviour in considerable detail. Simon (1978, p.279).

Simon (1984, pp.153-154) went further in speculating about the architect's processes, in the context of designing a house. He describes the generalities of commencing a project with a client, then adds:

> But the task itself, 'designing a house', evokes from his long-term memory a list of other attributes that will have to be specified at an early stage of the design: characteristics of the lot on which the house is to be built, its general style, whether it is to be on a single level or multi-storied, type of frame, types of structural materials and of sheathing materials, and so on. The task will also evoke from memory some over-all organization, or executive programme, for the design process itself.

At the time SImon made these statements problem solving models were substantially based on the notion of searching through static long term memory. More recently, some information processing researchers, exploring concepts such as situatedness, the use of agents and the view of creativity as an emergent social behaviour have introduced the possibility of more interactive and diverse information processing. Gero (1997). Other studies, on constructive memory and situated analogy, are acknowledging a model of memory that is not laid down and fixed, but instead is newly constructed, every time a recollection is needed. Gero (2002, p.5). These models appear much more human-like than earlier constructs and, in my view, appear to be moving more towards Gestalt ideas rather than away. This view will be developed further in future studies.

EVOLUTIONARY VIEW

Daniell Dennett is a philosopher who has advocated a whole hearted recognition of the full import of evolutionary theory in relation to human behaviour including manifestations of cognition such as consciousness, creativity and designing. An appreciation of where he stands is evident in the following passages from Dennett (2004, p.272).

> There are thoughtful people who scoff at Creationism, dismiss dualism out of hand, pledge allegiance to academic humanism–and then get quite squirrelly when it is suggested that a Darwinian theory of creative intelligence might be in the cards, and might demonstrate that all the works of human genius can be understood in the end to be products of a cascade of generate-and-test procedures that are, at bottom, algorithmic, mindless.
>
> A key part of Darwin's great revolution is that we are part of it. Human beings are just one species among many, fully biological, and hence capable of no miracles, restricted to the same sorts of processes and methods as the other species.

Dennett makes a compelling case, but accepting the evolutionary model and developing useful theories of human intelligence from it are different undertakings. Behaviourism, the dominant paradigm in psychology for nearly half a century, is essentially Darwinian. Its displacement, by cognitive science, was not the outcome of a failure of acceptance of evolutionary theory. Behaviourism was simply failing to progress. Indeed evolutionary concepts (eg. evolutionary algorithms) have been a part of cognitive research. The task for evolutionists, attempting to make sense of behaviour, is the complexity of so much intelligent behaviour that is wilful, in the *kicking the sandcastle* sense. The few, high level *chunks* of wilful selections, constantly over-rule and scramble the many, low level *particles* of natural selection. Humans are top-down creatures when it suits them, even when it isn't good for them; especially when it isn't good for them, may be truer.

CREATIVE COGNITION VIEW

The *Creative Cognition* approach, proposed by Finke, Ward, & Smith (1992, pp.17-26) is a considered alternative to Gestalt theory that is based on the idea that any cognition may be more or less creative. Finke et al propose that all cognition results from the same types of underlying processes, of which any may help to set the stage for creative insight and discovery. The Gestalt notion of productive thinking is replaced by two main types of processes; those used to mentally *generate* cognitive structures, or internal representations and those used to *explore* the creative implications of these structures. Rather than focus on problem structure, the Creative Cognition researchers propose that mental constructs, which they describe as *preinventive* cognitive structures, are formed by problem solvers and these semi-formed constructs are used to internally represent patterns, models, combinations and other constructs and may be externalized at any point in the creative act.

Like Mayer, (1989, p.40) who observed that a problem (or barrier) always exists relative to the problem solver, the authors of Creative Cognition distinguish cognitions that give rise to an idea from the

quality or value of the idea itself, since an idea could be arrived at resourcefully or accidentally. They emphasise the need to establish the cognitive processes and structures that are behind an idea and to identify the conditions under which creative discovery is likely to occur.

Interactions between the two processes are conceptualised by these researchers in what is referred to as the Geneplore model, which provides a unified account of the two phases of creative cognition. In the initiating *generative* phase one constructs pre-inventive structures, or mental representations having various properties that promote creative discovery. These properties are then exploited during an *exploratory* phase in which one seeks to interpret the preinventive structures in meaningful ways. Finke et al (1992, p.17).

Additional views on specific components of Gestalt theory offered by the authors of Creative Cognition are included in the discussion of the actual Gestalt components. Broadly speaking, Creative Cognition can be applauded for its attempt to provide a transparent rational generation model that is not entirely memory driven. However the plausibility of the Geneplore model and theory is limited by a lack of evidence that individuals generate and utilise preinventive forms in their daily activity. It is evident that the preinventive forms supplied to experimental subjects (typically odd looking shapes) are research devices that need not resemble an individual's spontaneously generated pre-inventive forms. But, that being so, there is a need for explanation and demonstrable confirmation of how people actually construct, harbour and employ partly formed mental representations that promote discovery in actual everyday settings.

The preinventive forms that designers may employ could have many forms. One may expect many to be visual, given that the first impression of architecture is typically visual. However *form* in architecture is not only visual. Form also embodies meaning, for example. So that pre-inventive forms could have a conceptual *other* nature, be deeper or more semantic and still be pre-inventive, or *half-baked,* to employ a more common term. The instances of pre-inventive forms Finke, Ward, & Smith refer to in describing their theory and research studies give an impression that individuals may possess many of these structures, that they may be quite abstract, but still useful tools, in problem solving. While this view is not disputed, it is also possible that designers may possess particular pre-inventive items (or pre-ideas) that they are groping towards, and not know or recognise them, until some moment of realisation. These forms are preinventive by definition, but they are not tools. They could be more like a curse to some individuals. People sometimes describe being driven by a *burr under the saddle* or a *gut feeling*. They may be driven by vague forces and urges which they can't fully realise, for weeks, months or years and then one day the pieces come together and a critical combination is recognised.

One possible architectural interpretation of pre-inventiveness is Darke's *generator-conjecture-analysis* view, referred to earlier, under Interview Studies. Darke (1979, p.38). The second and third stages of Darke's model (conjecture and analysis) are arguably not unlike the second stage of the Geneplore model (exploring). As mentioned earlier, Darke had noticed that architects she was interviewing were able to design more rapidly by latching on to a relatively simple idea, or what she refers to as *primary generators*, early in the design process. She cited an observation, by Hillier, Musgrove and O'Sullivan (1972, p.29-3-3), that design is *essentially* a matter of prestructuring problems, and proposed that the conjectures of approximate solutions are required early when designing, because many design decisions cannot be taken before the solution in principle is known. Darke proposed that designers use primary generators in conceptual design. Primary generators are mental constructs that Darke describes as components of the designer's cognitive structures. Primary generators may be value judgements or ideas that generate conjectures. By this characterisation primary generators may be regarded as analogous to pre-inventive forms. This raises research questions that are considered further in 6.6.3 - Further cognitive studies.

THREE PROCESS VIEW

In The Mind of the Puzzler, Sternberg and Davidson (1982) introduced a theory that originated from an interest in puzzles, or problems requiring *flashes of insight* or *leaps of logic*, rather than prior knowledge or laborious computation. Their curiosity at how people approach such puzzles (called insight problems) and whether they provide a valid measure of a person's intelligence led to a literature study and experiments to measure the relationship between performance on insight problems and scores on standard intelligence tests. Based on that research Sternberg and Davidson identified the following group of three intellectual processes that, separately or together seemed to be required in solving most insight problems:

1) *Selective encoding*, or the ability to select and "encode" information - ie. To understand which information is relevant to solving a problem, and how it is relevant. Selective encoding insights

typically occur when one recognises, frequently from an abundance of information, one or more things that have not previously been obvious. The insight involves sorting out information that is relevant from information that is not. Davidson (1986, p.205). Davidson describes a range of examples, such as doctors, or detectives solving cases, by recognising obscure symptoms or clues.

It is not difficult to imagine how selective encoding may be associated with insights in the context of designing. Designers sometimes find that a lot of information received from a client, or that is regarded as high priority by a client, is a reflection of a client's dislikes, based on their current experiences. The expression of what the client doesn't want can drown out the expression of their actual needs. Selective encoding in this case may begin with the realisation that the client is not addressing critical design requirements.

2) *Selective combination,* or the ability to combine different and seemingly unrelated bits of useful information. Selective combination insights occur when one puts together the apparently unrelated elements of a problem situation in a way that has not previously been obvious. As with selective encoding the necessary elements of the solution are available and visible. The insight may be associated with recognising a potential for, or a manner of combination.

3) *Selective comparison,* or the ability to compare the problem under consideration, with problems previously encountered, and recognise the analogy of another. Selective comparison appears to be comparable with the transfer process of analogy described by Gero (1990) and referred to earlier in Design Paradigms.

2.2 APPLYING THE GESTALT LEGACY

Throughout the twentieth century Gestalt research and interest in Gestalt theory has continued. While other theories of psychology have dominated, Gestalt theory has prompted many shades of response from direct attacks, faint praise, reinterpretations, and qualified reaffirmations - never wholly accepted or decisively rejected. Gestalt views of problem solving and insight have been revived by the development of cognitive psychology. There is qualified recognition of the value of Gestalt research and of some Gestalt concepts and approaches by cognitive researchers. Greeno (1978, p.240), Simon (1999). At the same time there are active Gestalt critics, who oppose general acceptance of the theory. Weissberg (1994, 1995).

As this thesis utilises Gestalt concepts to evaluate design discoveries it is necessary before proceeding to identify: 1) Perceived weaknesses and strengths of Gestalt theory, 2) How the research should reflect alternative viewpoints and 3) Theoretical components that will be employed in the research. The first and second of these are addressed in the next section, 2.2.1 Perceptions of Gestalt theory. The third is addressed in the section after, 2.2.2 Analysing discovery. Together, these provide a starting point for Chapter 3, Methodology.

2.2.1 Criticisms of Gestalt theory

It is not difficult to identify both a general critique and to find counter views and alternative interpretations of particular Gestalt theoretical components. Starting with the general, the following collection of the main criticisms has been drawn from prominent researchers.

GENERAL LIMITATIONS OF GESTALT THEORY

Several well known researchers have criticised general shortcomings of Gestalt theory. Weisberg (1994, p.157) has proposed that, over many decades:

> … we have not learned very much about insight, however, because it is still the center of controversy.

Weisberg cites examples of disagreement amongst researchers about the general need to invoke a special construct called insight in theories of problem solving. Three of the opposing papers Weisberg cites are written by him, but he is not the only critic. The fact that experts disagree on this matter is undeniable. However Weisberg has not offered reasons why, in this particular case, controversy has inhibited research progress, rather than attracting research and stimulating progress, which controversy is also known to do.

A more substantial issue than controversy has been raised by Greeno, (1978 pp.239) whose concern is with the little that Gestalt theory has provided, for building a solid body of theory

> Studies conducted by Gestalt psychologists provided numerous examples of thinking processes that were analysed insightfully, but few principles emerged that could lead to the development of a solid body of theory.

Greeno has also expressed concern that (at least in the late 1970s) information processing research too lacked a coherent body of theory. Greeno (1978 pp.239).

> Information processing psychologists have taken up the detailed analysis of problem solving that was begun by Gestalt psychologists, and this is being done in much more rigorous and systematic ways than were characteristic of Gestalt theory. But the analyses have been relatively specialised … Information processing theorists have provided strong concepts for use in analysing specific tasks but have not yet developed a coherent body of theory made up of general psychological principles that explain

> performance in broad classes of problems.

Greeno's critique is interesting because it expresses a real problem, the lack of a solid body of theory, but it also indicates that the shortcoming is situational. Thirty years later, cognitive science generally is still fair game for similar criticism, but the weakness is one of incompleteness, rather than a fundamental wrong. Cognitive scientists have drawn from the well of Gestalt theory, wished it contained more and possibly still do, but this is a problem that can serve to prompt greater effort.

INSIGHT NOT CLEARLY IDENTIFIED

A deeper issue for consideration is the nature of insight itself. One theorist, Davidson (1986, p.203) proposes that Gestalt theory does not adequately identify what insight is. She states:

> Calling insight an "unconscious leap in thinking" or a "short-circuiting of normal reasoning" leaves insight pretty much as a "black box" of unknown contents. Even were one of these theories correct, just what insight is would still need to be identified.

One problem is confusion about whether insight is a cause or an outcome. Wertheimer, referred to earlier, stated that the solver needed to have *insight into the problem*, or recognise how the parts of the problem fit together in new ways. Mayer (1995, p.3) describes insight as a process.

> The term *insight* has been used to name the process by which a problem solver suddenly moves from a state of not knowing how to solve a problem to a state of knowing how to solve it.

In Mayer's interpretation, the key to creative problem solving is the process by which a person understands the underlying structure of a problem, a process that the Gestalt psychologists called *insight*. Mayer (1995, p.28). However the *new direction* view of problem solving of Maier (1940) interprets insight as a consequence of problem solving, an attained state rather than a cause. The *restructuring* view could be interpreted in a similar way. To gain insight then, is to understand (something) more fully, or to move from a state of relative confusion to one of comprehension. By this view, insight is not itself a process, it is a part of the process of problem solving. Dominowski & Dallob (1995, p.39).

In any system there can be processes within processes, and some may be the outcome of others. This issue of definition is not symptomatic of a fatal flaw in Gestalt theory, but it certainly indicates a need to better coordinate the terminology.

SHORTCOMINGS IN THE METHODOLOGY OF GESTALT RESEARCH

Davidson (1986, p.203) also proposes that special process research (including Gestalt research) lacks experimental rigour and testable propositions.

> … it does not pin down what insight is. Defining *insight* as an "unconscious leap in thinking" or a "short-circuiting of normal reasoning" leaves us with a black box of unknown contents. Even if the special-process view were correct, just what insight is would still need to be identified.
>
> … the bulk of the evidence in support of these views is anecdotal rather than experimental, and for each piece of anecdotal evidence to support one of these views, there is at least one corresponding piece of evidence to refute it..
>
> … the positions are probably not specified enough, as they stand, to permit empirical test. As a result, it is not clear that the positions are even falsifiable.

The issue of inadequate testability is related to the terminology problem referred to above. It is ironic that a theory associated with one of the founders of system theory, about wholes and parts, should be weak in the area which needs to be a conspicuous strength. The approach taken in this research is to view insight as an experiential concept which combines a number of components, and to look more closely at the components.

NO NEED FOR A THEORY OF INSIGHT

Advocates of the null hypothesis, are skeptical of the distinctions claimed between processes involved in solving routine and nonroutine problems. This viewpoint has been described in research literature on the subject as the *nothing-special* view Davidson (1995, p.125), or the *memory* position, Finke, Ward & Smith (1992, p.144).

Examples of apparently significant creative accomplishments that may have occurred on the basis of reproductive thought, and therefore without restructuring, have been proposed by Weisberg (1995). These include Picasso's painting Guernica, Edison's electric lighting system and the discovery of the

DNA double helix, by Watson and Crick. Weisberg's aim is to counter the view expressed by some theorists that a reliance on past experience can interfere with effective problem solving. While these examples are well known, critically evaluating them in detail is beyond the scope of this study and perhaps unnecessary. Weisberg's case is inconclusive, being largely based on his assertions, that steps in the development of each work were incremental, because there was continuity with earlier work. In making this case Weisberg appears to be disregarding the possibility that a succession of insights could be wrongly viewed as incremental steps, simply because they are continuous. In addition, while Weisberg suggests that the examples he describes are creative works, he offers no evidence that any of his examples or any particular steps in their development have been claimed as insightful, either by the practitioners, or by anybody else.

In a study of scientists, Simon observed the respondents set themselves many different kinds of tasks, such as formulating problems, discovering phenomena, finding laws, inventing representations and so on. He concluded that in performing these tasks they appear to employ the same general kinds of problem-solving processes that other people, including architects, employ in their work. That is, they engage in heuristic search in a number of problem spaces. SImon nominates some of these, including spaces of theories, experiments, problems, phenomena, representations and so on, according to the contents of the individual memory. Turning to insight, Simon (1989, p.376) proposes:

> … the insight that is supposed to be required for such work as discovery turns out to be synonymous with the familiar process of recognition; and other terms as judgement, creativity, or even genius - appear either to be wholly dispensable or to be definable, as insight is, in terms of mundane and well understood concepts.

Given Simon's authority on the subject of his research, one hesitates to question such a statement. However, mindful of the inhibition, I think it is reasonable to ask the question, "dispensable for what purpose?" If the objective is to develop algorithms that perform a task in a computer, then there may be no need for a concept, until its computational viability is demonstrated. It could be true that low level processes that lead to an insightful discovery, by a person, may be like the processes that lead that person to a similar, non-insightful discovery. Conscious thoughts are no more than glimpses of the totality of mental activity, in millions of cells, at any moment. It is possible that, at the *machine* level, all human mental operations, insightful or otherwise, are based on a finite set of functions, like a computer's instruction set, which are the foundations of all mental activity. Differences between insightful and non insightful discovery at that level may be circumstantial and a matter of degree, reflecting the extent to which the problem solver is (say) functioning actively or passively. Differences in mental *noise* levels from one state and situation, to another, for example, may also be influential.

However conceding such points and dismissing Gestalt theory in its entirety are not inseparable. The clues from Gestalt theory are still indicative of other well articulated subtleties of human thought that may still be informative and useful. The reductionist approach made manifest in behaviourism also provided a functioning theory, but one with limited utility. It was shown to be deficient and has lost currency, as the cognitive premise, of humans as mentally active organisms, has been increasingly confirmed by research. Like behaviourism, the search based information processing model may also be an incomplete construct. It functions, but it is a bleak interpretation of human capability.

One critic of the information processing view who advocates a fresh look at the products of Gestalt research is Mayer. He uses four terms of reference in his critique; atomisation of problem-solving elements, componentialisation and mechanisation of problem solving processes, and concretisation of problem-solving states. Mayer (1989, p.54). Broadly speaking Mayer's critique is not so different to that of Rittel or Schon, that the decomposition process inherent in the information processing approach eliminates much of the *mental chemistr*y and the interactive dynamics of human problem solving, which are often crucial in determining which solution is realised. Mayer (1995, p.26) concedes that the Gestalt psychologists and their predecessors failed to provide a coherent theoretical account of human cognition, but also proposes that the Gestaltists' left us with questions, the beginnings of answers and a challenge:

> … to reformulate and clarify in a more productive way the questions we have inherited…

Just as ecosystems, such as rain forests, are treasured as a source of undiscovered chemicals and life-saving drugs, humans in their everyday environments are a similarly rich living source of revelations about the subtleties of intelligent behaviour. In this study, the key research question is not whether insight is necessary, or unnecessary, but whether appreciable numbers of designers experience insightful discoveries that assist their conceptual designing. This can only be answered by studying fewer, but still appreciable numbers of designers. The Gestalt model is pertinent, in being the

first systematic treatment of insight and in continuing to be the most comprehensive and best known interpretation of insight, by far. It can be conceded that Gestalt theory is a work in progress, incomplete and destined to be superseded by a more powerful and rigorous variant or alternative theory; that does not yet exist. But for now, Gestalt theory remains the richest source of clues and tools that can be applied to the study of human intelligence as found and the insightful discoveries of working designers in particular.

2.2.2 Analysing discovery

Discovery can be analysed by reference to components commonly associated with problem solving generally, which are fundamental to the Gestalt view of *insight*. In this initial description I have utilised an informative review of the stages of problem solving, by John Zakis found in an e-journal paper. Zakis (1997). Late in the nineteenth century (Zakis recounts) physicist and physiologist Hermann Helmholtz, described a three stage thought process, to which he attributed his scientific discoveries: *saturation, incubation* and *illumination*. Subsequently Henri Poincare proposed a similar model with a fourth item, *verification*.

The first item, *saturation* takes place as the problem solver becomes deeply involved with the problem. Zakis (1997, who also cites Helmholtz and Poincare). Later, Wallas (1926, p.80) interpreted *saturation* more broadly, as *preparation,* by which he meant the stage when the problem is investigated in all directions. This characterisation appears to have substantially displaced *saturation* in discussions about problem solving and is commonly used in research writings about insight. *Incubation* is widely recognised as a mulling over stage, when the problem solver ceases to work on the problem, typically after getting stuck. *Illumination* is said to take place when the problem solver experiences insight into the problem solution and *verification* occurs when the solution is tried and checked. Zakis (1997). Two aspects of illumination are distinguishable, the insight itself and the experience of having the insight. In Gestalt theory, insight is associated with changes in awareness of the problem or goals, called *restructuring*. Dominowski (1995, pp.75). The moment of illumination is popularly perceived as a sudden or unexpected event, popularly described as an "*aha!"* experience. Simon (1990, p.374).

An additional component, *fixation*, or a mental block inhibiting problem solution, occurring after the beginning of preparation and before restructuring, is also an integral part of the Gestalt view. Fixation has been studied specifically, by design researchers, Jansson and Smith (1991), Purcell and Gero (1996).

Five components of discovery have been distilled from the above concepts for more detailed consideration. They are: 1) Preparation, 2) Fixation, 3) Incubation, 4) Restructuring and 5) "Aha!" experience. These five components form the structure of the remainder of this chapter and of the research analysis of insightfulness described in the next Chapter.

PREPARATION

Preparation has been formally described as a period in which the problem solver gathers information, learns about, becomes familiar with, or "chunks" the problem, its elements and possible manipulations, thereby becoming more expert about the problem. Kaplan & Davidson (1988, p.18). Preparation is also thought to entail a confrontation with the problem and involves such actions as problem analysis, mental representation, conceptualising of the problem's core aspects and unsuccessful attempts to reach a satisfactory resolution. Seifert et al (1995, p.75).

Preparation is a logically indispensable component of the Gestalt view of problem solving for the simple reason that the problem solver needs to engage with the problem, to first recognise that it is novel, to appreciate that the situation is problematic and, thereby, become more likely to recognise or devise an approach, or approaches, that differ from what has previously failed. Davidson & Sternberg (1986, pp.177-179).

Preparation can therefore be regarded as necessary for insightful problem solving, but not a sufficient condition. There is no reason to expect that preparation alone will necessarily be rewarded by an insight.

FIXATION

The view that misinterpretation, or inappropriate representation is an influential *force* directing problem-solving, by providing resistance to new interpretations and inhibiting recognition of the true structure, is a key component of the Gestalt view of insight. Gestalt psychologists were especially concerned with misinterpretations and failure by an individual to see the *true structure*, describing the person as being *fixated* on an inappropriate interpretation of the problem. A clearly demonstrable form of fixation is *functional fixedness* which arises when the common or habitual use of an object appears to inhibit or distract the problem solver from thinking of another use. Of particular interest to Gestalt researchers were occasions when an individual misinterprets a situation or fails to see the *true structure*. Gestaltists regarded fixation on an inappropriate representation as a negative force, mis-directing problem solving efforts and providing resistance to a new interpretation. Mayer(1995, p.17).

There are different views of the mechanism of fixation. Dominowski & Dallob (1995, p.46) refer to a suggestion that fixation may be regarded as a temporary blockage of retrieval of information needed for a solution. The often temporary nature of fixation as apparent from experiments where subjects respond to hints, however the view of fixation as necessarily a problem of retrieval (rather than, say, unwillingness to search) could be questioned.

The phenomenon of fixation has been demonstrated in a variety of studies, including some design research. Jansson and Smith (1991, pp.3-11), Purcell and Gero (1996, pp.363-383). In idea-generation experiments with engineering students and professional engineers, Jansson and Smith found compelling evidence that fixation can occur. Purcell and Gero carried out a more complex series of experiments employing similar experimental designs to Jannson and Smith, with groups of both, novice and advanced architecture, industrial design and engineering students. Significant differences in fixation effects were found among the different groups. For example no evidence of fixation was found among the advanced industrial design students. Purcell and Gero associated fixation, where it occurred, with the absence of domain specific knowledge and a reliance on everyday knowledge, particularly when activated by exposure to a picture of a familiar example. They also concluded that fixation appears to exist in a number of forms and therefore one should avoid becoming fixated on any particular one.

INCUBATION

The view that solutions to problems, revelations, or insights are often realised by individuals, not while they are making efforts to solve a problem, but some time after they have stopped is not uncommon. Kohler (1969, p.163) described an interesting anecdote in his final public lecture, in 1966. Speaking of his personal experience, Kohler said:

> … new insights always occur when I am particularly inactive, either when taking a warm bath in the morning or, a bit later when I am shaving - both situations in which my eagerness to do mental work is exceedingly small. A well-known physicist in Scotland once told me that this kind of thing is generally recognised by the physicists in Britain. "We often talk about the three B's," he said, "the Bus, the Bath, and the Bed. That's where the great discoveries are made in our science."

This experience seems remarkable when it takes place after little, or no apparent effort has been expended in the time following ungratified early attempts at solution. *Incubation*, the metaphoric name given to this apparent mental *hatching* phenomenon, has been defined minimally as any interruption of conscious problem solving that later appears to have aided in attaining the solution. Kaplan & Davidson (1988, p.3). Kaplan & Davidson's definition reflects the fact that a specific process of incubation has never been conclusively demonstrated.

INCUBATION AS CONSCIOUS PROCESSING

In a review of proposed mechanisms of incubation Kaplan & Davidson (1988) compare and contrast the Gestalt theoretical view of incubation, as an unconscious but active constructive process, and alternative views, that account for incubation effects by means of conscious processing. They acknowledge that the unconscious work view is intuitively appealing but note that it relies on vague notions such as the *subliminal self*. One very simple counter explanation they offer is that series of brief conscious thoughts may, when unsuccessful, are simply forgotten. Kaplan and Davidson note that attention can be so intensely concentrated on a problem that it brings about a loss of self-consciousness and a corresponding failure to remember that one has even worked on the problem.

In order to better understand the differences between alternative views Kaplan & Davidson propose an operational approach whereby the term conscious is used to denote processes that can be verbalised and unconscious to denote processes that can not. Reference is made to the work of Ericsson & SImon (1984) who propose that only the contents of working memory can be verbalised. Applying this approach to an example Kaplan & Davidson first note that a person may recall and verbalise a fact they had previously stored in long term memory. The person will be conscious of the retrieved fact once it reaches working memory and is verbalised, but will be unconscious of the *process* of retrieving that fact. This, they propose is because *retrieval*, like *forgetting* and *priming*, operates independently of working memory. Kaplan & Davidson describe forgetting operationally as decay of activation of nodes in long-term memory, and *priming* as an increase of activation of these nodes. Forgetting, they add, decreases the probability of a node becoming a part of working memory and conversely, priming increases this probability.

Apart from forgetting and priming, Kaplan & Davidson argue that the other components leading to incubation effects are entirely conscious. This, they propose can be attributed to limitations of working memory. If there is a rapid turnover of information in working memory, while thinking about a problem, intermediate results may not stay in working memory long enough to be encoded into long term memory. Once a solution is reached a person may be conscious of an answer (currently in working memory) but retain little or no recollection of the path of thoughts that led to it.

The importance of this approach to the current study is mainly that it demonstrates that the distinction between unconscious, unnoticed and forgotten cognition is a very fine one.

RESTRUCTURING

Gestalt psychologists considered *restructuring,* or acquiring a new understanding of a problem situation, to be an essential component of insight. In the Gestalt view restructuring was thought to involve reformulating or changing from one representation of a problem to a different representation. Mayer (1995 pp.12-13).

Gestalt concepts

Mayer (1995) reviews a series of interrelated concepts drawn from the Gestalt tradition that were alternatives to theoretical views of problem solving at the time of their formation. These are described below, followed by some background information and comments.

REFORMULATION

Two opposed methods of reformulation were first identified by Duncker, suggestions from above and suggestions from below. Key points about the two methods based on descriptions in Mayer (1995, who cites Duncker, 1945) are as follows:

Suggestions from above. The insight occurs when the problem solver mentally redefines and clarifies, or reformulates the givens (ie. the problem) or the goal. Reformulation may occur once or, in complex problem solving, there may be a succession of insights progressing from the general to the specific. Mayer (1995. p.14).

Suggestions from below. The insight occurs when the problem solver reformulates the givens in a new way. Duncker has proposed that the major difficulty in problem solving is to understand the problem givens and goal in a productive way. The concept of suggestions from below is associated with the way the problem is presented. If restructuring results in an abrupt transition from one problem representation to another, then, as Dominowski & Dallob (1995, p.52) describe it, a good representation can lead quickly to a solution.

> …which should appear suddenly and disconnected from previous solution attempts rather than as a natural extension of prior efforts.

Suggestions from above, as the name suggests, is a top-down process. For example, the problem solver may recognise that the goal posts, or the ball, can be moved. Suggestions from below, in contrast, is a bottom-up process. In this type of insight the problem solver may recognise some previously unnoticed characteristic of the ball, or the goal posts.

COMPLETING A SCHEMA OR SCHEMATIC ANTICIPATION

The schema completion view is attributed by Mayer to Otto Selz (1881-1943) who originated the notion of *schematic anticipation*. Selz proposed that problem solutions are not the outcome of a senseless play of associations. Mayer (1995). Mayer refers to the following propositions that form Selz's theory of *schematic anticipation*. Mayer (1995, pp.8-9).

- Goal-directed cognitive operations must be initiated by a schematic anticipation of the goal.
- A problem is a coherent set of information with a gap.
- Creative problem solving involves figuring out how the givens and goal of a problem fit together within a coherent structure
- If the solution to a problem is not immediately obvious, subjects attempt to build a structure.
- New specific responses occur only as integrated members of a system.
- Insight occurs when a problem solver fills in a gap in a larger system or complex.

The great significance of Selz's observation, Mayer (1995) notes, is that it was psychology's first non-associationist theory of problem solving. It foreshadowed both Gestalt thinking and cognitive psychology. Selz's ideas influenced Gestalt theorists, particularly Duncker and both his ideas and protocol methodology have influenced cognitive psychology. Newell, Shaw & Simon (1958, p.153), Newell & Simon (1972. p.875), Simon (1999, pp. 9-10).

Selz's pre-Gestalt model does not include restructuring. However it is not clear from Selz's writings that structuring and restructuring are cognitively distinct. Simon credits Selz with finding the underlying structure of means-ends analysis and thereby of heuristic search. It is clear from the following statement by Simon (1999, p.10) that problem solving by schematic anticipation is not a one-off event, but rather is a process, involving a series of structuring and restructuring acts.

> What Selz does is to show how problems in general may be solved by replacing an initial schematic anticipation with successive new ones, derived from A (a given concept) and R (a relation), that approach closer and closer to the desired B (a desired concept).

Having regard for the above points, schematic anticipation may be regarded as both a structuring and a restructuring process which, in the design context, sounds very much like conjecture.

SUDDENLY REORGANISING VISUAL INFORMATION

In this model, which reflects the visual nature of insight, insight occurs when a problem solver literally looks at a problem situation in a new way - that is, when the visual information suddenly is reorganized or restructured in a way that satisfies the requirements of the goal. Mayer (1995).

Mayer (1995, p.11) refers to Kohler's observations of problem solving behaviour in experiments with apes. Mayer notes that Kohler, 1) proposed that insights, he had observed, were principally determined by an optical apprehension of the situation and 2) concluded that trial and error models of learning could not produce the successful ape responses, particularly not in the manner they emerged. Mayer summarises Kohler's description of insightful problem solving as the production of behaviours that:

- Represent *complete methods of solution* rather than individual responses,
- Appear *quite suddenly* rather than being gradually reinforced, and
- Were *never practiced formerly* - ie. They are not reproduced from prior experience.

Mayer also notes that interest in visual thinking is evident in modern cognitive psychology, in the work of Finke (1989) and Kosslyn (1980) and Mayer (1989). This is equally true of the field of design research. In Sketching Studies, referred to earlier under Protocol Studies, a number of different lines of enquiry into the ways designers employ sketches and drawings, or use their Mind's eye as a virtual space to model their spatial ideas and make visuo-spatial decisions, are described.

OVERCOMING A MENTAL BLOCK

Mayer notes that insight occurs when a problem solver overcomes a mental block and suggests this is an alternative to restructuring, rather than a trigger. Mayer (1995 p.17). Maier (1940) contrasts *habitual direction* (broadly synonymous with fixation) with *direction* (broadly synonymous with restructuring). But this is not the way fixation is viewed by Gestalt pioneers such as Wertheimer,

whose descriptions of insight combine the initial inadequate view hindering recognition (fixation) and the transition to a fundamentally different, more appropriate structural view (restructuring).

In this study, fixation (and overcoming fixation) is treated as a component of insight.

FINDING A PROBLEM ANALOG

Mayer (1995) credits Max Wertheimer, with suggesting that insight sometimes involves grasping the structural organisation of one situation and applying that organisation to a new problem. Wertheimer (1959, cited by Mayer, 1995, p.21) stated that the critical ingredient was the quality of the experience, with the following statements;

> - Successful transfer from one problem to another depends on not just past experience but the nature and structural fitting of past experience.
>
> - past experience is of high importance, but what matters is what one has gained from experience - blind, misunderstood connections, or insight into structural inner relatedness. What matters is how and what one recalls, how one applies what is recalled, whether blindly, in a piecemeal way, or in accordance with the structural requirements of the situation.

Mayer raises the point that solving a new problem, by using a previously solved problem, depends on experience and, thereby, could be said to support the associationist view. However, while acknowledging the value of prior knowledge and expertise, Mayer emphasises that the insightful use of analogy involves the emergence of something new, by the problem solver abstracting a general principle, or structure from specific problems, or recognising that a new and old problem share the same underlying structure. Mayer adds that, while expert problem solving depends on domain specific knowledge, experts possess both relevant knowledge and the capacity to use it. They represent problems differently to novices. They focus on the underlying structure and principles, whereas novices tend to focus on surface characteristics.

An educational implication of these observations, supported by experimental research by Wertheimer (1945 and 1959) and Katona (1940), both cited by Mayer, is that learners of problem solving need to develop the ability to focus on the structural organisation of a situation, rather than its surface features. Mayer (1995, pp.21-24)

Other Cognition views of restructuring

CREATIVE COGNITION

The Creative Cognition approach, described earlier in Cognitive views of discovery, envisages two main types of processes, those used to mentally generate cognitive structures, or internal representations and those used to explore the creative implications of these structures.

- Generative processes include retrieval, association, synthesis, transformation, analogical transfer, categorical reduction.
- Exploratory processes include attribute finding, conceptual interpretation, functional inference, contextual shifting, hypothesis testing, searching for limitations.

Since these processes are common to both insightful and non-insightful thinking no attempt has been made to apply them to the research in this thesis. However it is possible that the employment of pre-inventive mental structures, by respondents in their designing, may be identifiable. Finke, Ward, & Smith (1992)

THREE PROCESSES OF RESTRUCTURING

Sternberg and Davidson's identification of three intellectual processes associated with the solving of insight problems, namely selective encoding, selective combination and selective comparison, has been referred to earlier. Sternberg and Davidson (1982). The three views can be regarded as potential modes of restructuring.

- Selective encoding, or recognising what is relevant, is akin to items nominated by Mayer, especially Selz's *completing a schema,* given that relevance must be based on some form of schematic anticipation. The notion of bridging or filling a gap may also be associated with views of designing expressed by Cross & Dorst (1999, p.253).

- Selective combination, or recognising a potential for, or a manner of, combination, is implicitly structural and may be equated with Selz's *schematic anticipation.*

- Selective comparison, involving the recognition of analogies, is conceptually similar to Wertheimer's *finding a problem analog* and *analogical design*

No need for restructuring

Weisberg, who advocates a null hypothesis, provides two after-the-fact tests that may be used to evaluate whether restructuring has taken place. Weisberg (1995, p.56)

> 1. To determine if a problem is solved through restructuring, ask if the solution requires that any of the elements of the representation be changed.
>
> 2. Whether a given problem is solved through restructuring depends in part on the way the problem solver approaches it: if a person produces the "insight" solution right away, then the problem in question is not solved through insight, since there is not ever discontinuity in thinking, much less a restructuring

Earlier references to Simon under the heading *No need for a theory of insight* can also be interpreted as no need for a theory of productive thinking in relation to restructuring, since Simon (1989) attributes the insight required for discovery to recognition. This appears to me to be an odd position to defend for the following reasons. 1) At face value there appears to be nothing to gain from the proposition that humans are incapable of appreciating new relationships, or reinterpreting familiar things in new ways. 2) Three different forms of recognition are defined by Sternberg and Davidson. All may involve or prompt insightful restructuring, and 3) Some Gestalt views of insight, or productive thinking, can also be interpreted as forms of recognition. For example, Wertheimer (1982) described grasping the internal structure of a problem situation as the central component of productive thinking. Grasping is a metaphorical term meaning to get a mental hold-of, or to comprehend. It is marginally distinct from recognition in being more inductive, perhaps. But if there is a distinction it is trivial.

Having read and considered a variety of views I find it difficult to see why the *grasping* v *recognition* distinction should be a sticking point between Gestaltists and the *no-need* position. The dividing issue is the nature of the restructuring, or recognition, and this has two parts. 1) Whether the recognition or changed interpretation, is the consequence of productive thinking (ie. a new outcome, of a generative process) versus reproductive thinking (ie. a retrieval from memory, or the outcome of a search process.) This no longer appears to be a major issue, given that developing concepts such as constructive memory referred to earlier, utilise a model of memory that is reconstructed on demand. Gero (2002, p.5) in this model, some restructuring must be involved in every recollection. Whether restructuring is the consequence of conscious, or unconscious mental processes also appears to be an unnecessary issue, given that all conscious thoughts have unconscious origins. We are not conscious of the workings of our memory, only of what we remember.

The conclusion I draw from the above is that my research should proceed with an open mind and the subsequent analysis may explore such issues, while considering the insightfulness of designers, or at a later time.

Structuring and restructuring in design

Structuring activities in designing can be equated with aspects of restructuring referred to above, starting with the first item, *restructuring by reformulation*. Suggestions from above and suggestions from below can be equated with *top-down* and *bottom-up design*. In the description of suggestions from above, by Mayer cited above, insight is associated with the problem solver mentally redefining and clarifying, or reformulating the givens (ie. the problem) or the goal. Mayer notes that in complex problem solving, there may be a succession of insights progressing from the general to the specific. Mayer (1995. p.14) This is comparable to the process of conceptual design developing through a combination of conjectural prestructuring and restructuring. Both Darke (1979) and Lawson (1979 and 1997a & b) as described earlier, found among architects a tendency to structure problems, by exploring aspects of possible solutions, developing their design concepts through interaction between the possible and what is wanted and earning about their problems through attempts to solve them, rather than through abstract study and analysis. Lawson describes how a *primary generator* or *big-idea* may originate as a guiding principle and noted how respondents he interviewed described these constructs in providing common understanding, sustenance, or acting as a *distant light* to work towards.

Cross (1981, p.19) also observes that 'designers must, and do, pre-structure their problems in order to solve them.' Von der Weth (1999, p.454), describes step-oriented and function-oriented modes of designing, in a review of studies of designers. In experiments, experienced designers demonstrated an ability to prestructure, or produce good solutions to complex problems early in the design process using, what von der Weth refers to as a *function-oriented* mode, in conjunction with *correction variation*. In the recursive process of designing described by these researchers, prestructuring is typically followed by restructuring. Architect Richard MacCormac observes: `What you need to know about the problem only becomes apparent as you're trying to solve it.` (Lawson 1997b) Design restructuring in which designers opt, adopt, or abandon design components, or misconceptions may be an aspect of designing that is likely to involve insightful realisations.

Restructuring, restructuring

Before leaving the topic of restructuring I propose a particular interpretation for the purposes of this study. Restructuring can be regarded as a significant point of connection between Gestalt theory and designing. As the act of conceptualising integrated structures, or systems which are not simply the sum of their parts, (in other words, designs) designing can logically be described as *gestalt practice*. Structuring and restructuring are the basis of designing and particularly architecture. Buildings have structure in an engineering sense, but more fundamental to architecture is the essential organisation of a design. When Louis Kahn spoke of *form* he was not only referring to a design's visible shape or profile. Architecture is inherently organisational and designs are gestalts, produced through structuring and restructuring.

The fact of restructuring does not, of itself, prove that a discovery is insightful. However, in the scheme of things bounded by preparation, fixation, incubation, restructuring and the "aha!" experience, when a discovery is insightful, the restructuring action ("r" the verb) is the definitive event, while the restructuring ("r" the noun, or the changed interpretation) is the outcome. If there is ever doubt about, which is the restructuring, and which is the insight, the reason is likely to be serial restructuring. To give an example, where the *big idea* is a triangular floor plan; an observer might assume the insight is the use of the triangular form, but the designer might recognise an earlier revelation, that there was no need for the plan to be rectangular, was the critical discovery. In that case there could be two discoveries - two restructurings. In the example the first restructuring looks to be the more insightful, because it is critical. But one insight could lead to another or to several. In another case the second or later one could be the big one. This is totally circumstantial.

This leaves unanswered the question of the distinction between restructuring and insight. My interpretation is that *the insight* is the more general term for an insightful event, which includes the restructuring and critical aspects of its context, necessary to understand the event. So, in this study, descriptions of insightful discovery experiences can be found under Restructuring headings.

THE AHA! EXPERIENCE

The sensation of welcome and gratifying surprise marked by the feeling, that is well summed-up by the exclamation, "Aha!" is commonly associated with insight and is the basis for several definitions of the term. Davidson (1995, p.125).

Some researchers have observed or investigated associations between insight and other behavioural variables. Guilford observes three types of motivation that may influence individuals to become more insightful, 1) intellectual drives, 2) secondary sources of satisfaction and 3) interest in thinking. The intellectual drive has deep roots in the human genetic inheritance. Enthusiasm for problem solving going beyond the initiating need for behaviour and is not only evident in humans, but is also found in animals, such as apes and rats. Guilford (1967, p.321).

2.3 RESEARCH ISSUES AND OPTIONS

Achieving the general purpose of this research, to evaluate the extent to which designing is an insightful activity, is not a simple matter, as there is no available measuring instrument. This is a good example of an ill-defined problem.

When considering how to measure insightful activity in designing, three basic questions stood out.

- What are the most appropriate variables to measure?
- How can measurable data for each variable be collected?
- How can the data be best organised for its purpose?

The answers to these questions could be used as a base to construct a method of measurement. Further considerations such as interdependancies between particular questions and between the components of Gestalt theory were also important. A summary of the main issues considered and subsequent decisions made, follows below.

VARIABLES

Three main objects of study were identified, the respondents (ie. who they are), designing (ie. what they do) and insightfulness (ie. what happens, what they produce and experience). These items are of interest individually and they may also interact. It can reasonably be expected, that some designers will be more insightful than others.

To consider insightfulness in designing a balance between quantity and depth was needed. An obvious question of quantity is, how many designers in a given population are insightful? An obvious question of depth is, how insightful is this, or that designer? Answers to both are important, in order to provide meaning to either. For this study, quantity has been accorded the higher priority. As the research undertaken specifically for this thesis is intended as a beginning, of a potentially much larger project, a key objective has been to assess the feasibility of the proposed general line of enquiry. If a small sample was studied the effects of chance are likely to be greater and the results might be insufficiently clear or reliable, to warrant further research. Therefore a decision was made to select a sufficient number, about 40 respondents to both, reduce the influence of chance in the hypothesis testing, to provide a fuller appreciation of individual variation and to permit a modest degree of analysis and comparison between different sub-groups of respondents.

It was appreciated that resources and time are finite. The more respondents, the less time and effort are available per individual, thus reducing the potential for in-depth study. However it was recognised that this limitation can be moderated by selecting respondents who are: 1) frequently involved in conceptual design, 2) more likely to be encountering situations that require novel solutions, and 3) have a good track record of design performance, as judged by their peers. If there is an association, between success in conceptual design and insight, the selected respondents should score more highly on different insight scales than randomly selected designers.

In the preceding description of the research context a variety of issues, having a bearing on insightfulness, have been described. While some theorists have expressed doubts, about the utility of insight and need for a theory of insight, there appears to be less disagreement about the identity of the following components of insightful discovery, *preparation*, *fixation*, *incubation*, *restructuring* and "*aha!"* experience. As these terms are widely recognised by Gestaltists and critics of Gestalt theory it is proposed that employing them as indicators of insightful discovery is reasonable. The proposition is pragmatic, as it can be aimed simply at testing the likelihood of a design resolution being the outcome

of insightful discovery, without adopting particular articles of either Gestalt theory, or its theoretical alternatives. The study need not consider causation, or mechanisms, or ask *which theory?* until compelling evidence of insightfulness is found.

However, while the initial thesis study is exploratory, and not focused on causation, it can be expected to accumulate additional knowledge. Whether designers are insightful because of who they are, or what they do, is unknown. Aspects of a respondent's development, such as the influences during the formative years, education, personal attributes, talents, skills, knowledge and different ways of designing, are all potentially relevant to discovery causation. Given the longer term view and the possibility of positive findings, the research undertaken for the thesis should therefore collect and retain evidence that may relevant to later studies of insightful discovery.

COLLECTION

Much of the best known testing and development of Gestalt theory has taken place in the context of experimental settings employing insight problems. Research on designers has included both, laboratory like, protocol study procedures that are methodological descendants of Gestalt testing and, more worldly, interview studies. Again, the more controlled experimental approach has been predominant.

The decision to initiate this research by means of semi-structured interviews was based on three factors; 1) Recognition that insight components such as fixation and incubation involve a time factor which necessitates investigation of the whole experience of designing. 2) The need to study many individuals, rather than a few in great depth, for reasons already described above, and 3) the exploratory nature of the research, which required a more flexible and situated approach than could have been achieved from a questionnaire based methodology. The semi-structured interview format permitted foreseeable attributes of designers to be incorporated in the interview design. It also allowed other unexpected and sometimes unforeseeable observations and issues, that were important to an individual respondent to find expression. This last feature is important as some items were not recognised as significant, or recurrent, and accommodated in the study, until substantial numbers of interviews had been completed.

ORGANISATION

The method of data organisation was not fully resolved until after interviewing was completed. The most fundamental early decision, governing the structure of the interviews, was a general principle that the focus of the study would be on discoveries.

Details of the study organisation are elaborated in the next chapter, Interview Methodology.

CHAPTER 3

INTERVIEW STUDIES METHODOLOGY

3.1 STUDIES, AIMS AND OBJECTIVES

Interviews, in being the most available and direct means of acquiring first-hand information about design discovery, were viewed as being an effective means of achieving the general aims of the research outlined in Chapter 1, and to meet the needs and alternatives described in Chapter 2. The research involved two series of interviews. A preliminary interview study of five designers, recorded from January to March 2002 and a main interview study of forty architects recorded from November 2002 to August 2004. The interviews are typically, one-on-one, audio recorded, semi-structured discussions, of approximately one hour each.

3.1.1 Preliminary study aims

Two main aims were predominant in the planning of the preliminary study.

CONFIRM VIABILITY

The first aim of the preliminary study was to confirm that interviewing experienced practitioners is viable, in the sense of being acceptable to respondents and conducive to relevant and informative discussion.

It was intended that practitioners chosen for the main study would be prominent within their profession. It was unintended, but inevitable, that these individuals would normally be busy and subject to constant demands on their time, not only by their work, but also by other people than me, including product promoters, tele-marketers and other media representatives. Planning of the preliminary study was therefore strongly influenced by a recognised need for the research to be present and conducted in a way that would elicit and maintain the interest and good will of the respondents beyond the initial interview.

Particular objectives associated with these aims included the following respondent behaviour:

- Evident willingness to actively participate in the interviews, before and during an interview.

- Volunteering of relevant, personally revealing statements, during an interview.

- Getting involved in the interview and wanting to elaborate on matters of relevance.

- Developing a positive interest in the study that will facilitate further contacts and enquiries.

GAIN INTERVIEWING EXPERIENCE

This objective was both general and particular. The general need was to identify and develop an interviewing technique that was appropriate for the task. There was also a more specific opportunity to employ the more familiar setting of conversation with friends as a means of rehearsing. Objectives in that context included, becoming familiar with the questions, identifying and learning how questions will be interpreted, and how they might be misinterpreted. Developing methods of dealing with unexpected responses and events was also important.

GAIN FEEDBACK AND ACQUIRE KNOWLEDGE REQUIRED TO REFINE AND FINALISE MAIN STUDY

The preliminary study provided an opportunity to make observations from live interviews that can assist refinement of the interview questions and methodology, prior to finalising the main study interview questions and procedures. Particular objectives associated with this aim included the following:

Test and adjust interview length and structure, question selection, sequences and wording.

Interview length is impossible to predict accurately on the basis of reading, without live responses. The experience of the preliminary study confirmed the obvious, that different respondents will speak briefly, or at length, on different topics and that some will have more to say, or less to say, on any topic. One aspect of the interview structure is a progression from the general to the particular and the use of open-ended questions. This was intended to elicit revelations about a respondent's way of designing and their discovery experiences, without directly asking. For some, but not all respondents, this approach worked a little too well. Some answers rendered later questions unnecessary and could give an impression I wasn't listening. As a result some questions were deleted, others were moved or modified, or both.

Test procedures for recording, uploading, editing and transcribing of the interviews.

Details of the methods of recording and processing of the interview recordings are described later in this chapter. A significant feature of the preliminary study is that nearly all of the hardware and software I was employing were new to me. I had never combined them together to perform a particular function.

There are too many aspects of this process to describe. One example, the most critical, is the recorder, since it must work in real time when the respondent is present and talking. Second chances are possible, but humiliating. The Sony minidisc recorder I purchased for the task is a fine device that makes a high quality recording. However it is tiny. The controls, are minute and logically unlike controls of tape and cassette recorders. Eg. There is no rewind or fast forward. It is very easy to not record an interview. The preliminary study demonstrated the need for constant vigilance. The process of copying to my PC, editing and conversion to MP3 format was tedious but relatively uneventful and correctable when necessary.

Serve the aims and objectives of the research generally

This final objective was not a high priority in the initial planning, but once the interview stage was reached it grew in importance. The respondents in the preliminary study are good friends. But they are also full time professional design practitioners. In their interviews I expected them to express their perceptions and describe experiences of their professional activity frankly and honestly, but I really didn't think about that in a concerted way until the first interview.

The first respondent, P1, is consistently serious and professional in his manner of approach, to both life and work and he, being first, created an impression of how things would be that was sustained throughout the preliminary study. It dawned on me, before the interview had progressed more than a few minutes, that P1 and subsequently, the respondents in general were not talking about some abstraction. They were probing the source of their livelihood and telling me (and who knows, who else?), about it. It was a serious matter and the only relevance of the friendship lay in the fact that they might trust me more, than they would a stranger. The evidence, so to speak, is on the record.

3.1.2 Extended role of Preliminary study

As described above, the preliminary study had limited aims to explore, develop and test methods that would be applied in the much larger main study. It was unclear that the first respondents would open up to me, or that their observations would be suitable as research data. However reactions were better than expected. The respondents quickly became involved in the discussion and any self consciousness appeared to dissipate quickly, once they engaged with the questions. The respondent statements indicated that the preliminary study *model* was viable for implementation in the main study.

Only minor changes were made to the interview questions before commencing the main study. As the interviews took longer than expected, some questions were deleted or consolidated. Additional changes were made in the question order, to better group similar questions and reduce the likelihood of repetition when a response to one question made a later question redundant. After both sets of interviews were completed the original decision to treat the studies separately was reconsidered. I concluded that there was no compelling reason to dismiss the evidence of the preliminary respondents, or to treat it separately, for the following reasons:

1. There are few, if any, consistent differences in how the two sets of respondents participated in their interviews. Both groups treated the interview seriously, both responded openly and apparently honestly.
2. Variations to questions asked in the main study are minor. This is demonstrated in 3.2.4 Interview Questions and Variations, which shows both sets of questions, side-by-side. The qualitative nature of much of the study and the open ended interviews, depending on the experiences and talkativeness of individual respondents, made every interview different.
3. As the interviews were analysed one at a time it gradually became evident that the next, or any set of five people interviewed were significantly different to the previous five and that the next five were different again. This opening up of unforseen aspects of difference continued throughout the study, so that any set of interviews may be as different as interviews from the two groups. The variation can be seen in Figure 3.1-1 Respondent Discovery Summary, below, which shows all of the respondents in groups of five.
4. If there is any reason for separation, the respondents in both studies are identifiable. Any subset can be reviewed and studied together or separately if desired.
5. Finally a logical or in-principal objection to merging respondent data is self-defeating, given that there are future intentions to extend the research to include additional and more diverse respondents.

All of the above points encouraged me to adopt the view that all interview records should be regarded simply as data, that can be read, subdivided and analysed in many ways. The five respondents in the preliminary study, in that view, are simply a subgroup, as are males, or females, graduates of a particular university, or decade, former employees of famous architects and so on.

In the figure below, preliminary study respondents can be recognised by the use of ID's P1 to P5, while the main study respondents are signified by the ID's A01 to A40. Respondents and their Insight level are identified on the upper line in each cell. Insightfulness ratings for Hypotheses 1 to 3 (described later) are on the lower line. Insight levels, based on Hypotheses 1, 2 and 3 are signified by colours, yellow, blue and green respectively. Bolder colours and text are used to identify RAIA award winners. Blue and red text is used to distinguish male and female respondents. It is evident, just from looking at the table, that the distribution of any particular coded feature, in any column or row, may be entirely different from any other.

Discovery Processes in Designing Aug-06

Worksheet 5 - Respondent Discovery Summary

Respondents are sorted in rows of five in order of interview.
Each respondent cell shows:
Line 1: Resp.ID - Insight Level (L1, L2 or L3)
Line 2: Ratings for Hypotheses 12&3

	Respondents in sets of five				
P1 - 5	P1-L1 310	P2-L3 543	P3-L1 531	P4-L2 431	P5-L1 421
A01-05	**A01-L0** **201**	**A02-L2** **442**	**A03-L2** **541**	**A04-L3** **233**	A05-L3 543
A05-10	**A06-L1** **321**	A07-L3 443	A08-L0 010	A09-L2 441	**A10-L0** **222**
A11-15	**A11-L1** **300**	A12-L2 221	**A13-L3** **533**	**A14-L2** **441**	A15-L1 421
A16-20	A16-L3 443	A17-L1 321	A18-L0 000	**A19-L2** **432**	**A20-L2** **541**
A21-25	**A21-L1** **411**	**A22-L1** **400**	**A23-L3** **443**	A24_L0 201	**A25-L2** **431**
A26-30	A26-L1 411	A27-L1 522	A28_L0 001	**A29-L2** **542**	**A30-L1** **531**
A31-35	A31-L3 443	**A32-L2** **441**	A33-L3 343	A34-L1 421	A35-L1 301
A36-40	A36-L2 431	A37-L2 442	**A38-L2** **331**	**A39-L2** **441**	**A40-L3** **543**

Fig. 3.1-1 - Respondent Discovery Summary - Part of Worksheet 5

3.1.3 Study Aims generally

PRIMARY AIMS

Beyond the developmental aims of the preliminary study, the main aim in planning, conducting and analysing the interviews, within the context of this thesis, is to provide valid evidence for evaluating the three research hypotheses. Phrasing these as research questions, the aims are to reach an understanding of three aspects of conceptual designing, beginning with resolution of the hypotheses and then continuing to flesh-out as much information as possible about the manner and reasons for the findings.

1) TO WHAT DEGREE IS CONCEPTUAL DESIGNING INSIGHTFUL?

How frequently are design concepts the result of insight driven discoveries? How much are insight driven discoveries valued by the designers who experience them? What are the characteristics of these discoveries and the experiences that accompany them?

2) TO WHAT EXTENT ARE INSIGHT DRIVEN DISCOVERIES *HOT OR COLD?*

To what extent are insight driven discoveries *hot,* occurring *in-context*, when designers are working, or actively thinking about the matter of the discovery, or *cold,* occurring *out-of-context,* when designers are not working and not actively thinking about the matter of the discovery, or not actively thinking at all? What are the patterns of these occurrences?

3) ARE THE COLD DISCOVERIES MORE INSIGHTFUL OR LESS INSIGHTFUL THAN HOT DISCOVERIES?

To what extent do respondents distinguish their cold discoveries from their hot discoveries in terms that indicate insightfulness? What sorts of differentiation are present among different respondents?

SUBSIDIARY AIMS

Numerous possible subsidiary aims could be identified. In general, it is desirable that questions, and subsequent analysis of answers, be sensitive to variables distinguishing the designers and their actions. It is impractical to attempt to anticipate all of the many possible questions one might ask. However some obvious types of questions can be identified.

Attributes of designers - examples of relevant questions include:

- Are the insight experiences of top, award winning designers different to other designers?
- Are designers who work intuitively more likely to have insights than designers who work rationally?
- Are male designers more or less insightful than females?

Actions of designers - examples of relevant questions include:

- Are designers who think about their work all the time more likely to have cold discoveries than designers who don't think about their work, when they are not actually designing?
- How do the discovery experiences of designers who work alone compare with that of designers who work with a partner or in collaboration with colleagues?

Interview questions can support aims in two ways; 1) by specifically querying respondents about themselves, their lives and their actions, and 2) by open-endedness, that encourages respondents to reveal what they regard as important. The coding can support aims by having a logical and coherent organisation which locates and represents what can be anticipated as being useful, before the coding commences and which can logically accommodate unanticipated variables without requiring the coding system to be changed.

3.2 INTERVIEWS

3.2.1 Respondent selection

The preliminary study respondents, P1 to P5, 2 males and 3 females, are friends of long standing who all regularly undertake conceptual design professionally in different fields and have achieved some eminence in their field. The decision to interview friends was made, mostly, because I am not a professional interviewer and felt unprepared to commence by interviewing strangers. I chose these five friends because I expected they would participate and be vocal, frank and articulate. At the time of the preliminary study (in 2002) and even now (2006) none of the five knew the specific aims of the study, or its hypotheses. I did not discuss the Gestalt theory of problem solving, or notions of hot and cold discoveries, with any of the respondents before interviewing them.

The main study respondents, A01 to A40, consisting of 20 males and 20 females, were selected in a continuing and developing process that was a combination of two means of selection. The first method, I began by identifying architects who had received professional acknowledgement of the quality of their work by the Royal Australian Institute of Architects (RAIA). I phoned as many of these individuals as I could find in Sydney and invited them to participate. Then, during their interviews, I implemented the second method, by inviting these architects to nominate other architects, whose work impressed them and who they thought would be suitable to interview. I then phoned these individuals, repeating the earlier procedure. This has meant that among the respondents there are a few who have been recommended, by the recommended, rather than by award winners, others that have been recommended by two or more respondents and some who have become award winners during the course of the study. The objective I have tried hardest to maintain is that selection be a function of circumstances other than my preference. Effectively there have been three criteria: 1) formal peer approval by the RAIA, 2) Informal peer approval, 3) willingness and availability to be interviewed in Sydney.

Having practiced as an architect in Sydney myself, for more than twenty years, through several recessions, it was not difficult for me to cold-call strangers and invite them to participate. Surprisingly, only one or two declined initially. Several interviews followed weeks, or months of scheduling and rescheduling, typically because accomplished practitioners tend to be very busy. The only effective way to interview some was to settle on an approximate time, call again to confirm, on the day, and sometimes wait to be notified when an opportunity was likely. In some cases, after several postponements, it became evident that some practitioners should move up the queue, to replace others who were effectively unavailable.

Two particular individual differences are referred to and commented upon in this study, *gender* and whether or not respondents have received *professional recognition for designing* by the Royal Australian Institute of Architects, or RAIA. As the numbers of actual and potential respondents grew I moderated my selections to keep the numbers of males and females, and the numbers of prize-winners and non-prize-winners, balanced. Maintaining equivalent numbers was not so simple. Balancing one category was reasonably easy. But maintaining similar numbers of prize winners and non-prize winners, of each gender was difficult, because proportionally, far more men than women win architectural awards. As the women are fewer the task of finding alternative respondents was proportionally more difficult when some were unavailable. However, with effort and patience, I gathered a population that included some of the best known practitioners in Australia, providing a wide range of individual experiences and opinions. A third attribute, *year of commencing practice,* an indicator of age and experience is also briefly referred to in the study. It was not controlled. Respondents range over 40 years, the earliest commencing in 1955 and the latest in 1995. About half commenced before 1985.

The most complete source of information about the respondents in this thesis, including the interview recordings, transcripts and respondent tables, is contained in Appendix 2 - Respondents. The Appendix information is incomplete in one important way, the identities of the respondents are not given and some details, such as names of partners, are withheld to preserve confidentiality. The issue

of identification arose because many respondents are very well known are others are hardly known at all. In the context of the study all respondents make significant contributions. Who they are individually is not relevant to the research hypotheses, or to other matters associated with designing and insightfulness. It was my view that a respondent's observation can be judged better, on its merits, if the identity of the observer is not explicit, either to me or to another reader. If a reader wishes to know more about a respondent, the ID is sufficient to check the detailed Appendix records. That some readers may be able to guess the identities of particular respondents is not a concern. Indeed it is likely, when this work is reorganised for publication, a list of the consenting respondents and images of their work will be included.

3.2.2 Interview process

Nearly all respondents were interviewed alone in a single, unrehearsed audio-recorded structured session of about 60 to 80 minutes total, conducted by the author. There were some exceptions. When partners were individually interviewed in, a small office setting, while both were present, both joined the discussion on occasions. The interviews with A15 and A16, for example, include periods where both participated. Letting both partners run with the discussion appeared to be especially appropriate for these respondents, as their manner of designing, evident in the recording, is more interactive than many other partners in the study.

Parts of some interviews were recorded again after recording failures or errors, such as forgetting to record, unnoticed battery expiry, or errors using the pause-unpause toggle switch.

SETTING

In general the interviews were held at times and locations nominated by each respondent, mostly within a few kilometers of the city centre. Some were in outer areas such as the northern beach suburbs. Nearly all were conducted between the hours of 9 am and 7 pm at respondent's offices. In some instances the location was a practitioner's home office. Some practitioners chose to meet in cafes for convenience, or because they preferred not to be overheard by their staff. Since these locations are nearly all different it makes little sense to attempt to describe them individually. Most were suitable for the purpose.

One consequence of the different locations is that ambient noise levels and environmental conditions were inconsistent, but I am satisfied this is a minor consideration, more than offset by the convenience and familiarity for each respondent, of meeting in their chosen setting. In even the worst cases the effect of ambient noise, such as a neighbours building work (power saw audible in the P3 interview), wind noise (audible in the P5 interview) or traffic noise (audible in the A15 and A16 interview) was tolerable and did not impair the good flow and course of the interviews. The noise was an inconvenience to the transcribers but the worst noises (eg. buses passing by or noisy people in cafes) are infrequent and their impact on the transcription is minimal.

RECORDING

The combination of a Sony Minidisk Walkman MZ-R900 Portable Minidisk Recorder with a Sony ECM-DS70P stereo microphone mostly produced good quality recordings. However there were some complications.

The first batch of Sony minidisks was found to contain defective disks causing intermittent blank spots. This was detected before many interviews were affected, but the problem is evident in some preliminary study interviews (eg. P2) and the early main study interviews (A2 to A6). At first the cause was not clear as both the recorder and the disks were brand new and the problem was occurring with different disks However, a successful trial using TDK disks proved the Sony disks were faulty. Thereafter TDK and Panasonic media were used without incident for the remainder of the interviews.

One significant technical difficulty was the physically small size of the recorder and its controls. This necessitated care to ensure the recorder was actually operating, particularly after pauses, or if running on battery power. There were several incidents, some during interviews that were subject to interruptions, when recording was paused when the interview resumed, rather than vice versa. The

recorder makes audible mechanical noises at arbitrary times, as it transfers data between memory and disk. This is disconcerting but is only a symptom of a deeper problem. In at least one interview, the recording of one *take* or session of about 30 minutes was lost and needed to be re-recorded after a battery failure. A weakness in the minidisk memory-to-disk process means that a recording is not secure until a *take* is complete and terminated in the required manner. I found the best, most secure policy was to use mains power whenever possible, to only use premium quality rechargeable batteries and to fully charge them the night before recording.

SOUND EDITING AND COPYING

Following interviews, recordings were copied to my PC, initially in the form of editable digital WAV files, using Musicmatch Jukebox, a popular shareware digitising application. As the .WAV format is uncompressed, downloading was paused at roughly 20 minute intervals, at breaks in the discussion, in order to limit WAV files to approximately 200MBytes in length. The 200MByte downloaded file size enabled the editing application to comfortably manage two open files, in 500MBytes of RAM, which was my limit in 2002, when interviews began.

The sound recordings were edited using a wave editor application. The five preliminary study recordings (P1 to P5) were cut into short files, one for each question and answer. It became evident that this approach was time consuming and provided few, if any, significant benefits on playback. Subsequently a simpler method was employed for the forty main study recordings. Each main study interview is contained in four files, representing the four defined parts of the interview. Ie. Introduction, Designing and Designers, Working and Discovery Patterns, Completion. This cut provides manageable file sizes. The logic of it facilitates searches, when combined with an open transcript file and use of Ctrl+F for location checking.

The file editing process was completed by converting the WAV files to compressed audio coded MP3 files, using Musicmatch Jukebox again. These files were then copied to compact disks, that could be stored securely and transported as needed. The MP3 files can be re-played on a computer, MP3 player, or disk player capable of decoding MP3 format.

The recordings included with the thesis include nearly everything that was said from Question 1 through to the answer to Question 4 inclusive, with a few exceptions.

- Some informal chit-chat has been deleted.

  An important part of the interview technique is to achieve a relaxed informality that encourages the respondent to speak freely. A side effect of this is an occasional loss of relevance. Some periods of conversation have been excluded from the interview files. These include small talk before the first question, lengthy digressions during and interview and chatting after completion. Where this was recorded it has been archived in separate chat files that are not part of the thesis.

- Some recorded silences and noise have been removed completely.

  Most interviews were conducted during business hours at a respondent's office and, partly because of that, there are some unarchived deletions. These include periods when no one spoke for a long time, or when the respondent answered the telephone, was in a discussion with other people, or went off to do something else. A few ummms and other incoherent voicings have been excised too, mostly from the earliest interviews. As the interview numbers increased it became impractical to spend the time this level of editing demanded.

TRANSCRIPTION

Compact disks containing instructions and MP3 files of the interviews were subsequently sent by regular post to a transcriber who, after completing the transcription, would e-mail completed text files back to me for checking and correcting. Transcribing has been a major and influential component of this study. It is major, 1) because there is a lot of interview time in this study, at least fifty hours and 2) because one hour of interview time generates approximately four to eight hours of transcription time. The actual time varies, depending on the recording quality, the speed, clarity and straight-forwardness of the respondent's speech and the capability of the transcriber. All of the above mentioned factors vary significantly from one interview to another throughout the study. Proof-reading and correcting of one hour of transcript often requires two hours or more, especially if the transcriber has needed to do a lot of guessing, or has inserted a lot of <???> symbols, signifying an unclear recording.

TRANSCRIBERS

More than ten individuals contributed to the transcribing in some way, with varying degrees of success. The initial group were keen reasonably skilled amateurs whose work quality was satisfactory but who lacked the professional typist speed and temperament to complete more than one or two transcripts. Progress remained very slow, during 2003, until a solution was found. Thereafter nearly all of the transcribing was carried out by three ex-professional typists, all house-bound mothers with young children. The first, Rachael, started in early 2004. She completed about ten interviews and then referred me to Kellie, a friend of hers, who completed at least twenty. During her stint Kellie referred me to Cathy, her sister-in-law, who completed about ten. The contribution of the three mums, their dedication, honesty, good nature, persistence and speed, has been invaluable.

CORRECTING AND EDITING

The transcripts are as close as I could make them to the recordings. The interview transcribers were consistently instructed to type exactly what was said without corrections. The transcribers were not architects and had never heard many names and technical terms that are familiar to an architect. Generally I have checked the transcribed interviews by simultaneous reading and playback. This has been essential because, an entirely plausible looking passage of transcript can express the opposite meaning to the recorded statement. It only takes one missed or mis-heard word to do that.

In general the idiom of each speaker has been unchanged. Relatively little has been done to correct what has been said and where changes have been made I have tried to make them consistently. It surprised me how often people use the word *and*. Many respondents keep *and*-ing to their statements, producing lengthy sentences. To remedy this I have regularly broken the primary school rule of never beginning a sentence with "and". Even more frequent than the use of *and*, is the use of *like* and *you know*. Most of these are retained except where the frequency has been high to the point of interference. Eg. If more than once in the same sentence. One other frequent correction has been to replace *yeah* with *yes*. Hardly anybody in Sydney, it seems, says *yes* anymore. That includes me I now realise, but I think *yes* looks better in print, perhaps because it is culturally more neutral.

It has also been surprising, to me, to hear how often people, myself included, repeat words or phrases in normal conversation. Also, as people speak, they often think of a better way to express what they are about to say, in mid sentence. Much of this repetition and rephrasing remains in the transcriptions. However the passages of text cited in the thesis, or the Respondent tables, have been edited to facilitate reading and clarity of expression. For example, when an important statement continues through a dialogue process I have gathered the respondent's statements together into one citation and deleted my interjections or digressions, so that the point can be seen and read more clearly. It is possible to see or hear what was actually said by reading the transcription files or listening to the recorded interviews. The differences will be evident but whether the sense of any statement has been significantly changed in the editing is for the reader to judge. I haven't knowingly changed or edited any statement in order to express a different meaning.

SPOT TRANSCRIBING

The transcription process influenced the development of the study methodology in particular ways, which from small beginnings grew to become important. The main factor was time. It took time to develop a reliable and sustainable process of transcribing. There were uncertainties about people and how they would be paid. All took time to resolve. In the meantime, as the interviews proceeded, slowly at first, I discovered a method of *spot* transcribing. This began with little consciousness of where it would lead. The downloading of sound files from the recorder and replaying of files for checking required a constant presence where, for much of the time I did nothing but listen. In order to maintain control and timing of the recording I couldn't afford to divide and possibly lose attention, by attempting to perform some other activity at the same time. This provided an opportunity to carry out the *spot* transcribing.

In order for spot transcribing to be an effective use of otherwise unproductive time it was necessary to develop a real-time technique that did not require me to stop the downloading. The method I employed involved the creation of an Excel spreadsheet. In its initial form I set out the spreadsheet with each interview question being placed in a row (ie. down the sheet) and each Respondent being placed in a column. See Figure 3.3-3. The essence of the method is to type as much as can be recalled of a statement, type a separator symbol, consisting of … and then repeat, listen and type, repeating the process until the download ended. The first pass is not especially coherent, but it is relatively easy to edit and build-on once an MP3 recording is available for re-play.

I found this to be a quick and effective method of initially gathering information of relevance for the preparation of conference papers. Editing for this limited purpose is simplified by the fact that relatively little of a total interview, or set of interviews, is directly relevant to a particular paper and even less is likely to be cited. Therefore while the transcribing needs to be sufficiently complete and coherent, to avoid the need for continual replay of the sound files, only the cited parts need to be corrected to publication levels of accuracy.

Confirming the deeper truth of the old saying that *necessity is the mother of invention*, the delays in development of a fully satisfactory method of transcription led to a process whose outcome was the assembly of interviews in a spreadsheet format. This naively arrived-at outcome was immediately useful but it also provided opportunities for analysis of the data, which have continued to be valuable throughout the study. This aspect of the study is continued in 3.3.1 Development of Coding Method, Use of spreadsheets.

3.2.3 Semi-structured interviewing

Planning of the interviews has been influenced by key ideas of the creative interviewing methodology described by Douglas (1985). The phrase that Douglas employs to encapsulate his approach is *purposefully situated interviewing*. The method is based on the interviewer establishing a level of understanding and intimacy and largely subordinating the interviewer to the respondent, in order to optimise cooperative disclosure and motivation to achieve mutual understanding.

The interview design incorporates several features that are intended to encourage participation, self awareness, self disclosure and self understanding. Note, for reference, that complete interview transcripts are included in the Appendix CD, see p.9 for retrieval details.

INITIAL INFORMATION

The respondents were initially, informally invited to participate in an interview that would consider how they go-about conceptual design.

On the day of the interview respondents were supplied with an A4 page instruction sheet headed, "Discovery Processes in Design". See p.9 Appendix Contents, Appendix 1 – Methodology, Human Ethics, for retrieval details. The document contains information under the following four sub-headings: Summary, Why this study is taking place, Interview structure and, Confidentiality.

The Summary states:

> This is a study of how experienced designers actually go about their creative work and make discoveries during the conceptual phases of designing.

The Summary also refers to the study having two separate parts, an interview study and a discovery study. The latter was deleted from the project, before the main study commenced, when it became clear that it would not be viable, for two reasons, 1) it became evident that the work required to manage a second stage with 40 architects would be excessive, and 2) it became clearer during interviewing that the most accomplished respondents would be unlikely to participate in additional time consuming activities.

EVOLUTIONARY STRUCTURE OF THE INTERVIEWS

An evolutionary approach is advocated by Douglas (1985). He observes that people are different and require different forms of encouragement to bring about openness and self-disclosure. A variety of recommendations that explicitly and implicitly empower the interview subject have been recommended by Douglas. In general these were easy to adopt and follow including, allowing the subject to choose the site of the interview, not attempting to 'out dress' the subject, allowing spatial separation, eye contact and view of facial expressions, by sitting opposite or on two sides of a table.

Typically, interview meetings began with unrecorded small talk, while agreeing on a suitable interview location, setting up the recorder and sound checking. Respondents were invited to read over an information statement and to ask questions during the set-up and sound check. Recording would be seen to start with the first of the formal interview questions. As the respondents in this study were

frequently very busy and conscious of time a more structured interviewing approach, with less subordination to respondents than Douglas has advocated, was applied, to enable interviews to be completed within an hour, unless a respondent clearly wanted to lead and control the discussion.

The evolutionary intent is also reflected in the scope, sequencing and structuring of questions. The scope of questioning extends beyond immediate needs. More inclusive questions offered several advantages, such as: 1) making the actual research aims less obvious, 2) providing a discussion setting that encouraged the respondents to reveal what was important to them, 3) prompting revelations, that may prove to be crucial, that couldn't have been predicted, and 4) adding value to the thesis data, with the view to further research questions that might arise.

The main function of the prepared questions is to encourage the respondent to voluntarily make statements of relevance to the research, without leading or inducing biased answers. The interview questions were grouped and sequenced to progress from general, familiar, factual and more structured questioning early in the interview, towards more design focused, searching, and experiential questions. An important aim of the small talk and the first group of questions is to facilitate communication, by putting the subject at ease and creating empathy. The first objective is to establish that I (the interviewer) am warm, caring and respectful and that the interview will be a pleasant experience with nothing to worry about. Douglas advocates the building of a situated friendship, reciprocity in self-disclosure and the inducement of a sense of intimacy, to the degree that the subject feels the need for self-disclosure.

The main body of the interview, which is specifically about designing, also involves a progression of subject matter, as follows: 1) Questions about design in general: eg. "How would you describe your design philosophy?" 2) Questions about the respondent's way of designing: eg. "Could you briefly describe how you normally go about the conceptual design for a new project?" 3) Specific discovery questions: "Can you remember some times where you needed a breakthrough and came up with one?" and 4) questions with specific relevance to cold discovery: "Do you ever find design ideas unexpectedly come to you at times when you are not designing?"

OPEN ENDEDNESS

The principle of open endedness is manifested in both the instructions given to the respondents and in the wording and structure of questions. Douglas (1985) sets the scene for this approach with the following hypothetical sales pitch, under the sub-heading; *The truth about you*:

> The world is a serious place where only people who are directly involved in (designing) can know completely what it is like. You are that expert and I meekly beseech your help in gaining a more complete understanding of it.

Douglas's particular phrasing was not incorporated in the interview questions, however the Summary of the A4 instruction sheet, "Discovery processes in design" supplied to each respondent, referred to earlier, under Initial Information, emphasises the open ended approach:

> Only people directly involved in designing can really know what it is like. The aim of the Interview Study is to learn about designing and discoveries, through different designers describing their experience in their own terms. The time place and length of the interview will be agreed through discussion beforehand. It is considered that a minimum of one hour will be required and only one interview will be necessary. However as an aim of the interview is to encourage designers to explore and express observations about themselves that they may not have done before, the sessions will be open ended by mutual agreement.

The principle of open endedness is applied directly in the wording of the interview questions. Most questions were phrased in a way that permits respondent to interpret and make judgements about what is important to them individually. Examples of the type of questions are included below:

- What drew you towards your career in the first place?
- Would you briefly describe the main milestones in your career?
- What would you say were the main hurdles you needed to overcome to reach where you are now?
- What would you say are the most important qualities a person needs for success in your field?
- What do you see as *your* main strengths and weaknesses?
- How would you describe your design philosophy?
- How would you compare or contrast your way of designing, with other designers you know?
- Could you briefly describe how you normally go about the conceptual design for a new project?

In general, questions likely to prompt Yes, No, or other simple answers were not entirely eliminated, but were reduced in number and separated, to provide a contrasting break to the open ended questions which are more demanding, often inducing answers of 5-10 minutes duration.

There is progression towards open endedness in the structure of the questions. Later questions are constructed in a more variable manner, allowing different options to be explored, as the end of the interview approaches. If a respondent volunteers information that, in the judgement of the interviewer, may be critical to the study, the prepared questions can be set aside temporarily, in order to consolidate and extend what has been said, while the matter is fresh in mind. Item 3, in the section above, includes sub-questions aimed at drawing out greater detail of the circumstances of discoveries and the respondent's impressions. The question in item 4 above is optional, needed only if the respondent has not already offered remarks on cold discoveries, or to supplement earlier questions.

EMOTIONS AND INTIMACY

The ideas expressed by Douglas (1985) on emotions and intimacy are less directly applicable to specific questions than to the manner in which the interviews are conducted. Douglas is emphatic about the unavoidable importance of these factors and of the need to find, in every interview, the right balance of intimacy and warmth, of being a good listener and following the path of the golden mean - "almost nothing to excess."

The key points about emotions made by Douglas (1985) are that when we study past experiences through interviews we are largely studying the things that have aroused the individual emotionally. Therefore to understand the person it is necessary to learn about their emotions, experiences that give rise to emotional patterns and the beliefs and convictions that have grown from the experiences and, through which, are filtered new experiences. With regard to intimacy Douglas stresses the importance of building up intimacy within the constraints of the interview situation, emphasising that empathy, or lack of it, can be encouraging or discouraging to getting to the truth.

As the preliminary study involved interviews with familiar friends it was relatively easy to establish an emotional connection and an appropriate degree of intimacy with each individual. One surprise was that the respondents were more different from each other than was initially expected. This was a valuable finding as it signalled a need to adopt a flexible evolutionary approach that was sensitive both to individual nuance and larger variations, before finalising preparations for the subsequent main architect study.

3.2.4 Interview Questions and Variations

A brief commentary of the interview questions is provided below. Complete versions of the preliminary study and main study interviews are included in the Appendix, see p.9 for further details. The interview questions for both studies are grouped into four stages, 1) Introduction, 2) Designing and Designers, 3) Working and Discovery Patterns, and 4) Completion. The changes that were made from the preliminary study to the main study are presented below by using two columns when appropriate.

1. INTRODUCTION

Respondents are initially asked a series of recollection questions, about influences and milestones, in their progression from childhood to the present. The main changes to the Main study questions were to simplify the start and economise, by moving the straight-forward question, about milestones to the beginning, reducing time spent on the past matters, and by simplifying other questions.

Preliminary Study	Main Study
1.1 i. What were the most important or most formative influences? ii. What can you remember about yourself at key decision times? iii. What about your early interests or talents?	101 Would you describe main steps, or milestones in progression, from childhood to architect, to the present, and roughly when these steps happened? 102 What do you remember as important or

	formative influences in those early years?
1.2 Would you briefly describe key milestones in your career, such as education, early professional background, major changes, major projects, and roughly when, by years or decades if you prefer.	103 Can you remember any particular challenges or hurdles you needed to overcome? 104 Thinking back, what would have been your earliest recognised interests or talents? 105 In general, what sort of a scholar were you, at school and later?
1.3 Can you recall any particular challenges or hurdles you needed to overcome in order to become an architect? i. At school and college, which were your best and worst subjects? ii. In general, what sort of a scholar were you?	106 Which were your best and worst subjects?

The next group of questions shift attention from the past to the present. The main changes between the two studies in this part were to move the speculative question, about qualities in general, to the end and simplify the logic and wording of questions about respondent strengths and weakness.

The reordering provided continuity of the discussion, from best and worse subjects, to strengths and weaknesses. The general question had been intended to give the respondent a break from self evaluation, but this appeared to be unnecessary in the preliminary study. In addition it was awkward coming back to self evaluation after leaving the topic. The word architect was added to the speculative question, since all of the main study respondents are architects. These changes definitely improved the flow of the interview and provided a better way of concluding Stage 1.

Preliminary Study	Main Study
1.4 Turning to the present, what would you say are the most important qualities a person needs for success in your field?	107 Considering the whole spectrum of your abilities would you be more inclined to view yourself as an all-rounder, or someone with specific strengths and weaknesses?
1.5 What do you see as *your* particular strengths and weaknesses now, i. First, in your professional knowledge? ii. Could you also identify specific mental talents, or attributes which you consider are your strongest and weakest?	108 Which activities as an architect, would you say, best suit your talents? 109 Would you acknowledge any significant activities, in your work, which you are not good at? 110 What would you say are the most important qualities that an architect needs for success?

2. DESIGNING AND DESIGNERS

In the second stage of the interview, respondents are asked a set of questions on design and the way people design, that may prompt a statement of relevance to insightful designing. The questions progress from a focus on design values and *what* people design to *how* they design. The aim of the questions is to encourage the respondents to reveal themselves, both in statements about themselves and in what they choose to say about other designers.

Preliminary Study	Main Study
2.1 How would you describe your design philosophy? i. Which aspects of design do you think are the	211 How would you describe your design philosophy? 212 Could you name one or two architects

most important? ii. Who are some of the designers you most admire?	whose work you regard as the most outstanding and briefly, what impresses you most about them?
2.2 Designers are commonly associated with particular designs or outcomes, but designers are also known to have distinctive approaches or styles of working. For the next set of questions I want you to focus only on the way people design, or their actions, rather than what they design. i. First, have you noticed different ways of designing amongst designers you work with? ii. What are your views on why designers work in different ways? iii. Could you categorise any of these different ways of designing, based on your experiences? iv. Which category is most like you? v. How would you compare, or contrast your way of designing, with other designers you know?	Architects are commonly associated with particular types of design, but some are also known to be distinctive in how they work. For the next questions I want you to focus only on the way people design, or their actions, rather than what they design: 221 First, could you describe different ways of going about designing you have seen amongst architects? (eg. how they represent and work with the 'stuff' of the design) 222 Could you describe any differences in your way of designing, compared with other architects you have seen at work?
2.3 The next set of questions are about the actions of designing that you apply in your work.	
i. Could you start by briefly describing, how you would normally go about the conceptual design for a typical new project. ii. How does your method of doing things change from one job to another given the kinds of variation that you have? iii. Could you describe any patterns in the way your methods might vary throughout a project? iv. Looking back, to early in your career, what changes in the way you design now, come to mind? v. Are there any characteristics of the way you work now, that you would regard as constants?	231 Could you start by describing, with a "broad brush," the main features of how you like to go about the conceptual design for a typical new project? 232 To what extent do your methods change, from one job to another, given the normal kinds of variation that you experience? 233 Could you describe how your way of designing now has developed and changed over the years, since commencing practice? 234 Which characteristics of the way you work now, would you consider to be constants?
2.4 Perhaps you have observed that some designers tend to progress fairly steadily through a project, whereas for others, progress tends to be either sudden, or not at all? i. Which of these patterns is closer to your own experience? ii. Why do you think that is your experience?	Perhaps you have observed that some designers progress fairly steadily through projects, whereas others tend to fluctuate, apparently going nowhere for a time and then suddenly progressing. 241 Which of these patterns is closer to your own experience? 242 What, would you say, are the main reasons why that happens?
2.5 Thinking of the designing you have been doing over the past few years, are you more inclined to say most jobs are basically similar, or most are basically different?	Question 2.5 was not included in the Main study

3. WORKING AND DISCOVERY PATTERNS

In the third stage, respondents are questioned about *breakthough* experiences and situational aspects of their designing, not commonly thought of as ingredients of the design process. These are referred to elsewhere in the Thesis as their *action style*. Again both sets of questions are open-ended and intended to prompt statements of relevance to insightful designing.

The *breakthrough* questions are begun by asking if respondents can recall a breakthrough during conceptual design. If one is recalled, a series of sub-questions are asked about the circumstances of the breakthrough. The sub-questions are intended to elicit statements that indicate whether or not the breakthrough is insightful. Where a respondent confirms that breakthrough experiences occur, but is unable to recall an example, the respondent is asked to apply the sub-questions to their typical breakthrough experience and give more general answers.

The *action style* questions use the fictional detective Sherlock Holmes as a model to elicit revelations about individual occupational patterns. After mention is made to Sherlock Holmes' pipe, which he smoked when reflecting on a case, in 3.3) respondents are asked what they associate with their creative work and whether they owe any of their best ideas to something like that. The fact that Holmes was always the enquiring detective is stated, to introduce 3.4) when respondents are asked, a. As a designer, are you anything like that? and b. Are you always a designer? – never off the air? This set and the third stage is completed by c. when respondents are asked; When you get stuck on a tricky design problem, how do you deal with it?

The common, general expression *get stuck* is employed in the interview, rather than more precise technical alternatives, because; 1) its use is close to universal. Any designer would know what it means, and 2) the term conveys no inferences of causation, as would be the case with *fixation*.

In the preliminary study the *breakthough* questions were asked first but it became evident during the first interviews that, as with some earlier questions, it was better to maintain a continuous progression through the interview. The changes of approach, or subject, rather than giving the respondents variety, or a break from a particular type of questioning, could be disorienting, or give an impression of confusion, or lack of order. They also made it more difficult for me to follow up, or build on, something that might arise. Changes of subject also made it more difficult for me to remember and react appropriately to earlier respondent statements that had made later questions redundant. This could be irritating to respondents.

Preliminary Study	Main Study
[The following Breakthrough question has moved to Question 340 in the Main study.]	The fictional detective, Sherlock Holmes, was famed for being; always the inquiring detective, keenly observant, deductive and constantly on the case when there was a mystery to unravel.
3.1 Can you remember any examples where you needed a breakthrough during conceptual design and came up with one?	
IF YES:	310 How would you compare yourself, as an architect, with that image of the perpetual detective?
I would like to consider one or two of these in more detail. Just tell me what you remember.	
Ask, for each recalled instance:	Sherlock Holmes was known to be, not only quick on his feet, but also reflective and contemplative. The corresponding architect would be equally adept; when a situation demanded ideas and decisions on the run, as when it required a deeper and more considered approach.
i. Could you briefly describe the basic circumstances?	
ii. How did you feel, when you came up with the concept?	
iii. What about just beforehand?	320 How would you rate yourself in relation to these two types of demand?
iv. Was the discovery sudden or gradual?	
v. What were you doing at the time the answer	

first came to you? vi. Does anything else stand out in your mind, about the event? vii. Does anything else stand out as a common factor in these discoveries?	Some people have a favourite place, or time, or activity which they associate with their creative work. Sherlock Holmes would smoke his pipe when thinking about a case. He described a difficult problem as a '2-pipe problem'.
3.2 To what extent have these discoveries required you to rethink or abandon work? a. Can you describe any specific examples? b. Why was it necessary to reconsider or redo work?	321 Do you associate anything with your creative work? 322 Do you feel that you owe any significant ideas to something like that? 323 What are your thoughts on why it is helpful?
[Reactivation question 330 in the Main study was relocated from 3.4]	330 If you do get stuck or find you can't resolve a tricky design problem, how do you deal with it?
[Sherlock Holmes (Action style) questions moved to beginning of Part 3. Extra question, about being quick versus reflective, added.]	340 Can you remember any examples of when you needed a breakthrough during conceptual design and came up with one?
3.3 Some people have a favourite place or time or activity which they associate with their creative work. The fictional detective, Sherlock Holmes would smoke his pipe when thinking about a case. He described a difficult problem as a '2-pipe problem'. a. Do you associate anything with your creative work? b. Do you feel that you owe any of your best ideas to something like that? c. Why do you think this is useful to you?	If NO, proceed to question 350. If YES, identify the examples, then proceed: I would like to consider one or two of these in more detail. Query the recalled instances: With regard to: < item >: 341 Could you briefly describe the basic circumstances of the discovery?
3.4 Sherlock Holmes fame came from the fact that he was *always* Sherlock Holmes, *always* the inquiring detective, astonishing people with his observations. He was never fully himself until he had a tricky case to resolve. As a designer, are you anything like that? b. Are you always a designer? – never off the air? c. When you get stuck on a tricky design problem, how do you deal with it?	342 What were you doing at the time the answer first came to you? 343 Can you recall the extent to which you worked on the problem beforehand? 344 How did you feel, when you came up with the concept? 345 Did the discovery come to you gradually or suddenly? 346 Can you remember anything of your thoughts beforehand? 347 Does anything else stand out in your mind, about the event?
[Second Breakthrough question, 350 in the Main study, was not included in the Preliminary study.]	350 Can you recall any breakthroughs or discoveries which, although welcome, required you to rethink or abandon work? [Next part of 350 is similar to Question 340.]

4. COMPLETION

The final stage of the interview includes a question intended to elicit statements about design ideas unexpectedly coming at times when not designing, to be employed if a respondent has not offered any remarks on cold discoveries, or to supplement earlier questions if the offered answers give an incomplete picture. A positive response is followed by a series of sub-questions with the same intentions as the sub-questions in Question 3.

A final question about designing, 4.2, was planned for the Preliminary study but not used.

Questions 4.3 and 4.4 were included to elicit relevant thoughts that may have been missed or which have occurred to the interviewee afterwards. Both proved to be good generators of perceptions that would not have been expressed and are included, with minor changes, in the Main study.

The following are specific questions about cold discoveries to be employed if an interviewee has not offered any remarks on cold discoveries. They may also be used to supplement the above questions when the offered answers give an incomplete picture. 4.1 Do you ever find design ideas unexpectedly come to you at times when you are not designing? i. How often does this happen? ii. Could you describe one or two recent experiences? iii. What about the project iv. How do these ideas compare, with discoveries you make while working? v. Have you noticed anything consistent in this? vi. To what extent do you rely upon ideas just coming to you? vii. Are there any times or events in your daily routine that you associate with ideas?	The next questions about cold discoveries should be employed if an interviewee has not already offered any remarks on cold discoveries, or to supplement earlier questions. 410 How often do you find design ideas come to you unexpectedly at times when you are not designing? 411 Could you describe any recent or significant experiences? 412 How did these ideas compare, with discoveries you make while working? 413 Have you noticed any patterns or consistent features in these experiences? 414 Can you recall the extent to which you worked on these problems beforehand? 415 Generally, to what extent do you rely upon ideas just coming to you? 416 Are there any times or events in your daily routine that you associate with ideas?
4.3 Could you to tell me about anything else that is emotionally important, or important in any other way, to your work as a designer?	420 Could you to tell me about anything else that is emotionally important, or important in any other way, to your designing?
4.4 Does anything further come to mind that a stranger, like myself, may never think to ask you about, but which helps to explain 'how you tick'.	430 Does anything else come to mind, that I haven't asked, but which helps to reveal 'how you tick'.

3.3 INTERVIEW DATA

This is substantially a qualitative study, augmented with measurement in areas of particular interest. In such cases the study has been planned and data organised to facilitate simple numerical analysis. Methods of assessing insightfulness are intended to be sufficient for basic purposes, to reveal obvious trends and to assess and categorise individual experiences. The quantitative data is derived from respondent statements, however the statements themselves, in the respondents own words, are the most important and compelling evidence of their insightfulness and are the basis of theoretical ideas developed during the course of the research.

3.3.1 Development of Coding Method

The main aims of the coding in this research are to facilitate analysis of interview data and to provide simple and effective means for evaluating the research hypotheses. The essence of that aim is to manage multiple categories of both expected and unexpected data, in a way that is both inclusive and selective. Any statement may be important. Sometimes the importance of a statement did not become evident until it was recognised as being part of a larger pattern, after being uttered by a later respondent. It is desirable that any system preserves the possibility of finding such patterns, but it is impractical to continue regarding every word as being of equal importance, just on the off chance that it contains a vital clue.

FACTORS INFLUENCING CODING DEVELOPMENT

Development of computational methods of managing and analysing the interview data in this study has been a process of improvisation, evolution and discovery. The process was initially influenced by earlier published design studies and subsequently guided by concepts and procedures associated with qualitative research and the development of grounded theory.

Published material in the design study domain has been influential in different ways. The current dominant form of design thinking research, the design protocol study, has been influential as the model this research attempts to complement. It could be regarded as a reverse model for this study. The settings of protocol and interview studies and the information they generate are very different. For example, once the problem is set and the protocol session is underway the *agenda* (or sequences of actions and events) is largely determined by the designer. This becomes an object, if not the object, of study itself. In interview studies the *agenda* is set by the interview structure. A variation in that structure (for example, when an interviewee speaks at length about one topic, raises a topic, draws a sketch, or refers to an image) may be important, but only to the extent that it affects the meaning, or interpretation of what has been said.

A second difference involves the degree of abstraction or reduction. Many protocol studies focus on activities generically, eg. Drawing, looking, speaking and often consider a single designer or a small group working together. Typically, when referring to a statement, the coded record may show simply that the statement is a query, or a declaration about function, or structure, for example. Such coding can be used to show the distribution of time spent on particular transactions during the course of a design session. This form of interpretation may show that a designer made a discovery during, or after some particular event, but unless the designer's thoughts or words are encoded in a form that retains a succession of ideas in some recognisable form the source of the revelation may be lost.

In this study actual words spoken by respondents, and sometimes how they are said, are crucial. They may be the only evidence of a particular discovery and how it occurred. Respondent words may also reveal broader or more systematic aspects of how an individual designs, eg. by showing that a respondent's discoveries are part of a pattern of behaviour involving a combination of characteristics.

One weakness of interview studies is difficulty of verification. It is not certain that all respondent claims are true. This could introduce doubt about credibility and the validity of interview data. As the research has drawn on the experiences of many respondents, the damage from one individual's unreliability can

be offset by the evidence of others. Further evidence from other populations will be gathered to test and augment current findings as this research continues. Some additional confidence can be gained from closer examination of statements by respondents. While a particular question is typically only asked and answered once in these interviews, respondents frequently refer to matters more than once in different contexts. Such repetitions have been consistent, with few contradictions.

In the current study coding has been entirely the work of the author. This was difficult to avoid, given constraints of cost and time. I am aware that different coders may have produced different outcomes. I have changed my own views in some instances, particularly after reading the full transcripts of interviews, when previously I had worked with summaries. It is proposed that additional coders will be instructed to review existing data and to participate in future research as the study continues.

Every form of research has limitations. If one compares interview data with protocol data, for example, different strengths and weaknesses are evident in both. A protocol session may reveal and record precisely what an individual did in a particular time, place and situation. But unless one can reliably generalise from that individual, time, place and situation to others, the observations will have limited application and meaning. An interview study generates data that may be less reliable, but the simpler interview process enables one to investigate more individuals, times, places and situations, for a given amount of effort.

Considering both forms of study together, the fact that some aspects of the collected data from one or more sessions may not be entirely reliable, valid, or general, does not prevent the information from being valuable within a prescribed range of utility. Like microscopes and telescopes, in other settings, the two forms of study provide useful but different views of the behaviour of designers.

My decision to adopt an interview approach was strongly influenced by my reading of published interview studies of architects, including Robbins (1994) and Lawson (1997a&b). I saw Robbin's work first and, ironically, it was another PhD student in the KCDC (Michael Tang) carrying out protocol studies, who showed it to me. Soon after, I learned of Lawson's interviews. Lawson goes further than Robbins in providing an exploration of themes that functions as a cross section through the interviews. Both these works have provided encouragement to adopt the interview approach. Although more broadly focused than my study, they have served well as general guides and have influenced the formation of the study and planning of the interview script.

The Robbins and Lawson architect studies do not elaborate on the processes of planning, conducting and managing the interviews and processing the recorded information. However, the combination of these studies with knowledge drawn from published information about qualitative research was sufficient to enable the development of a hybrid of qualitative and quantitative methods of coding and analysis to begin. Qualitative methods have frequently been employed to explore areas like this study, which are not well known and where questions of human experience are involved. Strauss & Corbin (1998) In order to evaluate the study hypotheses some of the planned data in my study has been interpreted in a quantitative manner, eg. Simple numerical methods have been used to categorise respondents in different ways, but the quantitative study is basic. In this stage of the project I have not employed statistics to evaluate marginal behaviours. My interest here is not with the marginal, but rather, to look for definitive statements and measurable evidence that is so compelling, that statistical means of demonstrating significance are superfluous. My motive for this approach is pragmatic. I can only afford to carry out this exploratory research once, unless it leads to a potentially fruitful outcome. If insightful behaviour is not readily apparent, or is so marginal that it might simply be the outcome of chance, that is not fruitful. That would suggest that insightful behaviour is relatively unimportant.

COMPUTATIONAL APPROACHES

The data from the semi-structured interviews consists of, 1) planned *questions* asked by the interviewer, varying little from one interview to another, and 2) *responses* or statements, by each of the respondents. Responses, with few exceptions, are determined, or influenced, by the planned *questions*. The interview protocol also includes, 3) optional questions and follow-up prompts, in response to the respondent's statements. Sometimes impromptu questions are asked, to clarify statements and sometimes planned questions have been asked out of sequence. The indirect open-ended nature of the interview questions, aimed at encouraging disclosures without leading, has also contributed to the variety of responses. It is common for responses to one question to be relevant to others, and so, a particular question may be answered more than once. Some responses may reinforce other responses, or conversely, necessitate more careful interpretation. Sometimes this may

occur consciously, with the respondent intentionally elaborating, or correcting an earlier statement and sometimes it may have been unintentional.

It is a characteristic of interview research generally that respondents express their point of view in their own words. The same point may be expressed in different ways in different contexts. A single statement may contain more than one point. Any interview question, even an early 'ice-breaker' question, with no apparent connection to a hypothesis, may prompt an interviewee to say something that is relevant to a hypothesis. Any interview question may prompt revelations of no direct relevance to a hypothesis, but which are still informative. A response may reveal facets of the interviewee that could add meaning, or qualify other responses that have been identified as directly relevant, or it may be useful for future research involving these respondents, or others. Therefore any part of an interview may be relevant and so, an aim of the coding is to maximise the potential usefulness of this secondary information, both to enhance the present study and for future studies.

Coding development and implementation has involved three main computational approaches, each having distinctly different levels of sophistication and each embodying different strengths and weaknesses.

1) The first and most enduring approach has been an evolving use of a variety of spreadsheets, from simple beginnings that were not specifically related to coding.

2) The next approach involved use of software designed for qualitative research, NVivo. This was an attempt to adopt more advanced methods, which I suspended upon reaching a suitable stopping point, as NVivo did not prove to be time effective for this initial stage of the project.

3) The current approach has been to develop a standard coding pro-forma, like a questionnaire, to contain and systematically order key statements by each respondent and my observations about these statements. This has been effective so far and will be reasonably easy to convert to a future data base method, when this becomes necessary.

USE OF SPREADSHEETS

The following worksheets, consolidated into a single (Microsoft Excel spreadsheet) file, were developed and employed extensively during the course of the project. The worksheets are first listed below and then briefly described.

1 Activity Schedule - Gantt chart to facilitate fieldwork and transcription.
2 Completion schedule - Gantt chart to facilitate thesis production.
3 Question - Response Summary - Initial *spot* transcribing of interviews.
4 Response Analysis Table - Coded worksheet for investigating trends.
5 Respondent Discovery Summary - Insight ratings, all respondents, in rows of five.
6 Respondent Discovery Experience Analysis - Charts, for all respondents, Insight rating, RAIA award status, gender and discovery experience comment.
7 Respondent Graphs

Images of the most relevant worksheets 3, 4 and 5 are included in the Worksheet descriptions below. The complete Excel Project Spreadsheet containing all worksheets, plus separate image files permitting viewing of all worksheets, individually are included in the Appendix, see p.9 for further details. A more detailed description of each worksheet follows.

WORKSHEET 1 - ACTIVITY SCHEDULE

An Activity Schedule, see Appendix 1 – Methodology, Worksheets folder, was constructed, to plan, track and provide a coherent representation of activities such as interviews, transcribing and checking. It was used extensively before and during the fieldwork stage of the project. The schedule was laid out like a Gantt chart with time progressing from left to right and with tasks and other items, including activities involving the interview respondents, in rows down the sheet.

The success of this worksheet in use encouraged me to employ spreadsheets more extensively as a representational medium. As this worksheet is a component of project management, and is unrelated to the analysis of interview data, it requires no further mention.

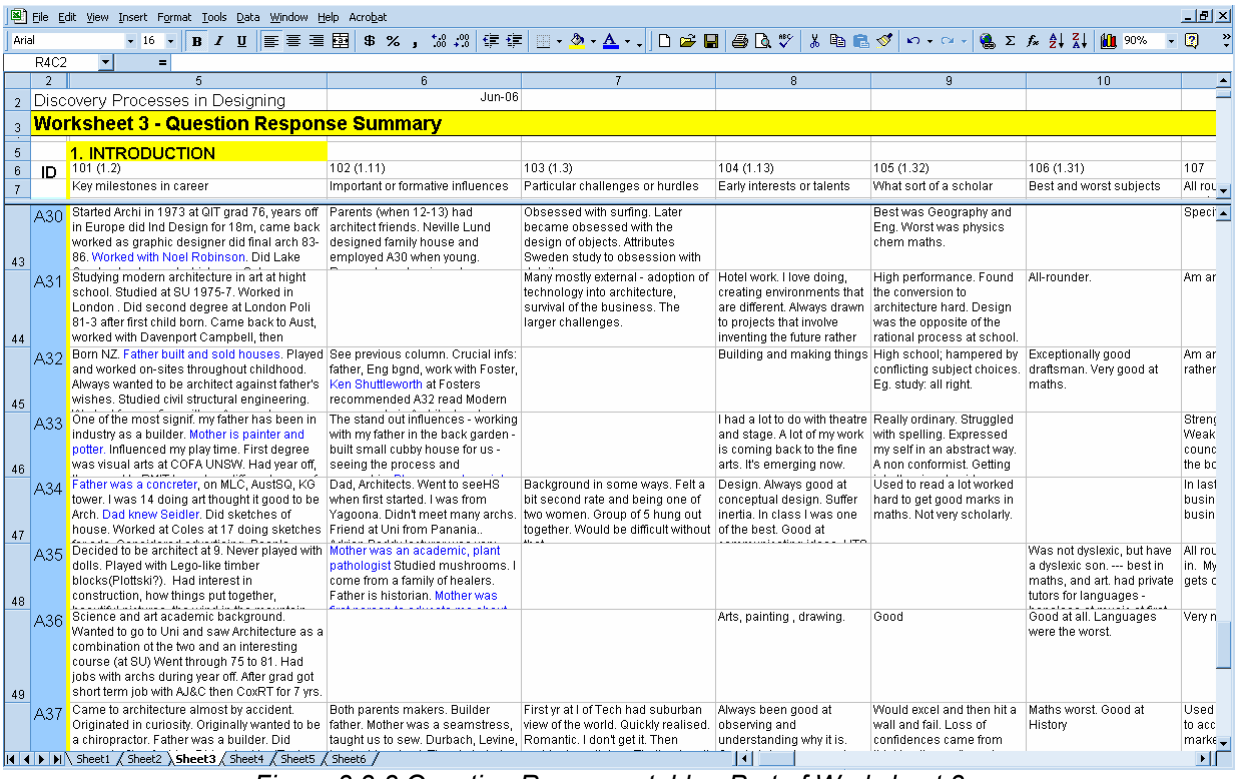
WORKSHEET 2 - COMPLETION SCHEDULE

The Completion Schedule, see Appendix 1 – Methodology, Worksheets folder, was constructed, to facilitate the final part of the project, culminating in the submission of the thesis. Although implemented late in the project this Schedule has been listed as the second Worksheet because, functionally, it is an extension of Worksheet 1. Like Worksheet 1 it is a project management device only and is unrelated to the interview analysis.

WORKSHEET 3 - QUESTION-RESPONSE TABLE

In the latter part of 3.2.1 Interview Procedure, Transcription, I referred to the initial *spot* transcribing of the interviews to a spreadsheet, referred to below as the Question Response table. This worksheet was made during the process of downloading interview recordings, giving me rapid access to the interview content, months before the interviews were transcribed. It was extensively utilised when writing conference papers and has grown since then, as it has been extensively used to assist thinking and preparation of the thesis. This form of representation enabled all questions and key statements of a respondent, or all respondents' answers to a question to be reviewed by scanning across or up and down the worksheet.

During the data entry stage the focus was on the respondents, with respondent records in columns and the question-responses in rows, allowing a respondent's record to be read by scrolling down the sheet, row heights varying to suit each answer. Once the attention shifted from data entry to analysis, being able to scroll down all respondents for a particular question became more important. When the new needs became evident the worksheet was rotated, to re-organise the respondents in rows, like the Activity Schedule.



	2	5	6	7	8	9	10	
2		Discovery Processes in Designing	Jun-06					
3		**Worksheet 3 - Question Response Summary**						
5		1. INTRODUCTION						
6	ID	101 (1.2)	102 (1.11)	103 (1.3)	104 (1.13)	105 (1.32)	106 (1.31)	107
7		Key milestones in career	Important or formative influences	Particular challenges or hurdles	Early interests or talents	What sort of a scholar	Best and worst subjects	All rou
43	A30	Started Archi in 1973 at QIT grad 76, years off in Europe did Ind Design for 18m, came back worked as graphic designer did final arch 83-86. Worked with Noel Robinson. Did Lake	Parents (when 12-13) had architect friends. Neville Lund designed family house and employed A30 when young.	Obsessed with surfing. Later became obsessed with the design of objects. Attributes Sweden study to obsession with		Best was Geography and Eng. Worst was physics chem maths.		Speci
44	A31	Studying modern architecture in art at hight school. Studied at SU 1975-7. Worked in London . Did second degree at London Poli 81-3 after first child born. Came back to Aust, worked with Davenport Campbell, then		Many mostly external - adoption of technology into architecture, survival of the business. The larger challenges.	Hotel work. I love doing, creating environments that are different. Always drawn to projects that involve inventing the future rather	High performance. Found the conversion to architecture hard. Design was the opposite of the rational process at school.	All-rounder.	Am ar
45	A32	Born NZ. Father built and sold houses. Played and worked on-sites throughout childhood. Always wanted to be architect against father's wishes. Studied civil structural engineering.	See previous column. Crucial infs: father, Eng bgnd, work with Foster, Ken Shuttleworth at Fosters recommended A32 read Modern		Building and making things	High school; hampered by conflicting subject choices. Eg. study: all right.	Exceptionally good draftsman. Very good at maths.	Am ar rather
46	A33	One of the most signif. my father has been in industry as a builder. Mother is painter and potter. Influenced my play time. First degree was visual arts at COFA UNSW. Had year off,	The stand out influences - working with my father in the back garden - built small cubby house for us - seeing the process and		I had a lot to do with theatre and stage. A lot of my work is coming back to the fine arts. It's emerging now.	Really ordinary. Struggled with spelling. Expressed my self in an abstract way. A non conformist. Getting		Streng Weak counc the bc
47	A34	Father was a concreter, on MLC, AustSQ, KG tower. I was 14 doing art thought it good to be Arch. Dad knew Seidler. Did sketches of house. Worked at Coles at 17 doing sketches	Dad, Architects. Went to seeHS when first started. I was from Yagoona. Didn't meet many archs. Friend at Uni from Panania..	Background in some ways. Felt a bit second rate and being one of two women. Group of 5 hung out together. Would be difficult without	Design. Always good at conceptual design. Suffer inertia. In class I was one of the best. Good at	Used to read a lot worked hard to get good marks in maths. Not very scholarly.		In last busin busin
48	A35	Decided to be architect at 9. Never played with dolls. Played with Lego-like timber blocks(Plottski?). Had interest in construction, how things put together,	Mother was an academic, plant pathologist Studied mushrooms. I come from a family of healers. Father is historian. Mother was				Was not dyslexic, but have a dyslexic son. --- best in maths, and art. had private tutors for languages -	All rou in. My gets c
49	A36	Science and art academic background. Wanted to go to Uni and saw Architecture as a combination ot the two and an interesting course (at SU) Went through 75 to 81. Had jobs with archs during year off. After grad got short term job with AJ&C then CoxRT for 7 yrs.			Arts, painting , drawing.	Good	Good at all. Languages were the worst.	Very n
	A37	Came to architecture almost by accident. Originated in curiosity. Originally wanted to be a chiropractor. Father was a builder. Did	Both parents makers. Builder father. Mother was a seamstress, taught us to sew. Durbach, Levine,	First yr at I of Tech had suburban view of the world. Quickly realised. Romantic. I don't get it. Then	Always been good at observing and understanding why it is.	Would excel and then hit a wall and fail. Loss of confidences came from	Maths worst. Good at History	Used to acc marke

Figure 3.3-3 Question Response table - Part of Worksheet 3

WORKSHEET 4 - RESPONSE ANALYSIS TABLE

As the forty main study respondents were progressively added to the Question-Response table Worksheet 3 grew very large. Its comprehensiveness was useful for reference purposes, but the relatively intact interview text did not facilitate use of the key data it contained. As no practical method of modifying the existing spreadsheet, without reducing it came to mind, I began a second worksheet, extracting the essential points from Worksheet 3 and organising them by stated subject, regardless of the initiating question.

The Response Analysis table (see next page) like Worksheet 3 has respondents in rows and attributes in columns. This form factor simplified cutting and pasting from the earlier worksheets but a more important advantage is that it permitted all 45 respondents to be displayed on the screen at once, when simple one line coding is used for the different attributes. This feature led me to develop a key word coding approach which facilitates analysis of groups of attributes.

Initially abstracts of statements were written into each cell. As the worksheet developed the format of key columns was amended by abbreviating the cell entries to sortable colour coded terms. The Excel cell comments feature was employed (see examples below) to contain more extensive descriptions or actual pasted extracts from the interviews.

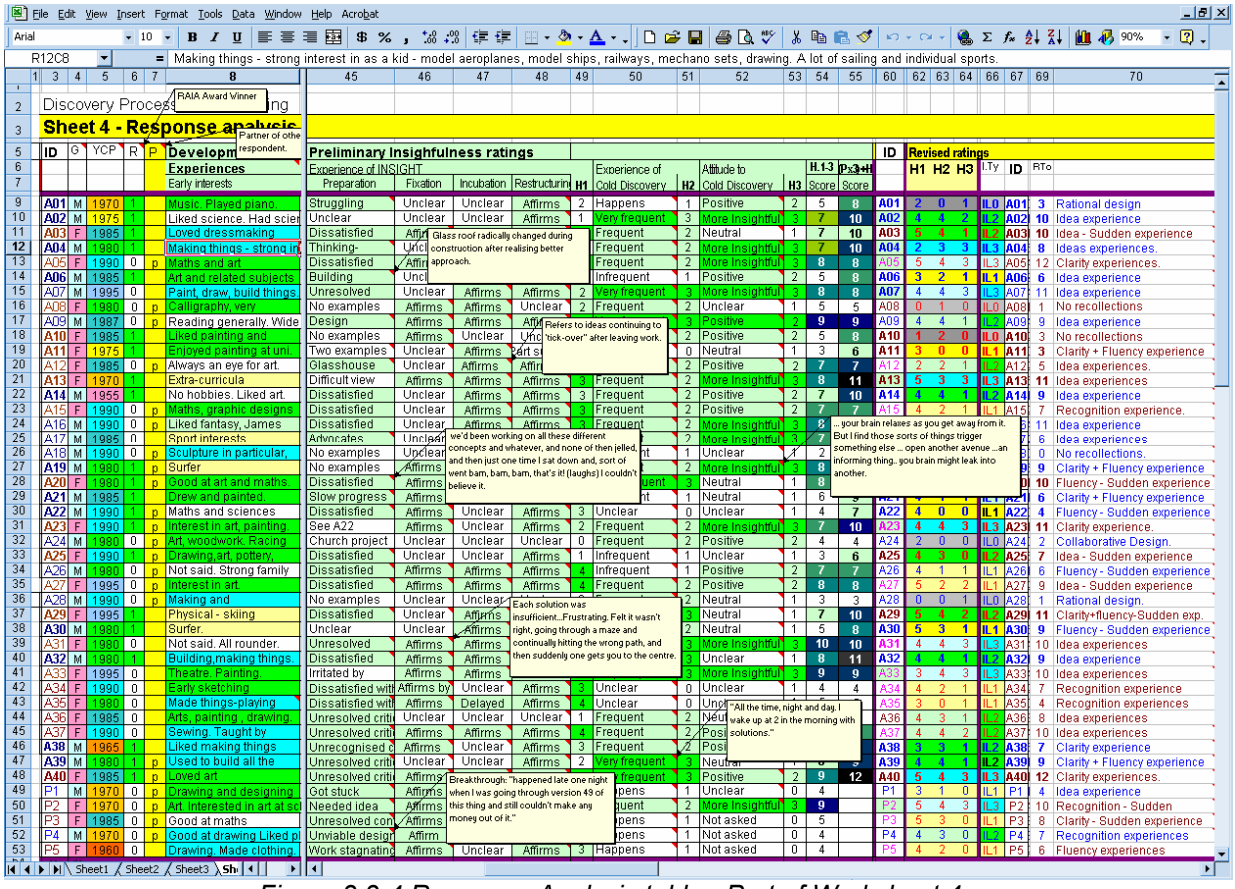


Figure 3.3-4 Response Analysis table - Part of Worksheet 4

WORKSHEET 5 - RESPONDENT DISCOVERY SUMMARY

This worksheet was constructed to enable insightfulness findings, for all respondents, to be displayed for checking and comparison in a compact representation.

The respondents are sorted in rows of five in their ID order, which corresponds to the order in which they were interviewed.

The information in each respondent cell is coded as follows:

- Line 1 shows:

  Respondent ID and Insight Level
  L1 = Resp. P1 - Insight Level 1

- Line 2 – displays respondent Insightfulness ratings for each of the three Hypotheses.

  A rating of 310 means:
  Hypotheses 1 rating = 3
  Hypotheses 2 rating = 1
  Hypotheses 3 rating = 0

Cells are colour coded, as follows.

- Yellow, green and blue signify Insight levels 1, 2 and 3
- Respondents with RAIA awards are shown in the bolder colours.

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Worksheet 5 - Respondent Discovery Summary

Respondents are sorted in rows of five in order of interview.
Each respondent cell shows:
Line 1: Resp.ID - Insight Level (L1, L2 or L3)
Line 2: Ratings for Hypotheses 12&3

Respondents in sets of five

P1 - 5	P1-L1 310	P2-L3 543	P3-L1 531	P4-L2 431	P5-L1 421
A01-05	**A01-L0 201**	**A02-L2 442**	**A03-L2 541**	**A04-L3 233**	A05-L3 543
A05-10	**A06-L2 321**	A07-L3 443	A08-L0 010	A09-L2 441	**A10-L0 222**
A11-15	**A11-L1 300**	A12-L1 221	**A13-L3 533**	**A14-L2 441**	A15-L1 421
A16-20	A16-L3 443	A17-L1 321	A18-L0 000	**A19-L2 432**	**A20-L2 541**
A21-25	**A21-L1 411**	**A22-L1 400**	**A23-L3 443**	A24_L0 201	**A25-L2 431**
A26-30	A26-L1 411	A27-L1 522	A28_L0 001	**A29-L2 542**	**A30-L1 531**
A31-35	A31-L3 443	**A32-L2 441**	A33-L3 343	A34-L1 421	A35-L1 301
A36-40	A36-L2 431	A37-L2 442	**A38-L2 331**	**A39-L2 441**	**A40-L3 543**

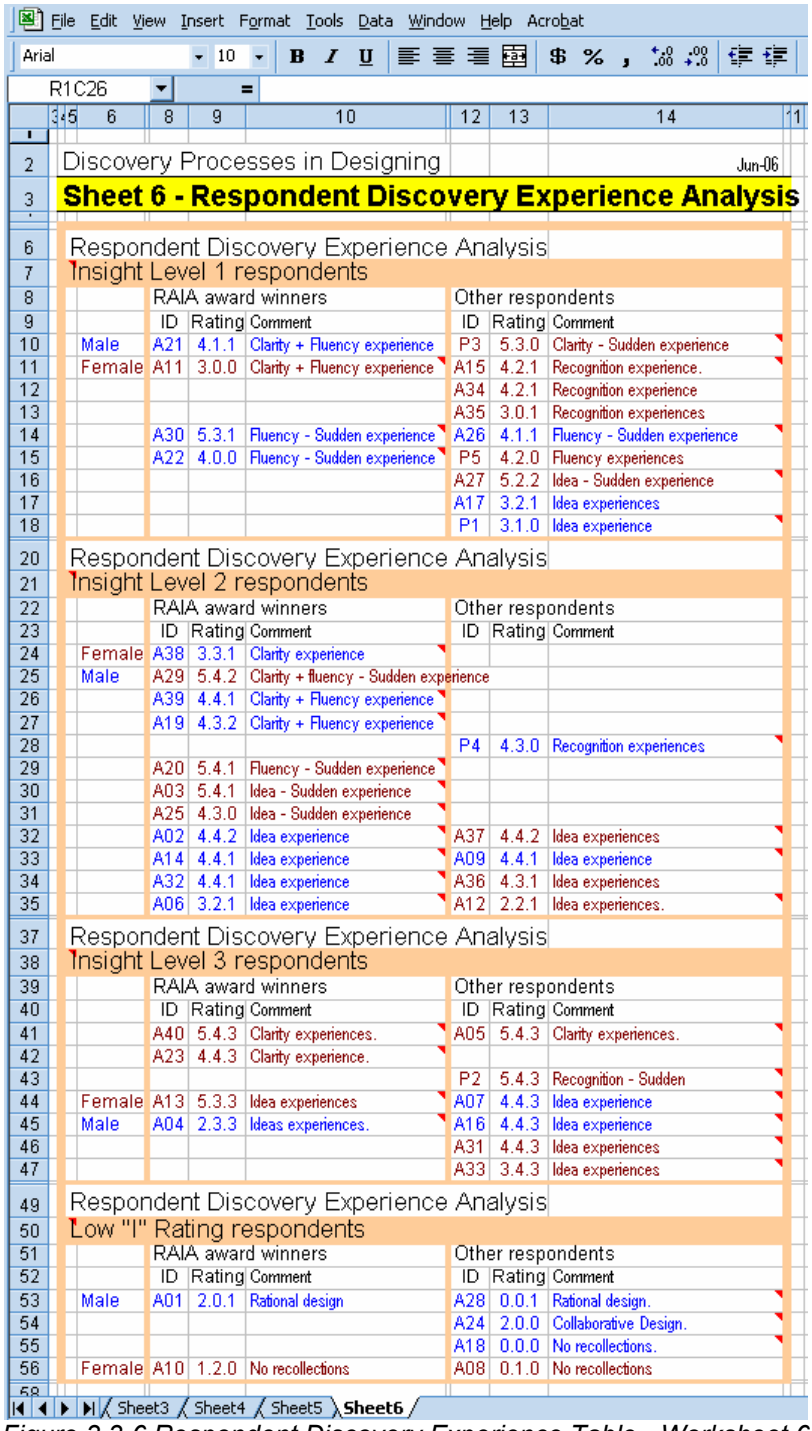
Check sums						Totals
L1-All	4	4	1	1	4	14
L2-All	2	3	2	6	2	15
L3-All	2	2	3	1	2	10
L0-All	1	0	3	1	1	6
Totals	9	9	9	9	9	**45**

Ratings	Male	Female	SubT
L1 RAIA awd.	**3**	**1**	**4**
L1 Other	3	7	10
L2 RAIA awd.	**7**	**4**	**11**
L2 Other	2	2	4
L3 RAIA awd.	**1**	**3**	**4**
L3 Other	2	4	6
L0, RAIA awd..	1	1	**2**
L0, other	3	1	4
Totals	22	23	45

Fig.3.3-5 Respondent Discovery Summary Worksheet 5

WORKSHEET 6 - RESPONDENT DISCOVERY EXPERIENCE ANALYSIS

Worksheet 6 (below) is another summary, showing the distribution of all respondents by Insight Level, and RAIA award rating. The distribution of respondents by Gender, Insight Rating and Discovery Experience is also made visible by this chart.



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Sheet 6 - Respondent Discovery Experience Analysis

Respondent Discovery Experience Analysis
Insight Level 1 respondents

	RAIA award winners			Other respondents		
	ID	Rating	Comment	ID	Rating	Comment
Male	A21	4.1.1	Clarity + Fluency experience	P3	5.3.0	Clarity - Sudden experience
Female	A11	3.0.0	Clarity + Fluency experience	A15	4.2.1	Recognition experience.
				A34	4.2.1	Recognition experience
				A35	3.0.1	Recognition experiences
	A30	5.3.1	Fluency - Sudden experience	A26	4.1.1	Fluency - Sudden experience
	A22	4.0.0	Fluency - Sudden experience	P5	4.2.0	Fluency experiences
				A27	5.2.2	Idea - Sudden experience
				A17	3.2.1	Idea experiences
				P1	3.1.0	Idea experience

Respondent Discovery Experience Analysis
Insight Level 2 respondents

	RAIA award winners			Other respondents		
	ID	Rating	Comment	ID	Rating	Comment
Female	A38	3.3.1	Clarity experience			
Male	A29	5.4.2	Clarity + fluency - Sudden experience			
	A39	4.4.1	Clarity + Fluency experience			
	A19	4.3.2	Clarity + Fluency experience			
				P4	4.3.0	Recognition experiences
	A20	5.4.1	Fluency - Sudden experience			
	A03	5.4.1	Idea - Sudden experience			
	A25	4.3.0	Idea - Sudden experience			
	A02	4.4.2	Idea experience	A37	4.4.2	Idea experiences
	A14	4.4.1	Idea experience	A09	4.4.1	Idea experience
	A32	4.4.1	Idea experience	A36	4.3.1	Idea experiences
	A06	3.2.1	Idea experience	A12	2.2.1	Idea experiences.

Respondent Discovery Experience Analysis
Insight Level 3 respondents

	RAIA award winners			Other respondents		
	ID	Rating	Comment	ID	Rating	Comment
	A40	5.4.3	Clarity experiences.	A05	5.4.3	Clarity experiences.
	A23	4.4.3	Clarity experience.			
				P2	5.4.3	Recognition - Sudden
Female	A13	5.3.3	Idea experiences	A07	4.4.3	Idea experience
Male	A04	2.3.3	Ideas experiences.	A16	4.4.3	Idea experience
				A31	4.4.3	Idea experiences
				A33	3.4.3	Idea experiences

Respondent Discovery Experience Analysis
Low "I" Rating respondents

	RAIA award winners			Other respondents		
	ID	Rating	Comment	ID	Rating	Comment
Male	A01	2.0.1	Rational design	A28	0.0.1	Rational design.
				A24	2.0.0	Collaborative Design.
				A18	0.0.0	No recollections.
Female	A10	1.2.0	No recollections	A08	0.1.0	No recollections

Sheet3 Sheet4 Sheet5 **Sheet6**

Figure 3.3-6 Respondent Discovery Experience Table - Worksheet 6

WORKSHEET 7 - GRAPHS

Excel worksheet 4, the Response Analysis table was employed to manually produce a large number of bar graphs to assist visual exploration of relationships between variables and to represent them when they are discussed in the thesis. Bar graphs are crude, but convenient, when portraying distributions among differently sized sub-groups, as they reveal both magnitude and shape allowing simple visual inspection, comparisons and evaluation of the strengths and weaknesses of trends.

LIMITATIONS OF SPREADSHEET BASED CODING

Use of Excel worksheets has been a productive success, in the sense that the medium has been employed in a variety of ways to perform many different analyses and to display a large body of findings, all in one comparatively small file, of less than 2 MBytes. The Excel application allows multiple worksheets and multiple windows of the same worksheet to be viewed. It is reasonably versatile in relation to formatting and displaying information. However I found several weaknesses that reduced the utility of the software, or made the use of it more difficult, or were annoying.

- The absence of support for representation of hierarchical or tree structures. This is a distinct limitation. One can work around it, but when there is no facility at all there is a loss of incentive to view variables as being up or down in a hierarchy.
- Difficult to combine keyword coding and notes. There are practical limits to the amounts of information that can, or should, be included in a worksheet cell, particularly if the cells are to be coded for sorting and filtering. The Excel cell comment facility is useful but crude in execution. The comment balloons are awkward to use and are unstable. Sometimes balloons disappear, by re-positioning themselves away from the cell they represent, or by compacting. Balloons that are visible on *mouse-over* frequently relocate, to some distant off-screen part of the worksheet, when either *Show comment* or *Edit comment,* are selected. With multiple comments this creates extra work and definitely drains the patience.
- Worksheet instability. When more than one worksheet is open the inactive worksheet will periodically, spontaneously revert to another worksheet, often the active one, but not necessarily. This can sometimes happen to the active worksheet. It can switch to another sheet as you are in the process of editing or pasting some item into a cell. This rates highest on my patience testing scale.

USE OF QSR NVIVO

QSR NVivo is a qualitative analysis software application, described by its authors as a tool kit for handling data, not easily reduced to numbers. In the second half of 2005 I invested about three months acquiring knowledge of NVivo, while organising and coding my data for analysis. Attractive features of NVivo compared with earlier versions and other software, such as Ms Excel, are that it:

- Enables hierarchical relationships to be expressed.
- Supports multiple coding - ie. Many to many, without duplication of records.
- Supports growth and changes to the database and coding structure.
- Treats interviews, references and any other parts of the thesis as documents, allowing them all to be coded and processed and linked by a common method.
- Allows the database to be set up as a model of the thesis, eg. Structured to match chapters.

In general these features offered flexibility and appeared to facilitate more thorough and detailed analysis than could have been achieved using a spreadsheet. The support for hierarchical *tree* structures, multiple coding and the making of amendments as the database developed and grew, are all valuable features. I found the process of building and coding the database, with NVivo, gave me useful insights into ways of organising and coding the data that may have taken longer to acquire any other way.

However, at the time of submitting the thesis I have not explored NVivo in sufficient depth to fully utilise its entire capability. Building my NVivo interview data base did not lead to the outcomes I was hoping for. Once I reached the stage of generating useful output for the thesis I found a number of shortcomings in the NVivo software that I could not easily overcome. The most difficult problem was, combining the coded interview material with a commentary. NVivo supports direct coding of transcripts, without changing the transcript. But there is no corresponding method of attaching comments *on the fly*, to passages in the transcript, or to coding, other than by manually creating additional documents and installing hyperlinks. One can generate reports of coding, but these are views, not documents. They can not be edited. One can copy and paste them into documents, but then they are no longer part of the database. At that time of this realisation, my time to complete the thesis was running out. I had two choices, 1) Invest more time learning about NVivo on the assumption that I would find an ideal method, or 2) Generate the coding and commentary another way, drawing on the coded information from the spreadsheets and the NVivo coding. I chose the second option.

The decision was made quickly, but not lightly. Decision making was assisted by an experience of long delays in attempting to resolve an earlier technical issue. That was not a critical matter but resolution was slow and advice I received after a month of enquiries was inconclusive. This time, as I could not afford, at least, a month of delays, further development of NVivo techniques was suspended. Instead a coding approach based on a standard pro-forma, in effect, a virtual questionnaire was developed.

RESPONDENT TABLE PRO-FORMA

During the process of developing the NVivo database the following coding objectives were considered necessary:

- Consistent organisation of all respondent statements by content, as provided by the Excel worksheets, to facilitate visual comparisons.
- Inclusion of commentary, or additional information, where it is important to indicate the context of critically important statements, or to distinguish spontaneous statements from prompted replies. This may require that the instigating question or some other precipitating remarks be shown. Remarks made before a question could possibly be relevant.

There were also issues of the extent of abstraction, retention of detail and remoteness from the specific aims of the research to consider. Coding should be informative while also condensing the information in the transcripts. When it is necessary, to acquire a deeper or wider understanding of a particular passage, a reader can refer to transcripts or sound files if these are available. Text in a transcript can be referenced by cutting from the coded format and pasting into a Ctrl+F dialog box associated with one or more transcripts.

The most direct way to achieve the coding objectives was to devise a logically structured respondent pro-forma that incorporated: 1) Relevant and potentially relevant categories of statement and 2) Adjacent annotation, supporting the selected statements, all in a consistent format. With regard to categories, the aspect of NVivo that most pleased me, the hierarchical structure of the NVivo data base, could be re-applied in the structure of a pro-forma. By combining the respondents' statements and a commentary, in the form of an annotated virtual questionnaire, I would have a resource that documented each interview, which could also function as a reference, in the Thesis Appendix, and as a source of examples in Chapters 4 and 5 of the thesis.

3.3.2 Respondent Table Coding

The Respondent table lists categories in an order which combines:

1. The staged chronological sequence of the interview, described in Chapter 3.
2. An ordering of responses in a logical form based on the following succession of categories - Respondent Details, Development History, Formative Characteristics, Design Thoughts and Values, Designing, and Respondent Discovery Details.
3. Hierarchical subdivisions within the above categories.

This form of organisation is necessary because there is a degree of repetition in questions, which need not be reflected in the data. In addition, as the open ended interview questions encourage the respondent to decide what is important, so many different types of answers may be given that it is both inadequate and unnecessary to map answers to categories based entirely on specific interview questions. In describing career events, for example, one respondent may refer to an influential family member, another may describe a building, winning a competition or making a particular discovery.

The main feature of the Respondent Table coding is an acknowledgement that statements should be cited and located according to the category, or categories, to which they are relevant and are decisive or revealing. Some statements are placed in more than one category. For example a statement that describes a respondent's design process which also affirms that the respondent designs intuitively will be included in Formative Characteristics/Rational-Intuitive, as well as Designing/Process. When more than one statement is placed in a category the statements are placed in the chronological order of the interview, unless they clearly make more sense when sequenced another way.

The Table describing and explaining the method of coding (shown below) has a similar structure and general appearance as the actual Respondent Tables, in Appendix 2, see p.9 for retrieval details. The following conventions are applied.

1. When the pro-forma is divided into two columns, the left hand column includes the hierarchical category headings and sub-headings.
2. The right column in the actual Respondent Tables is designed to accommodate respondent statements interleaved with my commentary. Indented (Times) font is employed for cited respondent statements and plain (Arial) font, as used throughout the Thesis, is employed for the commentary.
3. In the table describing the coding below, a similar convention is applied, except that my statements are about the coding rather than respondent observations. Any respondent statements shown below have been drawn arbitrarily from different respondents. They represent no one in particular and are selected only as examples to support the commentary, and help explain the method of coding.
4. The scope of the Respondent Tables is broader than the main focus of this thesis and for that reason some explanations are quite brief. The most critical and therefore the most detailed part of the table is related to hypotheses and the scoring method employed to assess insightfulness.
5. Explanations of title blocks and headings, that do not incorporate the two column convention just described, are located immediately below the item being described.

RESPONDENT DETAILS I.D: Enter one of A1-5 or P01-40 Female Male Architect Designer Select correct general description	Commenced practice: Enter nearest half decade eg: late 1980s Current status: Sole practitioner, Partner, Director Select or enter correct professional designation Awards: RAIA Not known Enter RAIA or other significant awards

Entries in a category may include the respondents' recollections, informally stated expressions of current sentiments and more deliberately considered judgements. Where a statement is identified as being potentially important it should include the respondents wording and an indication of the context in which the statement was made.

DEVELOPMENT HISTORY

Information in this category was collected incidentally as part of preliminary discussion in the early part of each interview. It is intended that this information will be utilised in a further study. This information has been retained in the Appendices, to more fully inform readers, however it is not specifically addressed in the thesis.

The function of this category is to accommodate experiences and perceptions of the world that may have significantly influenced a respondent.

EARLY EXPERIENCES	
Interests	Entries may range from early passing childhood interests to sustained interests that may still be important to the respondent. Typically (if not always) the report of an interest should include an action
Achievements	Milestones and awards that the respondent states as an achievement.
Education	1. Aspects of pre-professional education that may have been influential, and; 2. Times, places and possibly influential aspects of professional

	education, other than individual teachers
Ambitions	Like Interests, entries may range from early passing childhood thoughts to sustained ambitions that may still be important to the respondent. Similarly a reported ambition should (typically) include recollection of an event or action.
Situational factors	Broad category, intended to include influential (past) and influencing (present) experiences in life that do not fit one of the above categories. Typical entries include being born or living in another country, travel experiences, difficult or traumatic events, health or physical conditions.
INFLUENTIAL PEOPLE	Entries below should include an identification, indications of time and place, and a description of why the individual has been nominated. Specific reasons for nomination can be imagined for individuals in each of the categories below, but it is neither necessary nor practical to anticipate what these may be. A "hero" might be an inspiring designer, for example. However anyone might inspire, say something, or do something that a respondent later recognises was influential.
Family - friends	Individual, whose relationship with the respondent, either as a family member, friend or acquaintance at some time, from childhood to the present, is nominated by the respondent as being influential or important in some way.
Teachers	Individual, whose role in the education of the respondent at some time, from infant school to the present, is nominated by the respondent as being influential or important in some way.
Employers	Company, individual or peer group that either employed the respondent, or was associated with an employment and is nominated by the respondent as being influential or important in some way.
"Heroes"	Architect, designer or other individual, who through work, actions, statements, or reputation, is nominated by the respondent as being influential or important in some way.

FORMATIVE CHARACTERISTICS

Comments in the first paragraph under Development History above partly apply to Formative Characteristics. Reference is made to Formative Characteristics in the Thesis but, in general, this is not a key aspect of the current study.

Formative Characteristics are internal, or may be described as attributes of the respondent, unlike items referred to in Development experiences above, which are (initially at least) primarily external.

The categories below include responses to questions where the focus is on self-evaluation, or speculation about attributes and others which are not directed at self reflection at all.

Perceived strengths and weaknesses	Entries that bear on whether the respondent is an all-rounder or has specific strengths and weakness, or which identify these properties belong in this category. This is of future interest in identifying relationships between insightfulness and particular capabilities.
Perceived success qualities	Respondents are asked to express their thoughts on qualities needed for success. Answers which indicate personal or professional attributes or traits, valued by the respondent belong in this category. It is intended that in addition to the above, responses to this question may also be included in, or offer insights of relevance to Design - Thoughts and Values categories, such as Values-aims-goals.

Rational - intuitive	Respondents are not asked whether they are rational or intuitive. However many have stated either, 1) that they are rational or intuitive people, or 2) that their designing involves rational or intuitive process, or 3) that they, or their designing, includes both rational and intuitive characteristics Rational process or characteristics are signified by terms such as, methodical, rigorous, analytical, parameter driven. Intuitive process or characteristics are signified by terms such as, experiential, flexible, wholistic, emotions and feelings.
Visualisation skills	The printed interview does not specifically enquire about visualisation skills, but some respondents refer to aspects of visualisation directly, or indirectly, and this invited impromptu queries. As visualisation is an important topic of design cognition research generally and may influence insightfulness, relevant response are of significant interest for future research as well as the present. Relevant skills include both the abilities to visualise while designing, in the sense of understanding the 3D implications (what a space will be like) to do mental "walk throughs" or to systematically visualise details, such as wall, roof and corner junctions. Visual memory capabilities, either in the form of recollections of previously seen buildings, or being able to later, draw up a design, eg. That may have been visualised before going to sleep the night before, are also relevant.
Changes over time	Respondents are asked to describe how their way of designing now has developed and changed and they may also volunteer information about their development over time. Either type of statement should be entered in this category.

DESIGN - THOUGHTS & VALUES

Two category groups are oriented towards design and designing. The first group, Design - Thoughts & Values literally refers to what the designer thinks about design, what design is and what is important about design. Responses may be general; eg. The ingredients of good design, the role of design in creating a better or more sustainable world, or they may be personal; eg. The respondent's manifesto or aspirations as a designer. Some respondents may state both.

Own philosophy	Respondents are asked to describe their design philosophy. The actual purpose of the question is less to acquire a statement of philosophy and more to encourage revelations of what is most important to the respondent, in relation to design and designing. Consequently, responses to the design philosophy question may be entered in one of the locations below. Suitable responses for this location are those which encapsulate, in a few words, an attitude or belief about design (outcome), designing (action), or both, that is general and important to the respondent.
Values-aims-goals	The intention behind this category is to assemble clues to what is important to the respondent and what the respondent is intending to achieve, in both shorter and longer terms. The focus is on design, but anything the respondent raises as important may be revelatory. While both values and objectives are relevant to the matter of intent, collecting them together also facilitates the identification of a consistency or inconsistencies.
Emotion statements - eg. likes-dislikes	Likes and values are inter-dependent to some extent, but this category was created to contain less formally expressed, or less thought-about

	statements, (ie. less than those in the box above) that need not correspond to particular design aims and goals.
Top designers & why nominated	Sometimes when answering the philosophy question, or at other times, respondents use the example of a prominent designer they clearly admire. Whether explicitly intended or by implication, this may help to explain or reveal something about themselves, perhaps an understanding, a value, or a belief. Eg. A respondent may speak admiringly about *so-and-so's* work and emphasis the clarity of his/her/ their sections. This is revealing of the value of the section, to the respondent, not just the nominated architect(s).

DESIGNING

In contrast to Design-Thoughts & Values, this category group is about the respondent's actions that are associated with designing. It includes *focus*, *process* and *action styles*. These embody both strategic and tactical elements. Focusing can be described as strategies that involve setting boundaries and priorities, early, or even before, a project begins. Some designers may use the same strategy for all projects. For others, starting a project may involve identification and resolution of possible strategies. Process is more tactical, being associated with actions. I am using the process category to accommodate statements about the common actions that are generally associated with designing. Also included are statements about cognitive activities when designing. Action styles refers to actions as well, but this category is used to accommodate features of a person's designing that are not necessarily planned, or intentional, or perhaps not even noticed, that may be characteristics of general behaviour, or personality, not just designing.

FOCUS	During the interviews, in addition to identifying different aspects of design as important, the respondents expressed many different views on how they go about designing. In earlier research on architecture students and science students, Lawson (1979, p.218) observed the scientists adopting a problem-focused strategy and the architects a solution-focused strategy. As this series of interviews with mature professionals progressed more complex differences of focus became evident. At first two focusing categories *breadth* and *direction* were identified. However it later became evident that two categories were insufficient to adequately characterise the designers approach. In the current characterisation The names of the first two terms have been replaced, breadth has become *scope* and direction has become *orientation* as these terms are more general and flexible as descriptions. A third concept *framing* has been added to accommodate other expressions of intent that respondents used in describing the way they go about their work.
Scope	Scope statements indicate that a respondent's approach to designing or to design projects is typically either: o General, abstract or broadly focused, referring to typical attributes of projects, goals and activities. or, o Specific and concrete, with a particular focus, referring to the particularity or uniqueness of either the projects, or the approach the respondent would take for each project. In this study respondents have tended towards one or the other. It is possible that some may adopt both approaches according to the project. Eg. General for more routine "bread and butter" projects and specific for non-routine, more interesting or higher profile projects.
Orientation	Orientation statements refer to the category identified by Lawson (1979). On the basis of Lawson's findings it could reasonably be anticipated that significant numbers of architects would be solution oriented. This has

	been the case. No respondents were clearly problem focused, but other orientations were evident and their indicators can be specified. Generally the way in which a particular orientation is worded reflects the respondent's scope approach. In other words the respondent will make more general or more specific statements. The observed orientations so far are: o Solution - emphasising design outcomes in either general terms (eg. creating architecture that is technically well conceived) or specific terms (eg. "I approach each design afresh.") o Process: emphasising process, 1) as an imperative (eg. insisting that the design be the outcome of a process) or, 2) as a situational aspect of designing (eg. collaborative processes, with stakeholders, or workshopping) o Wholistic: emphasising the whole or the totality of projects. This view may be associated with other emphases like a high priority on developing understanding, or identifying unique features of the project, and Specific Scope.
Framing	Framing statements can be about almost anything relevant to design type, site, client or other situational factors. Sometimes there may be more than one. There is relatively little to be gained in attempting to define all of these, as this study is not making judgements about their validity, or utility. None-the-less, what is clear from the current respondents is that *framing statements* tend to have some level of association with the *orientation* statement. By describing broad variants of these it is possible to throw some light on types of framing statements that may be encountered: o Strongly related as a subset or implication. Examples: - Process oriented designer prefers to design collaboratively - Solution oriented designer emphasises importance of the *idea*. o Weakly related or unrelated third category of intent. For example, some respondents expressed interest in the inclusion of artworks in their buildings. Whether this is weakly or strongly related to orientation varies according to the orientation. It is arguably more strongly associated with a solution orientation than, say, a process orientation.
PROCESS	Process refers to stated actions and thoughts associated with designing. Many items coded in this category are associated with interview questions relating to designing or process, but aspects of process may be articulated on many occasions during the interview.
Other designers	Respondents are invited to describe different ways of going about designing seen among other practitioners. Relevant responses are those which focus on other designers' actions especially those that articulate a particular method.
Respondent's process	Respondents are invited to describe any differences in *your way of designing*, compared with other architects. Sometimes answers to this question may be articulated in the answer to the previous question.
Directional references	Directional references are specific process statements that contain a direction, such as going from the general to the particular, or design based on the plan, or the section. This item is not actively addressed in the current study, but is regarded as potentially significant.
Cognitive components	This category has been included to accommodate statements respondents make about cognition, in relation to designing. The statements may be about the respondent, or it may be about other respondents or designers in general.

ACTION STYLE	Action styles are apparently unplanned features of a respondents designing that are likely to be a reflection of more general attributes, and not just designing.
Progression mode	In the interview, reference is made to designers who progress steadily through projects, whereas others fluctuate. Respondents are then asked about their own experience. Relevant responses are those which employ terms like, 1) fluctuating, eg. inconsistent, spurts, fits and starts, uneven, or describe getting stuck in different circumstances, and 2) steady, eg. consistent, methodical, incremental.
Incessancy	Respondents are asked to describe the extent to which they feel they are always *on the case* or always the practitioner (designer or architect), in comparison with the perpetual detective, Sherlock Holmes. Relevant responses are those which address incessancy in either sense: 1) Always being the designer, or architect, and 2) Always being on the case. Respondents may affirm, or reject incessancy, or give qualified answers, associating incessancy with projects, moods or other circumstances.
Quick versus reflective	A second question about Sherlock Holmes was intended to indicate adeptness at making decisions on the run, compared with a deeper and more reflective approach. This question is primarily aimed at encouraging statements that may indicate insightfulness. However it also represents a variable that may be of interest in future studies. Relevant responses include those that indicate respondents lean towards one mode or the other, or are equally adept in either situation. Statements describing variation and reasons for the variation are also relevant.
Creative catalysts	A further reference was made to Sherlock Holmes, who would smoke his pipe when thinking about a case. Respondents were asked if they have a favourite place, time, or activity which they associate with their creative work. This was another question aimed at encouraging statements that may indicate insightfulness, from individuals who responded positively. A wide range of relevant responses, describing any item the respondent associates with creative work, discoveries attributed to the item and their view of why the item helps, are acceptable.
Reactivation	Respondents are asked how they deal with getting stuck or finding themselves unable to resolve a tricky design problem. This is another question aimed at encouraging statements that may indicate insightfulness. However the question has elicited such a wide range of responses it has prompted the creation of the Reactivation category. A wide range of relevant responses, describing any action the respondent is likely to carry out in the event of getting stuck, and other observations they volunteer about incessancy are acceptable.
Representation preferences	Preferences in the use of different design media were not the subject of a direct question, but are associated with questions about how individuals design. When respondents have revealed aspects of their preferences they should be added to this category.

RESPONDENT: <Resp. ID> DISCOVERY DETAILS

Testing of the Thesis Hypotheses is based on statements respondents make about discoveries. Coding of these statements needs to perform several functions as listed and described below.

1. Assist identification of responses or statements relevant to one of the three hypotheses.

2. Signify the type of relevance of that response to a hypothesis, based on key meanings in a statement. If a statement contains more than one key meaning, or has a bearing on more than one hypothesis, each meaning will be counted as a separate response.

3. Indicate a level of support for the hypothesis; either, positive, negative, unclear or neutral.

The decision to use a pro-forma method of coding originated from an appreciation that any respondent statement could be relevant to one, or more, of the three research hypotheses and to other parts of the study as well. The first step towards this decision came on realising that condensed coding in the manner of protocol studies was too reductive for this study. The verbatim method used in the pro-forma may be inefficient from a data management point of view, but maintains richness and flexibility by enabling the respondents' words and commentary to be seen together. There is redundancy but this can be moderated by cross referencing.

A score (of 1) is given for an indicator category if a respondent statement includes a positive indicator. The maximum possible score for each hypothesis is equal to the number of its indicator categories that are identifiably positive, based on respondents relevant statements. The three hypotheses, described in detail in the pro-forma below, have the following numbers of categories: Hypothesis 1 = 5 categories, Hypothesis 2 = 4 categories and Hypothesis 3 = 3 categories. Each Hypothesis is important. It is not suggested that a hypothesis having a scale of five is more important than one with a scale of 3. A respondent's score consists of the three hypotheses scores. Therefore a respondent scoring 3 on hypothesis 1, 4 on hypothesis 2 and 3 on hypothesis 3 is given the score 343.

Use of the term indicator is meant to acknowledge the fact that the presence of a positive value for one or more indicators is not irrefutable proof that an insight has taken place. It is possible that no quantity of indicators will be sufficient to satisfy a confirmed insight skeptic. But it can be shown, by an accumulation of indicators, that some individuals appear to be more insightful, or less insightful, than others.

It is, of course, possible to create more sophisticated scales. For example degrees of Preparation, Fixation or Incubation may be identifiable in the defined statements. It is also possible that some categories may be more important than others. Many refinements may be developed in the future, if the simple procedures I am adopting indicate that greater efforts are warranted. But, for now, simplicity rules. I want to avoid a situation where over refinement gives a misleading impression of accuracy. Basic methods should demonstrate whether respondents show unmistakeable signs of insightful behaviour, worth investigating more fully, or that there is nothing of particular interest.

INSIGHT EXPERIENCE - HYPOTHESIS 1

Score

Total 5 max.

STATEMENT OF HYPOTHESIS

Unexpected discoveries during the conceptual phase of a design project include both;

i) insightful discoveries which resemble Gestalt insights, or what Gestalt theorists describe as productive thinking, and

ii) non-insightful discoveries which can be attributed to normal cognition, or reproductive thinking.

CONFIRMATION CRITERIA

As stated in Chapter 2, insights are associated with the solving of novel or ill structured problems. Prima-facie assessment of the insightfulness of conceptual design discoveries is based on indicators associated with components of insight, described in Chapter 2 Analysing discovery, namely: 1) *preparation*, 2) *fixation*, 3) *incubation*, 4) *restructuring* and 5) "*aha!"* experience.

PREPARATION	Preparation has been characterised as a period in which the problem solver learns about, gains familiarity with, or "chunks" the problem elements and possible manipulations, or becomes expert about the problem. (Kaplan & Davidson, 1988, p.18) Preparation is also thought to entail confrontation with the problem and actions such as problem analysis, mental representation, conceptualising of the problem's core aspects and unsuccessful attempts to reach a satisfactory resolution. Seifert et al (1995, p.75) As preparation alone is not a sufficient condition of insight, it can be expected that statements about preparation may be offered regardless of whether a discovery is insightful or not. Statements about preparation, made prior to insightful discoveries may differ from statements made prior to non-insightful problem resolution. In this study, respondents receive a score for preparation, if one of the following indicators is present in statements about a particular described discovery. - Thinking - Had thought about a design but not worked on it. - Working - Had worked on a design (eg. attended meetings, inspections etc) but had not started designing. - Sketching - Had started sketch designing. - Stopped - Stopped designing, before resolution achieved. - Proposal - Produced a design proposal, but not a great one. If the respondent can't remember a discovery, or declines to describe a particular one, a score (of 1) is also recorded if the respondent affirms preparation in general statements about discoveries previously experienced.	1 or 0
FIXATION	The view that misinterpretation, or inappropriate representation inhibits problem solving is a main component of the Gestalt view of insight. Mayer (1995). A score for Fixation is recorded if one of the following indicators is present in statements about a particular described discovery. - Misunderstood or misinterpreted key aspect of problem. - Inappropriate solution - excessive attachment to, or persistence in attempts to impose, inappropriate or unworkable solutions. - Mental block - acknowledged *mental block, getting stuck*, *brick-wall* stage, or equivalent barriers to progress. - Initial lack of progress - respondent emphasises that a discovery or break through followed an initial, or earlier, period of no progress. As with Preparation a score is recorded if the respondent refers to fixation in general statements about discoveries previously experienced.	1 or 0
INCUBATION	Gestalt theory views incubation as an unconscious, but active constructive process. But there are alternative views which account for incubation effects by means of conscious processing. Incubation can be defined in a non-committal,	1 or 0

	minimal way, as any interruption of conscious problem solving that later appears to have aided in attaining the solution. Kaplan & Davidson (1988). Given the strong association of incubation and insight it can be inferred that signs of incubation prior to discoveries, is an indicator of the discovery being insightful. Whether incubation is the outcome of conscious or unconscious processes is not material to Hypothesis 1, 2 or 3 and therefore is not investigated in this research. A score for incubation is recorded when a description of a discovery contains a positive indicator of incubation. Indicative statements include: - Rejected continuation - Rejected continuing or repeated attempts to solve problem when stuck. Eg. Statements like: "the more you try the harder it gets." - Action assuming incubation - Described actions that indicate acceptance of incubation. Eg. Going away and waiting for ideas to emerge. - Action to promote incubation - Described actions that increase the likelihood of incubation occurring. Eg. An activity regularly undertaken like swimming, or intentionally putting the thought out of mind. - Credited incubation process - Attributed discovery to process that can be associated with incubation. This category includes descriptions or statements such as: subconscious processes, unconscious incubating process, process occurs while mind is on other things, process is occurring constantly. As with Preparation a score is also recorded if the respondent refers to incubation in general statements about discoveries previously experienced.	
RESTRUCTURING	Gestalt theorists attribute restructuring to awareness of new relations among problem components, or grasping the internal structure of a problem situation. Insightful restructuring can be identified from descriptions of a discovery including its origins how it is perceived by the person who experienced it and the manner and extent to which the discovery has impacted on the designer's work. For this analysis the term restructuring is used as the name of the category that includes the basis of the insightful discovery, whether it involves revelation, recognition, reinterpretation, redefinition, or ideas. *Restructuring indicator categories* Identification of sub-types of restructuring is proposed, partly to achieve a more positive and rigorous identification of restructuring activity and also to permit a detailed study of insightful behaviour. Restructuring events - Definite, but lacking specific detail - Recalled as quick, rapid or sudden - Recalled as unexpected, without warning or out-of-the-blue. Restructuring outcomes - Definite, but lacking specific detail - Schematic anticipation, or confirmed perception of a larger schema or model, in which the situation, or the design, is an	1 or 0

	integral part. - Visual perception, or confirming a reorganisation, or a new arrangement, that is substantially visual - Reformulation, or confirmed redefinition or re-interpretation of the problem or givens - Recognition of an analogy, between the structural organisation of a previously experienced situation and the current situation, or design. Non-restructuring event, not specific	
"AHA!" FACTOR	Arguably the most familiar indicator of insight is the experience of elation that sudden awareness leading to insight commonly brings. It is more the exception than the rule for insight to be mentioned without reference to Archimedes leaping from his bath or Isaac Newton under the apple tree, or some such anecdote. The "Aha!" experience is not sufficient alone to confirm that an insight has occurred. People may have a similar experience when they remember a name, some time after it didn't come to them, when it was needed. However there is no reason to overlook this experience as a contributing sign, when a respondent refers to it and when one, or more, of the other indicators of insight are present.	1 or 0
COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2 STATEMENT OF HYPOTHESIS Among some designers, unexpected discoveries when they are not actually working on their design, described in this thesis as *cold* discoveries, are important in their designing. CONFIRMATION CRITERIA Confirmation of the hypothesis relies upon respondent's recollections and perceptions of discoveries. There are two main conditions to be identified; • Whether a particular *cold* discovery, or cold discoveries collectively, are important. • Whether a particular discovery is *hot*, *cold*, or something in between.		Score Total 4 max.
IMPORTANCE	Importance may be a function of degree of influence on quality and progression of a design, or in terms of some broader context. Eg. Future designs. Importance is also directly influenced by frequency. It can reasonably be expected that high frequency levels provide greater confidence that cold discoveries will occur than low levels. Regular, frequent *cold* discoveries may create expectations and influence the way a designer works.	
Value	Value may be expressed by a respondent in different ways. Predominant are statements that relate *cold* discoveries to the respondent's designing, or which compare them to *hot* discoveries. Less common but significant are statements which confirm a level of reliance upon cold discovery. Broad categories of responses include the following: o Comparisons with hot discoveries Positive to very positive Neutral or non-committal	1 or 0

	Negative o Reliance on cold discovery Some to Strong reliance No reliance o Unclear response	
Frequency	Frequency refers to how often design ideas come when the designer is not designing. Responses typically, have been expressed imprecisely, in proportional or relative terms. The following categories, grouped approximately in order, from most to least frequent, reflect that. o Strongly affirmative Always, Most of the time. Very much so, Often o Medium affirmatives Quite often, A fair amount, Reasonably frequently o Weak to insignificantly affirmative Sometimes, Occasionally, Not often, Hardly ever	1 or 0
HOTNESS-COLDNESS	In this study, the metaphorical terms *hot* and *cold* discoveries are used to distinguish between discoveries made during the *heat,* and particularly the *peaks,* of active design sessions and discoveries that emerge when designers are not working on a design. For the testing of Hypothesis 2, working on a design, or designing, requires the intention to design and the deliberate application of that intention, shortly before and during the time of discovery. The location of the design activity is not critical. For example, some respondents travel a lot and have stated that being in a plane for several hours, away from phones and queries, is ideal for designing. Flights have become a regular time and place of work. Conversely a designer at a drawing board, or doing some paperwork, who suddenly experiences a revelation, while daydreaming, or gazing absent-mindedly through a window, was not working on a design, within the terms of Hypothesis 2. The revelation may precipitate a session of designing, but it is a *cold* discovery because the revelation came first. The terms *hot* and *cold* are also employed in the Hypothesis 2 analysis, to characterise discovery situations in greater detail. Two qualitative aspects of *hotness* and *coldness* are defined as follows: 1) A relative time, referred to as *hot time*, and 2) an absolute time, referred to as *cold time*. *Hot time*: is associated with the relative proximity of a discovery to earlier designing, or problem solving activity, that could be regarded as *preparation* (see Hypothesis 1) and therefore to what may be described as the relative *hotness* of the *trail*. Shortly after a design session, while the experiences are fresh in mind, the designer may still be seething with thoughts that could prompt a discovery, after he or she has started to engage in some unrelated activity. It is also possible that proximity before an expected design session may be associated with discovery, perhaps due to increasing levels of arousal as the session draws near. Statements by respondents that suggest either of the above conditions apply, in relation to a recalled discovery, or to a pattern of discovery, may be regarded as indicative of cold	

	discovery. *Cold time*: is an absolute time concept, applying to discoveries that take place beyond the time when proximity to earlier *preparation* events is likely to be a significant element in the discovery. This is not in any way denying the importance of earlier preparation. It is the opposite. The concept of cold time is based on the supposition that some recollections, or impressions of earlier preparation will fade from memory relatively quickly, while others might not fade much at all and may even intensify over time. *Cold Time* is related to times, activities and events, other than working.	
Proximity to hot time:	The following indicators of relative proximity to peak levels of design activity, or *hotness*, may be used for descriptive purposes. • *Hot* - Discovery made during periods of design activity, especially at peaks in sessions as, for example: when designers are alternating rapidly between activity modes. Akin & Lin (1996) This is the archetypal hot discovery. • *Ending* - Discoveries made as a design session is clearly past its peak or is being wound-up or ending. Within this period thoughts and memories of the session are likely to occupy or still be fresh in the designer's mind. • *Post session* - Same day - Discoveries made following a design session, after some unrelated activity such as a meal. During this period unresolved problems from the session, including the subject of the discovery, are likely to be easy to remember, if not completely fresh in the designer's mind. Next day - Discoveries made the following day or soon after. During this period unresolved problems from the session, including the subject of the discovery, are more likely (than earlier) to have been displaced, or even superseded, by other significant matters. Latter day - Discoveries made after several days or longer, during which time it may be anticipated that further design sessions have taken place. The period could extent to weeks, or longer but significance after a day or two is likely to owe more to the session than the time. Eg. A once in a lifetime design session with Renzo Piano may change the direction of a designer's career, whereas a routine work session that led nowhere may leave no durable trace at all. • *Resumption* - Discovery after intentionally commencing, or resuming, a design session and directing attention towards the subject of the unexpected discovery. Resumption discoveries, that emerge rapidly on resumption of designing, after a break, appear to warrant further study as a distinct discovery form. • *Parallel* - These include discoveries and discoveries of relevance to one design, made while working on another.	1 or 0
Nature of cold time:	The second interpretation of time arises when activities related to the daily cycle of living may be associated or influential in the	1 or 0

	discovery process. The list below is not exhaustive as different events may be routine for different people. However it is anticipated that a relatively few categories will be required to account for this variable. - Waking - from sleep, at different times and places. - Meal times - activities associated with preparation and eating. - Ablutions - washing, shower or toilet, dressing, grooming. - Travel - walking, driving, commuting, log distance travel - Other work - while carrying out non-design work or chores. - Other Design - other aspect of same or different project. - Mental leisure activity - eg. reading, doing a puzzle, gaming - Physical leisure activity - eg. walking, jogging, swimming.	

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3	Score Total 3 max.
STATEMENT OF HYPOTHESIS Discoveries made during active design sessions, described in this thesis as *hot* discoveries, are more likely to be the outcome of normal cognition, or appear to be that way, while discoveries made when the designer is not actively considering the problem, that is, *cold* discoveries, are more likely to show signs of being insightful.	
CONFIRMATION OF HYPOTHESIS A necessary condition for Hypothesis 3 is that a respondent confirms that some discoveries are insightful (Hypothesis 1) and that some are cold discoveries. (Hypothesis 2) Confirmation of Hypothesis 3 relies upon individual perceptions of discoveries. These may be volunteered when a respondent is describing a discovery, or in response to Question 4 which asks the respondent how ideas, that come when not designing, compare, with discoveries made while working? Evaluation of Hypothesis 3 is more subjective than Hypotheses 1 and 2 as it is mostly a matter of judgement by the respondent. The following scaling criteria are employed:	
o Respondent: a) Is dismissive, or makes negative remarks about cold discoveries (eg. no use, waste of time, unreliable, misleading), or b) has a low score for Hypothesis 2 and little, or no basis, for judgement.	0
o Respondent statements about cold discoveries are not negative but are not clearly positive either. They are either neutral (eg. always thinking, all the same, as good as other discoveries) or unclear in not embodying a clear positive or negative value. (eg. more general, more specific, little things, not sure, hard to say)	1
o Respondent refers to at least one beneficial feature of cold discoveries but does not directly affirm they are more insightful than hot discoveries. (eg. worth trying)	2
o Respondent makes positive references to cold discoveries, with at least one reference indicating greater insightfulness, than hot discoveries. (see below)	3

Comments by Respondent	Broad categories of responses have been mapped to particular adjectives and phrases as follows: o Indicators that cold discoveries are more insightful Adjectives associated with insight eg. clarity, creative, essence, resolvable, specific, stronger Phrases associated with insight eg. - key things, pushes boundaries, solves problem. o Indicators that cold discoveries are possibly more insightful Qualified indication - a chimera, deficient, a random thing	

	Limited indication - minor ○ Indicators that cold discoveries ar not insightful Unclear - can't recall, difficult to compare, Neutral - all as one, similar, the same Negative - misleading, useless, waste of time	

3.3.3 Reporting of results

Interview findings are presented in detail in the next two chapters, as follows:

- Chapter 4 - Respondent Characteristics - which includes a summary of general attributes of the respondents and details of three key aspects of their designing. These are Design Focusing, Design Processes and Design Action Styles.
- Chapter 5 - Design Discoveries - which reviews the coded interview data contained in the Respondent Tables, included in Appendix 2, see p.9 for retrieval details. This Chapter has four parts. The first three are associated with the testing of insightfulness in relation to Hypotheses 1, 2 and 3, while the fourth part describes the incremental designers who do not support the hypotheses.

CHAPTER 4

RESPONDENT CHARACTERISTICS

4.1 GENERAL ATTRIBUTES

As the evidence from the 45 interviews of this study is very extensive, the cited statements referred to in this chapter are a fraction of the total. Selections in this chapter have generally been chosen because they express a distinct point of view. Additional respondent IDs are included, when a respondent has said something that is similar to an already cited statement. The cited statements are frequently an amalgam of statements from that respondent. Discontinuities are signified by three full-stops… Some statements have been copied from Excel worksheet cells and comments and may be abbreviated, compared with the full transcript. However the sense of the statement should be the same as the transcript.

Note that the full interview transcripts are available for checking, or pursuing an interest, in Appendix 2 - Respondents. Audio files are held at the University of Sydney but are not generally available for distribution as they are subject to human ethical restrictions and copyright.

YEARS OF PRACTICE

The 45 respondents ranged in age from late 30s to late 70s with youngest an RAIA award winner commencing practice in 1998 and the oldest commencing in the mid 1950s.

The approximate distribution of experience of practice is as shown below in five year increments.

1955	1960	1965	1970	1975	1980	1985	1990	1995	All
1	1	1	4	2	11	10	10	5	45

Fig. 4.1-GY at right, which plots Gender against Year of Commencing Practice, indicates that the ratio of female to male practitioners is much greater among the more recent and younger practitioners, than respondents practicing before 1984. Change of gender balance will be referred to later, when it is considered likely to have influenced other trends.

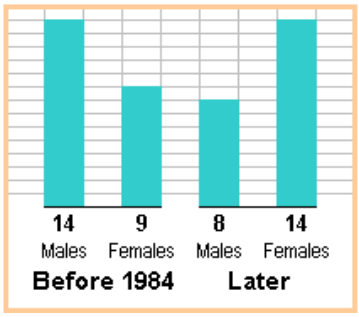


Fig. 4.1-GY Gender by Year Commenced Practice

GENDER AND RAIA AWARDS

A tabulation showing the numbers of all respondents by gender and RAIA award status, is shown below. An additional row of figures is included to also show the numbers of respondents who are partners of another respondent.

	Male Respondents			**Female Respondents**			**Totals**
	RAIA Award Winners	Others	Sub totals	RAIA Award Winners	Others	Sub totals	
All respondents	12	10	22	9	14	23	45
Partner of a respondent	3	8	11	4	7	11	22

Fig 4.1- A Respondent key distributions

There are slightly fewer RAIA Award winners (12+9=21) than "Others", or non award winners. (10+14=24) While more of the award winners are men than women, (12:9) the proportion of females to males is higher than the actual ratio of female to male RAIA award winners. eg. Of 23 national award winners and commendations for 2005 the few females named were all partners of males.

PARTNERS

In the respondent population, proportionally more female (4:9) than male (3:12) RAIA Award winners are in partnerships with respondents. Whereas, proportionally more male (8:10) than female (7:14) non-prize-winners are in partnerships with respondents. This could suggest that partnership is more fruitful for females (in terms of RAIA status) than it is for males, or that female architects are better at choosing talented partners than are males.

The subject of partnership has been mentioned at this point because it is an obvious feature of the respondent population and also to foreshadow interest in further study. Partnerships are a particular form of collaborative design and practice and, judging from the partnerships encountered in this study, they are a richly varied form. Although partnership is referred to at times in the thesis, it is not an object of study in this thesis.

DEVELOPMENT HISTORY AND FORMATIVE CHARACTERISTICS

This research is not designed with the intention of comparing the respondents with some other population. Therefore such observations or judgements that are made apply within the respondent population only. At times broader more general observations are offered, as a matter of interest, or when a particular attribute has surprised me in being unexpectedly high or low. Such statements are intended as no more than an expression of my own reactions, or conjectures that a particular observation may warrant future systematic investigation, to establish its significance.

EARLY EXPERIENCES

Respondents were queried about *interests*, *achievements*, *education* and *ambitions*. The respondent tables also include a *situational factors* category, to include other influential experiences in the life of the respondents.

There are relatively few surprises in these variables. Among the respondents there appears to have been widespread interest from early childhood in creative activities. Nearly half of the respondents nominated arts activities such as drawing, painting or music. Another quarter of the respondents nominated activities that involved making things, such as building, making models, sewing or dress-making. These experiences appear to be scattered among the respondents and not obviously associated with other variables identified so far, such as gender or RAIA award winning performance. Most of the respondents described themselves as good scholars. Six stated they were all rounders with no particular strength or weakness. Considerably more respondents nominated mathematics as a love, or a best subject, than as a weakest or worst (ratio 17:7). Some people might not expect so many architects to be highly numerate.

INFLUENTIAL PEOPLE

I have sometimes heard people such as parents, teachers and employers, who guide others, express the view that a little bit of encouragement goes a long way. This view would be supported strongly by many respondents as it is evident in their statements and sometimes their actions. Encouragement, by example, appears to be particularly powerful, as the examples of people near and dear to the respondents appears to have been highly influential in their lives. It is difficult to separate the power of the encouragement from the receptiveness of the respondent. But it appears, from what many have said, and from the way they have said it, that being amongst family and friends actively designing and making things, during childhood, has pre-disposed them to take up an occupation where they can design and make things too. One experience, many respondents have in common, is early and intimate exposure to family, or close friends, who are working intuitively, or creatively, or insightfully. It appears likely that every-day, or frequent, exposure to familiar people who are successfully making things, actively and confidently intervening in their environment, has been a stimulating and perhaps empowering experience. Currently it is impossible to say how this sample compares with others, but this is an interesting finding that will be reconsidered once additional, systematically different, respondents are interviewed in the future.

PROFESSIONAL EDUCATION

Teachers, during school and professional training years, mentors, especially those who have provided employment, and outstanding practitioners, all appear to have been highly influential to many respondents, sometimes profoundly. However, their contributions appear to be particular and many of the individual experiences appeared to be unique. One instance of uniqueness concerns designers or architects nominated as being the most influential. Most respondents referred to the well known practitioners, Le Corbusier, Louis Kahn, Renzo Piano and the like, but each has a special one, most respondents referred to one other, that no one else mentioned. Clearly this practitioner has a special appeal either communicated through published work or personal contact experienced by the respondent. This appears to be very interesting, but is too complex for analysis in the context of the current study. Whether unique personal experiences, or more general experiences of professional education, are associated in some way with insightful discovery has not been explored in depth and is referred to in 6.3.1 Replication and extension studies.

4.2 DESIGN FOCUSING

Although some respondents claim they avoid consistent or routine approaches to their designing, there are consistencies in beliefs and ways of designing among all respondents. The respondents are consistently different from each other. Some advocate consistent methodical approaches to practice.

The presence of both consistencies and differences should be no surprise. It is well known that individuals interpret and mentally structure and categorise their perceptions, rather than attempting to respond to every event as unique. Bruner, Goodnow and Austin (1967, p.1). This is a compelling source of consistency. The respondents are also intelligent, and as professional designers, they have learned how to make informed choices in managing their occupational and personal activities, throughout their lives. They not only categorise what they see and experience, but they also structure their actions. As they have led different lives, they focus on different aspects of the totality of particular projects, setting particular goals and employing their particular knowledge and skills in particular ways. It can be assumed natural selection governs this behaviour, and contributes to particularity. Focusing preferences and other strategies, that in their personal experience, produce nothing, or lead nowhere, are less likely to be chosen again. Conversely, preferences and strategies, that lead to discoveries and ultimately to good design outcomes, are more likely to be chosen again, and again. As choices are made repeatedly, over years, then decades, of professional practice, the behaviour will become more automatic as a *fait accompli*. Each designer becomes increasingly familiar with his, or her, way of going about designing. Formerly hard-to-acquire skills become second nature, unseen and mostly unnoticed, except to curious others.

Few of the respondents have either shown, or stated that they are introspective, or even curious about their own inner workings. Few have spent a lot of time working with other architects and fewer still have pondered over the meaning, or implications of fundamental differences in the ways they go about their work. It would be an exaggeration to suggest this apparent reticence is associated with anything like a taboo, but notions like: *if it ain't broke, don't fix it*, or the story of the caterpillar, who lost the ability to walk, after thinking about the order it moved its legs, may influence thinking about thinking, among some.

The remainder of this sub-chapter has three main parts comprising, 1) an analysis of focusing categories, 2) observations about the distribution of focusing categories, and 3) a collection of representative focusing statements by many of the respondents.

4.2.1 Focusing categories

In a 1970s study of architecture students and science students, by Lawson (1979), a distinction between *solution-focused* and *problem-focused* strategies was observed. Lawson described the architecture students as having a more solution-focused strategy and the science students as having a more problem-focused strategy. In this study there are some similarities to Lawson's study, but perhaps because the respondents are accomplished practitioners, there is a richness of variation not evident in the younger population of students. So rich is the variation that during the course of this study I found it necessary to employ additional categories to describe the variation.

Focus orientation

The distinction Lawson observed I refer to as focus *orientation*. About half of the respondents indicated that they are *solution-oriented*. No respondents were identified as *problem-oriented*. Respondents not categorised as solution oriented made statements indicative of either, a *process*, or a w*holistic*, orientation. Within each category respondents' orientations were expressed in different ways, indicative of differences in the way the respondents regard their projects and in the values and

priorities that guide them. To account for these I identified two more focusing categories, *scoping* and *framing*.

Focus scoping

Focus *scoping* distinguishes between statements about designing that are: 1) *generic*, or that generalise about projects as a whole, or classes of project, or imply that a project is part of a continuum of design activities, or a body of work, and responses that, 2) focus on what is *specific* to individual projects, suggesting that each project is regarded as unique. Generic scoping reduces the complexity of a problem by categorising items into recognisable classes or parameters. The opposite, Specific scoping, at first glance, looks like a complicating action. But, typically, it is associated with what may be described as an *audition* process, to identify potential design *ideas* (ie. big ideas) or *generators*. Success in this approach (identification of an ideal generator) also leads to variety reduction. Darke (1978)

Scoping statements are often direct, sometimes repeated in different ways and their effect can be seen in other statements the respondent makes about designing, leaving few doubts about the individual's preference. However it is not proposed that respondents are exclusively generalisers or always intent on the particular. Individuals make choices about when to generalise and when to consider specifics. But why they make their choices is less well known. Respondents who have made generic statements about their approach, may also refer to specific project related features as well. The strategic aspect of scoping may influence the designers' decisions about when to be general and when to be specific. Interest and knowledge presumably play a part too.

Focus Framing

Focusing tends to be more finely tuned or framed according to aspects of design, or designing, that individuals interpret as being high priority, or interesting, which structure, shape and characterise their designs. I refer to this as Focus framing. Among other researchers, Schon (1983 pp. 309-315) has referred to frames as settings, which "shape their practice". Akin (1995, p.354) refers to frames of reference that "restructure the problem in such a way that the creative process is enhanced".

In architecture the most evident and dominant of frames is *modernism*. Although not many of the respondents enunciated the label of modernism, to define or characterise their work, all appear to accept an interpretation of modernism as a given.

4.2.2 Distribution of Focus Scoping and Orientation

Focus scoping and orientation have been plotted against Gender, RAIA Award Status and Year of Commencing Practice, see Figs. 4.2-dfG, 4.2-dfA and 4.2-dfY in the right hand column, below. Distribution of focus framing has not been graphed as there are many categories and the boundaries between them are not so easy to define. The common feature, when the graphs are considered together, is that no particular focusing strategy emerges as being characteristic of a particular gender, or award status, or years of practice. There are differences between the left and right sides of the graphs, but they are not large.

Considered individually; the first graph, Fig. 4.2-dfG shows more females than males are Specific-Solution oriented.

In the second graph, Fig. 4.2-dfA, a lot more Award winners than Others are Wholistic in their orientation, and fewer Award winners are Process oriented.

The third graph, Fig. 4.2-dfY, suggests that more experienced practitioners are likely to be Specific-Solution oriented, rather than Specific-Process oriented.

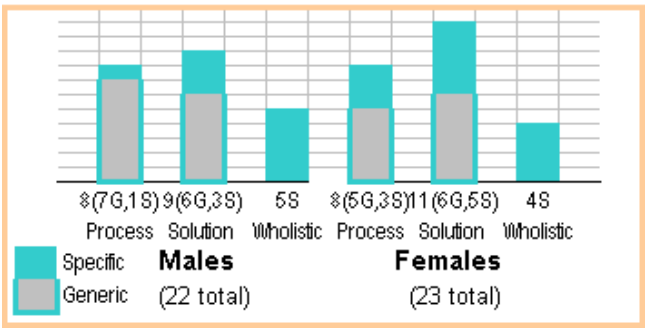


Fig. 4.2-dfG Design Focusing by Gender

Collectively, the graphs show that Solution orientation is preferred by more than 40% of respondents, which is a lower proportion than might be expected in the wake of Lawson's (1979) study. It is also clear that respondents design focusing appears to be influenced by gender, award status and degree of experience, but the differences are not large. An individual in either of the sub-groups might have the same focusing strategy as an individual in the other, and not be unusual.

The outset of designing is fascinating and a worthy topic of future research. However the processes that designers intentionally set in motion, at the outset of conceptual design, are not my focus. Of greater interest are the unexpected revelations and outcomes that arise further down the design track.

Before proceeding to the individual respondent statements, the following points should also be noted.

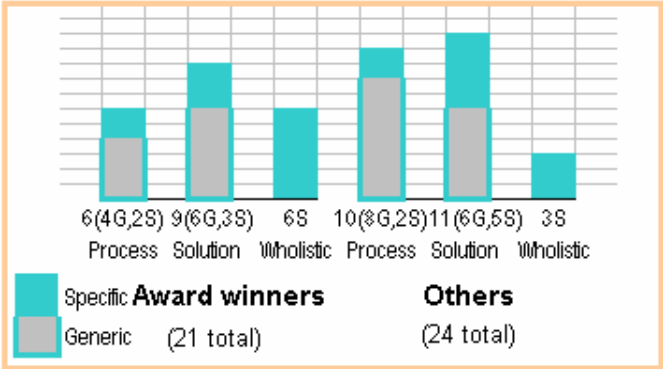


Fig. 4.2-dfA Design Focusing by RAIA Award Status

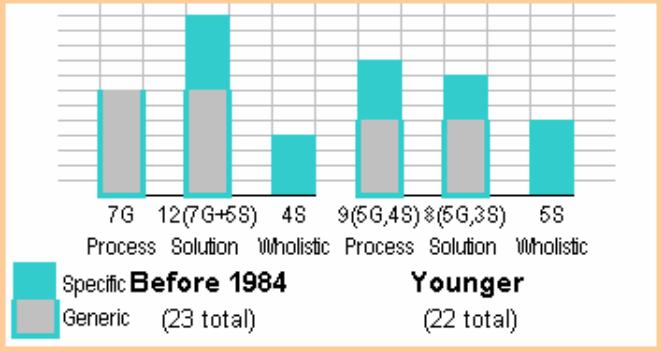


Fig. 4.2-dfY Design Focusing by Year commenced practice

- The statements that follow are little more than a record of what was said. The interviews were not rehearsed. The respondents did not see the questions beforehand and no corrections have been made to the transcripts.
- I have edited statements extensively to pick out the most concise key points. It should be possible to locate the full statements in the transcripts by word searches.
- It is not claimed that any individual exclusively adopts a particular orientation, scope or framing approach.
- Many respondents make a point of affirming the importance of client and site, but some do not mention either. This may appear to be an odd omission, but I think it is a case of overlooking, or inhibition towards stating the obvious, rather than a sign that design fundamentals such as site and client are considered unimportant.

4.2.3 Respondent Focus Statements

4.2.3.1 FOCUS ORIENTATION AND SCOPINGS

The largest group (20:45) of the respondents made statements that indicated a Focus Orientation towards design solutions. Indicative statements are those which focus on the client, brief, site or some other aspect of a project, as design generating features or *design positives* before addressing constraints or *design negatives*. A substantial number of respondents indicated a more abstract orientation, some referred to *the process* or indicated a *process orientation (16:45)* and others expressed a more *wholistic orientation*. *(9:45).* Process-oriented statements assert the importance of the process of design realisation rather than the givens, or the outcomes of projects. A wholistic orientation is evident in statements that are inclusive of all aspects of the project.

The majority of the respondents (24:45) indicated that their Focus Scope is Generic, ie. they generalise about projects, or view each project as part of a continuum, rather than as unique. However the ratio of Generic to Specific Scope statements varies considerably with Focus Orientation. (See Figs. 4.2-dfG, dfA & dfY above) Among Solution oriented respondents the Generic proportion is

60%. (12ge:8sp) Whereas among the respondents making Process oriented statements the Generic proportion is more than 80%. (13ge:3sp) Conversely among the respondents expressing a Wholistic orientation all respondents were focused on characteristics of projects that made them unique. (0ge:9sp)

More observations about this matter are continued in the review below which describes each Focus orientation separately. In the review, respondents whose statements indicated Generic and Specific scopes are also separated, to enable the association between the two scopes and the interpreted orientations to be compared. The association is easy to see. Scope preferences appear to influence qualitative aspects of a respondent's Focus Orientation. Orientation may also influence Scope. For example, a Process or Wholistic orientation, when combined with an emphasis on design parameters and constraints, appears to be a strategy of variety reduction, as described by Darke (1978) and referred to earlier. This approach effectively renders designs more generic.

It is possible that Focus orientation and scoping preferences are associated with psychological attributes, such as cognitive styles. There are many cognitive styles and it is possible that both Focus orientation and Focus scoping may be influenced by one, or another. Possibly relevant cognitive styles include Reflection versus Impulsivity and Field independence versus Field dependence. Messick (1976). This is a topic of potential interest for future study.

Solution orientation

Statements that indicate a Solution-orientation typically focus on design generating aspects of project, brief, site or other matters. Such statements tend to reflect the designer's Focus scope as well as their Solution orientation.

GENERIC SCOPE

Over half (12:21) of the Solution oriented respondents made statements indicating a Generic scoping.

A06, A16, A25 and made general statements of intent:

- I am trying … to show that there is a way of creating new architecture that is both stimulating and challenging, yet relates to the people it's designed for… I work from [the plan] rather than from sketches or from other things first. A06.
- Doing buildings that are technically well conceived and resolved, but which are interesting in a conceptual way. A16.
- A modernist view… changing… was rectilinear. Now moving away from that. More emphasis on quality of space, using the space as plastic form, sculptural. A25.

A32 also described an approach that was centred on continuing objectives and development of a process. See 4.2.3.2, Focus Framing.

A07 declared a wariness of fashion and the notion of the latest thing. In his view it is more important to find a different point of view and this is best derived by resolving issues arising from parameters of the project. Referring to context, A07 stated:

> … there are a number of approaches to context … one is to contrast with it and the other one is to fit in with it and I think, from the outset of developing a concept, it's the initial choices that you make which are important and they start to define … a lot of the path that you go down … I think looking for the parameters is probably my design philosophy... testing them, seeing what they are, seeing how much they can bend… ... Design starts from a large scale mud map, a small piece of paper with a large black pen. A07.

A08 made a similar observation to A07 about working from the general to the particular:

> … most architects I know seem to take a large picture view of something and then do… if you like, an overview sketch and then work back to details at later stages, which is how I design. A08.

A14 and A33 made observations about the context that could position them toward the Specific scoping category, but they not singular in the manner the individuals categorised as specific below.

> More than most, A14 has an agenda which develops with each task. He speaks of themes, but many elements of his work are constantly developing from one project to the next.
>
> Architecture is logical… I work with reality, the north, the winds. I like to know what's there.... I want to be good. .. You can see a development of themes in my work. A14.

A33 emphasised sensibility and expressed interest in a range of aesthetic and technical approaches.

> … you should be able to walk into it and feel it and it should be relating to the context… I think the building should be able to represent and respond to the surroundings… We develop a kit of parts, like a cell… With [the] house we started with a module for a living space. A33

A26 expressed an unusual view which may complement his partner (A25), who has a strong visual spatial orientation as well as reflecting a strong interest in building construction.

> I start thinking how it's going to be built… I am in a minority in starting with the way things are put together. A26.

SPECIFIC SCOPE

Slightly fewer than half (9:21) of the solution oriented respondents made statements indicating a Specific Scope. Their statements suggest a stronger interest in the particulars of each project.

A02 refers to two specifics, a unique solution and a sensibility to the client.

> [I] tend to believe there is one right solution, in terms of organic form… [You] need to match your artistic dreams and the client's requirements. You can take a client with you as much as you can, but they've got to live in it. A02.

A03 expressed a strong interest in applying passive solar technologies, which necessitates sensitivity towards the particularities of a site and to opportunities.

> [I] have seen architects being more dogmatic about a theoretical idea and not letting opportunity of getting sun or breezes ruin that idea... Rather have an idea that would be positively influenced by the opportunities. A03.

A18 and A36 also affirm a specific intent, in relation to the site and to the particulars of each project as the source of a strong driving idea.

> Our designs are very site specific regardless of whether it's urban or non-urban area... In every one we try to seek out an idea which is strong, can be tested, that will drive the project…that idea might be program, or brief related, or site related, or more typically with us it's somehow welding the brief and the site together with a clear idea. A18.

> I certainly don't have a style. I think site specific and client specific. A36.

A29 expressed an intuitive approach that embodies an interpretation of Kahn's notion of *what a building wants to be*. In this approach, designing begins by developing the form, as a system of venues that provide good experiences for daily activities, based on an understanding of the client and site. A longer than usual statement is included, because it is extremely specific and brings together many ideas.

> … my approach to architecture is often based on intuition and once I get a clear understanding [of] what the clients' needs are and aspirations are… I enter into a sort of state of mindfulness or consciousness, where your only concern is how the occupants are going to experience a building and how a building is going to function… whether it be a place to sleep, read, eat, work or simply reflect. The act of turning a door handle, looking through a window or arriving at a place filled with afternoon sun is very important to the overall development of ideas… these processes often evolve well before the visual form of the building. So in a way the sensual intimate experiences of sound, smells, tactile qualities and moods become more important that the object itself.
>
> I suppose that's my philosophy… I would be designing for what the building wants to be and then the form… and structure of the building… comes along way after that... other friends…would always go from the other end. They'd be designing these structures… A29.

A35 whose practice includes mostly houses appears to focus strongly on developing an understanding of her clients, which then drives the design.

> … what I design is [a] stage for life and so what I do is, I design edges for the life... I'm dealing with people, finding the essence of what that person is about

P1 (a graphic designer) affirmed the specific solution orientation more simply and directly, in two statements.

> It should be simple and get to the point… a simple message … It depends on the objective. Without an objective you can't really design. P1.

Process orientation

Most of the Process-oriented respondents (12/16, all architects) indicated a Generic scope. One likely reason for the strong association between Generic scope and Process orientation is that a process is a behavioural construct, which provides a coherent structure of events or outcomes. If the process is any good, it will be perpetuated, by natural selection. In being ongoing, and more regular, a process becomes more influential. ("It's what we always do!") Continued re-application may encourage and strengthen generic interpretations of items, events and projects.

GENERIC SCOPE

Individual reasons for Process-orientation are evident in the following broad groups of respondent statements describing Analytic and Collaborative processes.

Advocacy of Process generally

A30 is an industrial designer and architect, who leads the Sydney office of a large architectural practice. He was critical of architects who seek inspiration in magazines and of the notion of genius.

> [I] don't subscribe to the genius [notion]. What I strive for is authenticity… where the thing you have manufactured is traceable and is the direct result of you having intellectual engagement with a process. A30.

A30's advocacy of rational process contrasts with his acceptance of an intuitive approach to designing. This potential conflict is resolved in a very designerly way by his interpretation of process, which combines what he refers to as *humility*, *facilitation* and *intuition*.

> … I see myself as the *intuitive* architect... I think it comes down to that notion about sketching and drawing and whatever, that you intuitively find your way your way through it. I guess what I'm saying is you intuitively find your way through a problem…
>
> … there is a common thread in those things however and that is the willingness to listen… *humility* is the most important aspect of being an architect, and real humility, not fake humility… Humility means that you're able to dive down underneath the layers that we put on ourselves, to be able to find, or investigate many more solutions, I think.
>
> … design philosophy in that case… is to do with humility, but it's to do with *facilitation* as opposed to design, and if you are skilful and talented at what you do… you take facilitation as your design philosophy and you build upon that somewhat objective notion of facilitation and you find a solution beyond that. Go through the hole past facilitation and then there's the solution. You don't come with the solution and try and fit it through the facilitation hole.
>
> Facilitation is the philosophy. You are making sure that the stakeholders understand that you have understood.... you are facilitating realisation. This is the opposite of the artist in the garret. A30.

Analytic process

Earlier, reference was made to the view, expressed by Darke, (1978) of design as a process of variety reduction. Darke referred to the multitude of potential solutions being reduced by the designer's knowledge of external constraints and ability to structure the problem in solveable terms. In Darke's paper emphasis is given to the second part of the process, the development of a primary generator and conjectures of approximate or possible solutions. However both the first and second parts of the process, the identification of constraints and the generation of conjectures can be reductive, albeit in different ways.

For some Generic scope designers there is a Process orientation that is primarily analytic. To these architects, analysing constraints and determining building envelopes appears to be a major part of what they identify as *the process*.

Use of a constraints-first approach is a reductive process, of design by elimination. Its strength is that of simplification. By overlooking what may be unique, or by regarding it as unimportant or incidental, the designer is able to render the scope of a project, or projects of a type, less specific and more generic, as this statement by A17 suggests:

> … normally we… just go and look at the site, look at the constraints, because most of our work is in the inner city. It's so constrained by the planning instruments that... we rely on the constraints to form the design rather than opportunities… it's not sort of very conceptual either. If the <site> has some more freedoms than the typical sites then we'll have a go at something that's a little bit more three dimensionally, or formally interesting, but usually they're very constrained. A17.

Other respondents in this category made statements that reinforce A17s constraint first approach but offer different perspectives. A01 (and A07, who is referred to in the Generic Solution category) commence a project by identifying and considering the project brief or site parameters, that act as design constraints, or *design negatives*. A01 described his approach of identifying parameters which, as he put it, *define the envelope*, as:

> Methodical, deterministic, grounded in the historic process, in precedent, in the environment and very much in the requirements of the brief… I've always admired the buildings of the past and I've seen architecture as a continuum rather than a series of avant-garde waves. A01.

A11, a partner in one of Sydney's best known large architectural firms describes her modus operandi as a research based process, analytic and interactive, in the sense of being *inclusive* to many inputs.

> Analytic … setting up what the goals would be and then evolving it, testing it,
>
> Interactive… using as many other elements as I can and other professionals as part of the team.

A17 also described an analytic process orientation, which is *responsive to the opportunity*.

> We don't have a style, but a theoretical approach that is repeatable… Our work is in the city... constrained... We rely on constraints, look at site, get spatial sense of what client wants and work with that. Not very conceptual... If [the] site is freer we will have a go. A17.

A19 was not prescriptive about context, but emphasised the importance of the work being situated, in a way I would interpret as meaning, at one with its place and its users.

> The design must have something to do with the place that it's located … it must respond to that in some way importantly and not just be seen as ... some sort of idea, or theory that you've got, that you can just put anywhere. And then it must work, for people … whilst the design may have other meanings, other depths to you as a person ... the design doesn't rest on those things being [explicable] to you alone. The design must have… resonance with people that are going to use it as well… one should see design as a process that requires consultants and other people to add to it, but somehow not to downgrade it. A19.

Collaborative processes

Architects in small and large firms have worked collaboratively with consultants, such as structural, hydraulic and mechanical engineers and quantity surveyors over many decades. Some of the respondents in this study indicated that they also collaborate with clients, colleagues and assistants when designing. In other words, they don't design alone and then hand over sketches to be drafted. This aspect of designing practice has not been closely investigated in this study, but it is possible to make some observations. One feature of respondent statements about collaboration is that there are varying degrees of acceptance of sharing both responsibility and credit.

A number of respondents have worked with Renzo Piano, one of the world's most esteemed architects. Others have praised his way of working and, in particular, the operation of the Renzo Piano Building Workshop. Renzo Piano's use of the term *workshop* owes much to a Piano family tradition of building and making. Pritzker (1998) However an additional interpretation of *workshopping,* relating to collaborative designing, is also evident in several respondent statements.

A12 and partner A24 who have both worked extensively on major projects with Renzo Piano, in Italy and elsewhere, have implemented workshopping procedures in their practice:

> … like to workshop ideas as a group. not to jump to conclusions about an idea too quickly. A12
>
> … like to thrash around in team environment… Work-shopping very effective. Quite amazing. Try to foster that here. A24

A34 described a combination of workshopping in the sense of discussion group design and a devolving of responsibilities as jobs progress.

> Reviews [are] important. I am a really good reviewer. We all collaborate. Nobody has ownership of an idea or concept. You get a better result with more people working on the scheme. I drop out as jobs head towards documentation. A34.

A28 expressed interest in the collaborative approaches of Piano and Günter Banish, although the approach in his (A28's) practice appeared to be oriented more toward devolving responsibilities, than to workshopping.

> I think one difference is that we do allow the staff, to be project architects, to have an ownership of the design and be involved from start to finish. We do that in about 90% of projects. A28.

SPECIFIC SCOPE

Analytic and collaborative process

The genesis of an outstanding high-profile design typically requires intelligent contributions from a range of individuals. Ongoing prompt resolution of frequent inevitable conflicts is also a requirement. Frequently the leader's activity is public and subject to requirements of immediacy when contributors are together. Great and sustained skill is required from architects leading these projects to satisfy a range of requirements, from the most emotional expectations to the most mundane physical necessities.

One respondent who regularly performs such work, A21, could at first glance be classed as solution oriented. He certainly has a skill at finding solutions. But the way he finds them is through an unusual, but strongly affirmed view of process, involving other people.

> Architecture is not an intellectual activity... it's more about intuition... so I draw... explore possibilities ... look for a certain clarity... I am quite happy doing it in public... a design has its own life ... like launching a boat. You give it a push and then you climb into it... what you've got to do is follow it... let it have it's own life... in my view the path is found... it reveals itself… involvement of other people in the process is very important. I will be far more creative working with other people than working alone. A21.

Clearly A21 is not referring to a collaboration of equals, but he is not commissioned to be an equal. His responsibility is to achieve a good outcome and this requires good quality input from many people whose knowledge and responsibilities, to put it briefly, are often deep, but often narrow as well. A21 clearly relishes the task of working with others, but is also fully aware that ultimately he is responsible for guiding the boat. Architects heading practices or design teams may also lead and orchestrate their staff, in a manner like A21, although this was not strongly evident among the respondents. A30's description of process (above), combining *facilitation* and intuition has similarities with A21's view. Neither of these architects made distinctions between stakeholders.

A27 spoke of the difficulty of articulating a design approach. She described a client driven approach to design problems, that is rational and modernist, methodical and thorough.

> We start with as much information as possible about the site and we have a very thorough brief from the clients. We try and work that out with them and then budget as well… We still believe in… starting with a very strong concept and a clear diagram, we'd start with [the] plan… we're not about having a style… we are much more about the approach that we take to each job and each client as an individual. And at the end of the day, it's their house... So we try and not have ownership, right from the outset. A27.

Graphic approaches

A23 concisely combined similar ideas to those presented above and a method, mapping and distillation of ideas into a diagram.

> No typical project. Always come back to the program, site and context, mapping it, trying to distil a diagram... use collaborative approach, working as a team... ideas arriving from that, rather than pre-empting... brings additional richness. A23.

A37 has developed a diagrammatic approach, which she refers to as *layering*, drawn from experiences she had working with a number of architects in Europe.

> … people that I've worked with, and the way I ... work is, we'll really get to know, site program, clients, and then from there... make associations and then wind [these] into the way you work, to answer pragmatic problems... you kind of float out there ...you get quite attached to something about the site... and that leads off to other things... it happens in layers, it gets more complex and hence simpler once you start working over the problem ... to build up those layers. A37.

Wholistic orientation

I have categorised the statements described below as wholistic because they indicate readiness to consider the totality of design and context, in a broad sense, less as a problem and more as the source of an understanding that leads to solution. As a wholistic approach is broad, by definition, it should be no surprise that these individuals cover a range.

A04 described a rational inclusive approach, emphasising mental openness and development of levels of understanding of, a) critical project aspects, such as the place (the opportunities and what the building must respect), the needs of client, users (including the distinction between wants and needs) and b) the theoretical perspective of architecture, as follows:

> Understanding that architecture is about idea, as much as it is just about shelter, or protection… that comes from a real interest in the history and culture of architecture

A08, whose practice includes projects in South-east Asia and in Australia, also described a rational approach, emphasising the importance of developing understanding, first by extracting a design brief from the client, then analysing it and developing a thorough understanding of the site, including the climate and cultural aspects of the location. A08 described such intelligence as being fundamental in resolving design issues, ranging from cross ventilation to whether the building should be regarded as primarily a contextual or a signature design or a combination of the two.

A05, A15 and A10 described intuitive approaches. A05 focuses on the *essence* of the project, A15 refers to the *feel* and, like A4, emphasises the idea, while A10 described her approach as still evolving.

> [I] try to understand the essence of the project. Designing involves defining that essence and the essential way of realising and expressing that essence. Method involves spending time on site and with the client, in effect an immersion process, combining lots of sketching and contemplation. (A05)

> [The] client's brief is functional. Need to get whole feel...I look at the type of feel, the heaviness and lightness of the site… Usually come up with a lot of light and heavy options, see how they sit… there has to be a strong idea, a gesture, or a direction and that everything has to belong to that idea and as Louis Kahn said, you shouldn't be able to take things away from it or add to it, it should be an idea in itself (A15)

> [I] try and work with site...and also personalities of clients... Intuitive approach ...Like to treat every job as different so I don't get caught in a rut...Still evolving. (A10)

A22 described an approach that is wholistic, first in considering all aspects of the project, second in attempting to reconcile both the rational and the intuitive and third in an acceptance that design continues through projects. These are evident in two comments he makes below. 1) he refers to comparison made about Mies van de Rohe and Le Corbusier (attributed to Vincent Scully), 2) he briefly describes a process that recalls A21's metaphor of the boat combined with A30s notion of facilitating, then 3) he describes the idea of design continuing from conception to site.

> "Mies van de Rohe solves all of his problems by having very few to solve. Whereas Corb (Le Corbusier) often solves very few problems, but then he takes on the whole world" … Corb and Frank Lloyd Wright and, say, Schindler, their buildings are very imperfect, but they are so wonderful that the imperfection is part of what makes them wonderful.

> You start out like a fishing trip, sorting things out. A spark can come through in a variety of ways. Need one or two strong ideas.

> … with us, design goes all the way through to site. With us the conceptual is just the beginning and there's a whole layering of information and testing of the idea and sometimes as you test out the idea, you've got to go back and refine your concept, so for us the design does continue.

A22 is also an advocate of the diagram as a means of capturing and conveying the main ideas.

> … often, if we're floundering with a project, we're just sort of stuck, we'll go back and say "right, what's the diagram?… you've got to reassess that diagram… Often we'll just keep re-drawing that diagram… You should be able to draw it quickly and simply... it might be a sectional diagram, it might be a form diagram, it might be plan diagram, but there's a diagram which sort of captures it all.

A38 described an intuitive approach which placed emphasis on specific understanding beginning with the features of the location, but also understanding life, people and the skills of making. A39 also described a specific understanding driven approach.

> my approach would be to never proceed with conceptual thinking until I feel I understand who I'm doing the building for... you're trying to discover the joy in something. You're trying to discover how to embody or capture, or provide a sanctuary for the user's own exploration of life… there's no pattern, and it's always a struggle… A39.

A39's approach was complemented by his partner A40, a landscape designer, who described her objective as to reflect each building in the landscape. A40 emphasises the importance of understanding the brief and site aspects, such as topography, adjoining land, where it's viewed from, usage, movement and parking, to provide a basic structure of how the site will work

Respondent, P4's stated approach also struck me as belonging in this category, although it is not a perfect fit. Clearer instances could be found in a larger sample. What gives this example ambiguity

and also makes it interesting is that the intended outcome, which I have identified as the focus, is not the same as the respondent's initial goal.

> The process for me is, almost always, not to a particular solution. It will always be to generate some alternatives for assessment... (that comes from a planning background). I'll formalise what their requirements and constraints are, then come back with three conceptual models of what this thing might be. Then we'll talk about that. And out of that process the real brief emerges. Always. That's a classic planning model … There's a point where you see…what is the major thing that is pushing this job around….that's different for every job…but there seems to be, often, a nub thing...that, if you solve that everything else will fall into place.

4.2.3.2 FOCUS FRAMING

Focusing can be more finely categorised according to aspects of design, or designing, that individual designers interpret as being of the highest priority, which then structure, shape and characterise their designs. While not many of the respondents used the label *modernism,* to describe their work, all appear to accept an interpretation of modernism as a given. Modernism, in architecture, could be said to constitute a broad base, or structure, upon which the designer can construct a conceptual mesh of alternative *frames* which represent beliefs, values, or priorities and which serve as primary or lesser design *generators* and *shapers*. The need for this additional dimension is most evident among respondents who made more Solution oriented statements and, to a lesser extent, some categorised as having a Wholistic orientation. Respondents who stressed the importance of Process made fewer statements about outcomes. It is possible that Process oriented designers disapprove of, or feel inhibited about making such statements, which they may regard as preconceptions. The Wholistic designers (who all made specific scope statements) share some features of both of the other categories. They are Process oriented in their attention to the whole project and, typically, in seeking a global understanding. But they are also Solution oriented, in that the purpose of the understanding is a strong idea, or clarity of vision, that will form the nucleus of a design solution.

Two broad Framing approaches can be identified: 1) Functional - Client related, referring to items that affect design performance as experienced by users, and 2) Conceptual - Audience related, referring to design ideas and features experienced by others, who see the building or images of it. However, these imperatives are not easy to separate. Sometimes the distinction is clear, but functional imperatives once accepted become elements of architectural expression. This is the nature of modernism. A design approach that, for example, values greater thermal comfort being achieved with less consumption of energy, that aims to maximise opportunities to utilise passive solar principles, can be expected to result in structures that allow sun entry and heat retention, during cold months, and the opposite during hot months. This can partly be achieved by orientation and layout but, may also involve facilities to make seasonal changes to the configuration of parts of the design. Functional elements like these influence both the appearance of buildings, and how buildings and architects are interpreted.

Set out below are examples of Framing statements. For the reasons just described, they are not categorised into definite Functional and Conceptual groups. Instead they are sorted into a sequence from the more explicitly Functional to the more explicitly Conceptual.

Environmental

UTILISING CLIMATE AND SUNLIGHT TO ENHANCE OUTDOOR LIVING AND ENJOYMENT

- … I have a definition of architecture which is; architecture is the art and science of the creation of shelter for human activities in the environment… apart from keeping the rain off… there are parts of the environment which are beneficial, like sun in the winter time and cool breezes and being able to be outside, and so on…. I'm very concerned about outdoors, living outdoors, and things like that. A14
- a built environment has to bring pleasure to the occupants. There are times when you might want to be creating a different sort of effect, but generally for most work, for most people, it's a higher priority. And part of my philosophy to try and make things as enjoyable as possible, which means encompassing climate and sunlight. Sunlight's really important for people's well being... A20.
- It's the place. You've got to immerse yourself in the place. A38.

MODERN BUILDING TECHNOLOGY COMBINED WITH PASSIVE ENVIRONMENTAL TECHNOLOGIES

- … moving forward… being contemporary and being of our time is very important… using the latest

light-weight technology and hands-on passive techniques... None of our buildings are air conditioned. They all rely on natural ventilation, correct orientation, sun shading, all of those very simple things, but we have this desire to use those very simple hands-on low-tech passive techniques… to add extra layers to our architecture. A32.

- I let passive solar, or ventilation etc, really influence design. Have seen architects being more dogmatic about a theoretical idea and not letting opportunity of getting sun or breezes ruin that idea...I wouldn't engage in an idea that could be ruined by that. Rather have an idea that would be positively influenced by the opportunities. A03.

Spatial views

SPACE FOR LIVING ACTIVITY

- I would be designing for what the building wants to be. The form of the building would come after that. You start with activities. I would spend weeks just thinking about it. A29.
- the built design, is successful if it is enhancing the ability for the occupants to do what they need to do in that space. It inspires them to do it better… A31.
- My current theory about architecture is -- I make shoes for people to live in ... The shoes I design are not boxes… I design a stage for life. A35.

SITUATED SPACE

- I believe that architecture, you should be able to walk into it and feel it and it should be relating to the context… so it's influenced by its surroundings, like geography. It's purely not object making. A33.

POSITIVE AND NEGATIVE SPACE

- … the spaces that the buildings create are as important as the buildings themselves… We try to create something beautiful with the left over space… I like the idea of positive-negative space… that's probably a philosophy that comes through in all the work.

Art and Sculpture

ARCHITECTURE AS A CONSTRUCTED ART FORM

A21 expressed the notion of architecture as an art form most directly.

… I am very interested in architecture as a constructed art form… in painting, you work with paint, in architecture you work with construction.… What underpins that is an understanding and an approach to architectural form, seeing that as… very central ... A21.

HIGH TECH OBJECTS

A16 was explicit about his association with modernism and that there were additional dimensions to the work he was doing with his partner, A15.

We are, modernist … we've been exposed to and worked with some of the leading practitioners of certain strands of modernism that focus on building technology and putting buildings together in accomplished, technological, three dimensional ways, however that's our background, it's not actually what we're interested in really.

When we were living in Germany … we spent a lot of time looking at modern art… and getting a lot of enjoyment out of looking at conceptual art, installation art and realising that there's a relationship between these forms of art and architecture, and there were architects in Europe who were actually exploring that very successfully in very interesting buildings... that merged the gap between sculpture and architecture, but actually leaning to the sculpture side of it … in those years it kind of clicked, that that's the direction we wanted to be going. Buildings that were technically accomplished and well resolved <which> have a conceptual creative angle that is singular, in no way is it specific to a project and to a site and a brief, and the building would function as an object ... A16.

GETTING THINGS RIGHT

… it's important to think about the sculptural consequences as well as the functional and operational. Phillip Cox said roof is the most important, get it right and the rest will flow… [I] think, in the end, the solution that looks the… easiest and simplest is the right one. I love [finding] magic coincidences in geometry - there is an underlying geometry in things - in nature. A36.

RESPONDENT'S PROGRESSION FROM VOLUMES TO SPACES

A25 like A16 adopts a sculptural approach but with greater emphasis on client and context and less emphasis on construction technology.

> … it would definitely be a modernist view. But it's been changing… <in> my early twenties to thirties it was… purely rectilinear, very concerned with square volumes... I've still got that thread running through my work, but there's more of an emphasis on the quality of the space and actually using the space as plastic form to be sculptured... there might be a rectilinear thread through the whole scheme but there could be something completely skewed and sculptural hinged around the rectilinear basis… Calatrava is quite remarkable … in his engineering side, but also the sculptural side and the solutions he provides, they're really quite beautiful. A25.

Conceptual

IDEAS

> … there is always a clear expression of an idea and I think that results in buildings that are very particular and resolved… I like the idea of layering the spaces and looking through spaces into other spaces. A05.
>
> … Important to have a strong idea, [to] be able to answer the big idea question. A40.

GESTURES

A26 described architects he liked, then added:

> … as I'm getting older, I'm looking more for … the incredible gesture that takes your breath away... that's why I've come home to work really, so I can concentrate on thinking without distractions… Piano for instance, had it in that Noumea building… One of the great things about Ronchamp is… the appropriateness … a level of appropriateness, which is maintained right through the whole building. A26.

INTERPLAYS

Several respondents referred to alternative approaches which they disapprove of, if used in isolation, but which they like to combine expressively in their designing.

A08 identified two alternative architectural types that characterise many modern buildings - signature and contextual.

> A lot is contextual. Don't agree with putting signature buildings in every country. Can be contextual with signature showing through. A08.

A13 and A36 made similar observations about geometric formality and informality, although they expressed the idea differently. A13 described the design as being structured, while A36 described working to a grid:

- Have to have something that is quite structured that doesn't look structured. Go to site, how to relate that back. Do have to have an overlay of a rigid geometry, but then it breaks away, softens loosens. A13.
- I like to work to a grid.… Although then I like to break it… I think that if you work with the grid then often a lot of things fall into place down the track, in terms of construction technique and structural rationale… I like to hang the design off … some kind of backbone or something. A36.

A10 has developed the notion of interplays further, combining spatial and art interests to create and integrate interior and exterior spaces.

> Interest in outside spaces, integrating inside and outside, and in integrating artwork. Have been commissioning and working with artists. A10

LAYERS

A37 described a learning and structuring process based on the methods of architects she had worked with, which began with observations, as one got to know all facets of a project, which led to the identification of associations which, in turn, led to reinterpretations that helped the designer to build a system of layered or associated solutions.

SUBSTANCE

More emphatically than any other respondent, A39 made it clear that he was in the business of creating architecture and that the architecture should be evident throughout his designs.

> There has got to be substance in everything that's done, you know, everything. And I mean real substance, not just superficial substance… There has got to be an explanation and a logic and an honesty and a tradition with everything that's done, in different creative ways, but in the magic, in the way of magic. A39.

4.3 DESIGN PROCESSES

Respondents were asked about designing and processes. The questions were not only intended to prompt statements about how they designed, but also draw out clues about individual thinking, discoveries and insight experiences, removing the need for me to ask. Some respondents found these questions difficult to answer. Many designers said they were not introspective, not self conscious, or had not looked at how others went about their designing, but ultimately a diversity of views of process, both judgemental and descriptive were expressed. There are many different understandings. Many can be expressed as polar opposites, and are design process variables, rather than all-encompassing descriptions of how people design. A description of variables that are evident in respondent statements follows. As I have stated in other parts of the thesis, this subject is rich with variation and will be the focus of further investigation and analysis with the view to developing better descriptions of the variables and how they relate to each other.

IDEA DRIVEN

The idea driven approach encapsulated by Darke (1978) in the term *primary generator* was evident in statements by numerous respondents.

A05 viewed the clear expression of an idea as characteristic of her work:

> I think the work's quite unique, in that there is always a clear expression of an idea and I think that results in buildings that are very particular and resolved. A05.

Her partner, A18 confirmed, referring to their projects:

> In every one we try to seek out an idea which is strong, can be tested. That will drive the project. A18.

A15 described a little of what the idea should be:

> There has to be a strong idea, a gesture or direction. It should be an idea in itself. A15.

A36 proposed that *getting the big picture right* was particularly valuable in big projects where one can often lose control of the details. She proposed that if the overall concept is strong enough, relates to the site well enough and responds to the environment well enough, then the concept will survive changes in details.

While the importance of the *idea* is commonly held, there are also many views of how ideas should originate.

EMERGENT UNDERSTANDING VERSUS UNDERSTANDING LED DESIGN

It has been proposed by Lawson (1997a & b) that the design process can be seen as a negotiation between problem and solution, in which problem and solution emerge together, and that designers tend to learn about their problems through attempts to solve them, rather than through abstract study and analysis. It is not doubted that many designers progress in the even-handed manner suggested by Lawson's description. However, among the respondents, the balance between understanding as a driver of design, and understanding as an outcome of design, varied.

The emergent understanding, or learning-by-designing approach has variants, exemplified by A26, who acknowledged use of precedent literature, such as magazines, as an initial stimulus, adding:

> I would throw things on paper, do some little sketches. I go through a tortured bit to get a handle. I like to do a design and throw it away. A lot of times you get a long way and chuck it. I like that. After that I know what to do. A26.

P4 characterised his process differently, as finding the nub.

> The process for me is, almost always, not to a particular solution. It will always be to generate some

> alternatives for assessment. There's a point where you see…what is the major thing that is pushing this job around….that's different for every job…but there seems to be, often, a nub thing...that, if you solve that, everything else will fall into place.. P4.

Several respondents placed emphasis on the consideration of general or specific aspects of the design, to achieve a thorough understanding first, before attempting to plan, or optimise. Implicit in this approach is a notion that understanding should lead the process, rather than be an outcome of (perhaps half-baked or misleading) conjectures. According to A05, designing involves first defining the *essence* and then the essential way of realising and expressing that essence.

A09's approach is analytic initially, looking for clues and trying to avoid ideas of finished project early in the process. A12 stated that he liked to workshop ideas as a group and not to jump to conclusions about an idea too quickly. A24 made similar comments. A19 also expressed an approach, of first understanding the principles of site and brief. A38 advocated designing through a process of developing understanding of the *place*, proposing that the way to gain the understanding is through immersion in that place. In at least one project A38 had sought to achieve this understanding by camping on a remote site for several weeks.

A40 emphasised the importance of having a strong idea, of being able to answer the big idea question, adding that she doesn't look for the big idea, rather it just arrives She described the emergence of understanding following thorough enquiry and investigation, for both herself and for her partner A39, as follows.

> A39 and I both work the same, like that. We won't sit down with a piece of paper going, "gotta get this design, gotta get this design!", you know? We don't ever do that. We just, often, do other stuff and then when it comes, then we draw it. (laughs) Too busy to do that, sitting down there, trying to work it out.

MAGAZINE BROWSERS VERSUS ORIGINATORS

In his statement cited above, A26 was not suggesting that he copied from magazines. Other respondents, including A36 also referred to looking through magazines, for general reasons, such as inspiration, when they got stuck, but none advocated the *borrowing* of ideas.

A range of expressions of disapproval of magazine based designing were voiced by several respondents. A30, who is the principle of the Sydney office of a large national and international practice, was very critical of copying which, he claimed, he had seen practiced many times. He suggested that the majority of architects design this way. A31, who described designers who copy stylistic elements from magazines as one of a series of types, and A39, were also strongly critical of the practice.

INSIDE-OUT, VERSUS OUTSIDE-IN

The inside-out, outside-in bi-polar model of design direction attracted judgemental comments. Both P3 and A11 were critical of designers who let the exterior (eg. lining up windows) dictate the interior. A27 contrasted her approach with the outside-in practice.

While some respondents named other well known architects who, in their view, designed from the outside in, some respondents acknowledged this as a method they would employ. A36 observed:

> Some people think God is in the details ... some people, think if you can get the big picture right... the concept will survive... I don't believe in designing buildings from the inside-out only. A36.

A16 expressed a more assertive outside-in approach. He referred to strongly expressive and sculptural architecture that he and his partner, A15, had visited and admired in Europe. In addition he acknowledged a strong liking for Frank Gehry's work. He liked the technology, and Gehry's visually assertive approach, which he described as:

> … very conceptual, where one idea emerges and is made to work. A16.

GENERAL TO PARTICULAR, VERSUS PARTICULAR TO GENERAL

The notion of working from the general to the particular was commonly expressed. A19 described starting with the big picture (principals and brief) first, then to the spatial, and after that the edges. A02, A08, A07, A10 and A36 described a similar progression. A07 described starting with a mud map, A10

differentiated between overview and detail sketches, while A36 characterised the progression in terms of layers.

A21 attributed a particular-to-general approach to Carlo Scarpa, as starting in one corner and then growing from that detail, taking on different forms as it grows.

To illustrate the contrast between the two approaches, A26 described an anecdote he heard from Keith Cottier, a well known Sydney architect. Around the 1960s Keith was sharing digs in London with Glen Murcutt and both were designing entries for a competition. As the story goes, Glen started from a single cell unit and worked outwards, while Keith's designing started from the City and worked back.

PLAN VERSUS SECTION OR 3D REPRESENTATIONS

Respondents differ in their views of whether the generative source of a design is the plan or the section. A17 describes his designing as intuitive and views planning as the most important act, adding, that is why Le Corbusier is important to him.

A08 described working a lot with sketches. Her approach involved working with plans and 3D sketches, at the same time.

A34 makes extensive use of a sketch book.

> I think there's a whole generation around my age who are exactly the same… I look at a site, I look at how you might fit units and I do it by freehand… A34.

INTUITIVE VERSUS RATIONAL DESIGN

Finally, one influential determinant of process, perhaps the most influential, is the intuitive versus rational issue. A30 was familiar with this topic. Referring to his *pet theory*, he observed that there are two types of architects, the intuitive architect and the educated architect, who works through a process to reach a solution. He described the distinction in developmental terms.

> … if you enter 1st year and you come out at the end of 6th year and you've learnt how to design a building, then you must be doing it in some kind of process. If you start 1st year and you realise that what you do over the 6 years is hone your innate ability, then you're not necessarily doing it by process, you're doing it by intuition and your ability.… humans do things innately. So… you're starting to learn how to fine tune that ability. That's what I see as being the difference. A30.

A30's approach is interesting in combining intuitive decision making with rational Preparation, which he refers to as *facilitation*, meaning facilitating realisation of design solutions, by actively learning from others and bringing clarity and order to what has been learned.

A21 like A30 is also emphatically intuitive, as the following statements make clear.

> Architecture is not an intellectual activity ... it's more about intuition ... so I draw ... explore possibilities ... I do look for a certain clarity ... I am quite happy doing it in public ... a design has it's own life ... like launching a boat, you give it a push and then you climb into it ... what you've got to do is follow it ... let it have it's own life ... in my view the path is found ... it reveals itself. A21.

A35 goes further to a point that must make some clients, and some architects, uncomfortable.

> I'm a Buddhist, so I believe in that thing about designing with the heart and mind... I've spent a lot of time developing my heart, listening with the heart. Now, when designing for people, what I do, I wait, until a seed drops into my heart and the seed has to come, somehow from the relationship with that person. A35.

In contrast to these views, A01 described a grounded approach based on precedents and parameters. A04 expressed the view that his successful projects have a strong intellectual base. They might have "little whims and passions, but there is a very rigorous intellectual base." A11 described her approach as research based, fairly analytical, setting up goals, evolving it, testing it. A31 affirmed the use of the collaborative rational process, drawing on expertise, to provide strong solutions.

4.4 DESIGN ACTION STYLES

In several parts of the interview respondents described their perceptions of different aspects of the process of designing. The previous section provides considerable information about the intentional aspects of how the respondents go about designing. There is considerably more detailed information about how each respondent goes about designing in Appendix 2 - Respondents. Statements about design actions associated with design discoveries are included in Chapter 5 - Design Discoveries.

The term *Design Action Style* refers to consistencies, in the way individuals design, that have developed and stabilised over time. Statements in this category mostly followed questions that addressed aspects of how the respondents work and design, intended to elicit statements that could indicate insightfulness, or rule it out.

Action style components include:

- Progression Mode - whether an individual's progression through a project is more often steady and incremental, or fluctuates, either not progressing, or suddenly progressing, at different times.
- Incessancy - whether respondents think of themselves as incessant practitioners in being always the architect, or always "on the case". I thought it possible that individuals who were incessant practitioners, in one way or another, would be more likely to report insightful discoveries, at times when they were not intentionally designing, than individuals who are not incessant.
- Quick versus Reflective - whether respondents considered themselves to be equally adept when designing and problem solving required decisions on the run, as when it required a deeper and more considered approach. This was another question aimed at encouraging statements that may indicate insightfulness, particularly from individuals who preferred to mull over matters. This variable has not been analysed in the current study.
- Creative Catalysts - whether respondents have a favourite place, or time, or activity which they associate with their creative work. This was another question aimed at encouraging statements that may indicate insightfulness, from individuals who responded positively, that has not been analysed in the current study.
- Reactivation - how respondents respond when they get stuck or find themselves unable to resolve a tricky design problem. I thought it possible that individuals who were inclined to stop working when they got stuck would be encouraged to make statements that may indicate insightfulness if they had experienced discoveries from this strategy.
- Representation Preferences - refers to preferences in the use of different design media. This was not the subject of a direct question but was indirectly associated with questions about how individuals design. Respondents revealed aspects of their preferences in a range of circumstances. Where these statements are relevant to discoveries they are included in Chapter 5, however representation preferences have not been analysed in the current study.

4.4.1 Progression mode

The question ending Stage 2 of the interview declares that some designers progress fairly steadily through conceptual design whereas others tend to fluctuate, apparently going nowhere for a time and then suddenly progressing. Respondents are asked: 1) Which of these patterns is closer to your own experience? and 2) What would you say are the main reasons why that happens? The question is intended to elicit indications or revelations of insight driven behaviour from individuals who have this experience. I expected it was likely that individuals whose progression was prone to fluctuations would show more signs of insightful designing such as fixations, incubation and "aha!" experiences than individuals whose progression was incremental.

The distribution of responses is as shown in Fig. 4.4-pnG at right which shows Male and Female respondents in separate columns. The graph shows that, overall, respondents with a Fluctuating progression slightly outnumber those who describe their progression as Steady. (16:13) However there is also a large group (more than one third of respondents) whose experience includes both Steady and Fluctuating progression. Slightly more Males are Steady whereas Fluctuating progress is more clearly predominant among Females.

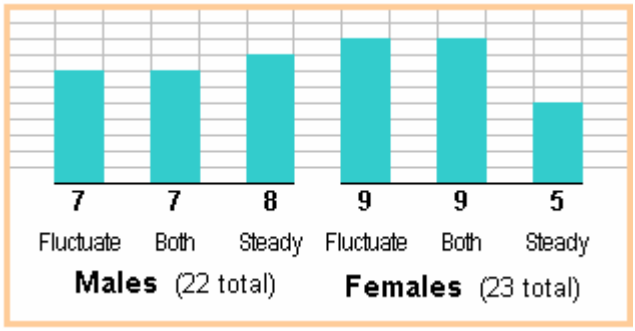


Fig. 4.4-pnG Progression by Gender

A similar pattern is evident when Progression is plotted against RAIA Award status, as shown in Fig. 4.4-pnA. The graph suggests that award winners are more likely to experience a Steady design progression, than non-Award winners and less likely to Fluctuate.

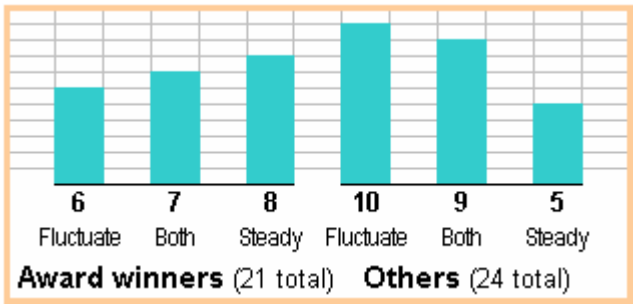


Fig. 4.4-pnA Progression by RAIA Award status

The third graph Fig. 4.4-pnY shows the most variance of the three graphs, particularly in the Both column. The implication of the variance is that, over time, as they become more experienced, practitioners tend to become more definite, if not set, in their mode of Progression. However the trend is partly an outcome of the Before 1984 population containing proportionally more male practitioners (14/23) than the Later (8/22), see Fig. 4.1-GY at the beginning of this chapter. Note that proportionally more females describe themselves as Both (Fluctuating and Steady) and fewer describe themselves as Steady, than males,

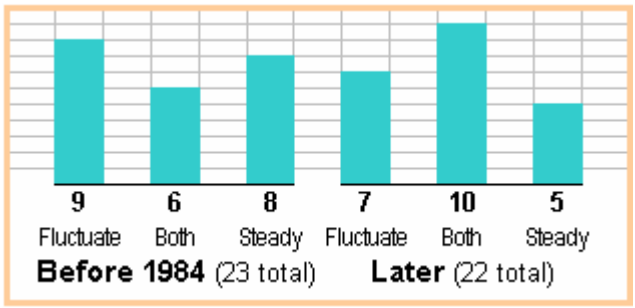


Fig. 4.4-pnY Progression by Year Commenced Practice

FLUCTUATING

Respondents who describe their progression as discontinuous or fluctuating nominate a variety of reasons which appear to reflect two different perceptions that are sometimes mixed. The first, is a more passive view, in which discontinuity is a phenomenon, over which the respondent has little control, like the weather. The second, is a more assertive view in which discontinuity is a phenomenon that can be harnessed, or ridden, like the surf.

P2 attributed progress to acquisition of ideas, "ideas come in chunks". Then, following an idea, activity is intensified. A40 made a similar response distinguishing between gathering information and then interpreting. A32 described the experience of sometimes designing in minutes while spending weeks agonising over something else, while A29 and A35 related delays to temperament.

- I find a lot comes down to energy. I work in waves… I find sometimes I get really excited, but sometimes I lose that interest. A29.
- I am not a plodder. I like to sit and do nothing and then I race. A35.

For A17 the intermittent process is routine.

> Usually we think about it and talk about it. Put off everything (stall) for as long as possible. A17.

A33 equated getting stuck with writers' block and combined ideas and moods into a creative dynamic.

> … More the writer's block one. You get to a point where you combust with frustration and then that frustration produces an idea. A33.

A5 was more assertive, suggesting that discontinuous progress is a natural outcome of the exploration of ideas:

> … you've got to come up against things and then you either test that, you go around it or you find another way… I do it very quickly.... I think it's very much a methodical process, but it's a bit two steps forward one step back, two steps forward one step around… A5.

BOTH FLUCTUATING AND STEADY

Nearly one third of the respondents described their progression as varying, sometimes fluctuating and sometimes steady. This group can also be split, in much the same way as the group above. Some respondents indicate that their progression is not under their control for personal reasons, some associate Progression with projects and for some both factors are involved.

A22 exemplifies the perception of progression as personal.

> If left to my own devices I fluctuate. If structured more steady. A22.

A07, A37 and P2 referred to circumstantial factors, typically project related.

- Some problems you can resolve more quickly. Other times you get writers block, so to speak. A07.
- Sometimes it is like, "easy as". Other times I go blind and might be fighting myself … up against a brick wall. A37.
- I experience both. Again it depends on the project. P2.

P3 and A27 also described project related circumstances but observed that fluctuations in progression may be related to unfamiliar or ill-structured problems.

P3's kitchen projects were routine but the comment below reflects her struggle with the design of her family house, which was non-routine.

> It depends on how much learning curve you have. P3.

A27's statement also reflects the difficulty of finding an idea for some projects.

> Have had some projects where we have struggled initially until you have that central idea. A27.

A20 referred to a task related block, resolved by a cold discovery.

> Good at delivery on time… But jobs don't gel… Sometimes you know something is not right. You might be hanging the clothes and then a breakthrough. A20.

A38 and A39 both made general statements that indicated a capacity to manage dynamic situations, where immediate action is required, such as when sailing, or working alone in the outback, and also to think deeply and reflectively. See also A38's comments about the mind of the hunter, under Incessancy.

STEADY

The Steady category includes a small range from more steady to steady. Fluctuations are typically attributed to situational factors, as in this description by A12.

> We fluctuate for external reasons. Jobs go off the boil. Our ideas are always very strong, but can go astray when the client doesn't understand, or share the vision, or doesn't care. A12.

A12 also describes a steady process where discontinuities, if not intentional are viewed positively.

> ... generally there's one direction that is pursued and then I'll steadily work on that ... sometimes it sits for a little while. I think it needs to. A12.

A34 referred to past cathartic experiences, but described herself as achieving, with age, an awareness of the state of the industry and recognition of the need to work quickly. She suggested her problem now was not too few ideas, but too many ideas. A18 saw himself as working steadily, with design improvements being not always, but generally, incremental. This view is similar to those expressed by A08, A11, A25 and A28.

A01 observed a fact of professional life that has, almost certainly, required practitioners to moderate, or attempt to moderate their fluctuations at some times.

> … when you actually start to work with big projects you end up being tied into constraints which are set

by people other than yourself, always by project managers, by clients.... And certain things have to be done. Sometimes that process forces you to make decisions. A01.

Regardless of their fluctuations, most respondents appeared capable of accommodating varying demands of their occupation, including the need to make progress when deadlines required it.

4.4.2 Incessancy

During the interview, subjects are asked: how they would compare themselves as an architect, with a described image of the perpetual detective, always on-the-case, Sherlock Holmes. Use of the verbal imagery of Sherlock Holmes was employed, both to help get across a series of questions and as a relief from more direct probing questions that precede and follow. Respondents were asked to describe how they would compare themselves with the image of the perpetual detective?

The detective metaphor prompted some unexpected observations of analogies between detective work and aspects of being an architect, such as analysing the site and working out what the client really wants. However, nearly all respondents addressed the incessancy aspect of the question. Most affirmed they are incessant practitioners in one form or another by always either, thinking, conceptualising, processing, enquiring, exploring, investigating, or seeking. Some simply agreed, but most responded to one, or both of the two aspects of incessancy implicit in the wording of the question, namely *being the perpetual practitioner*, reflecting the fact that being a practitioner is a vocation in life, rather than a job, and *always being on-the-case*, or being constantly pre-occupied with active projects.

The distribution of responses is as shown in Fig. 4.4-iyG, at right which shows Male and Female respondents in separate columns. It is very clear from the graph that most respondents regard themselves as incessant practitioners.

Since the Always trend is consistently dominant, corresponding graphs plotting Incessancy against RAIA Award Status (4.4-iyA) and Year of Commencing Practice (4.4-iyY) are not displayed in the thesis.

The nature of the Always, Sometimes and No indicators is explained in more detail below.

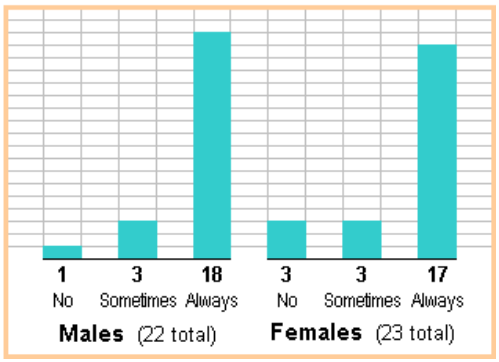


Fig. 4.4-iyG Incessancy by Gender

BEING THE PERPETUAL PRACTITIONER

REPRESENTATIVE RESPONSES INCLUDED:

…one of the joys and one of the frustrations of being a designer is that you are constantly observing, correcting (laughs) you know your mind's always straightening pictures or moving furniture or selecting a better colour, or whatever, and that's just the way you'll always be. P2.

Similar comments were offered by P1, A04, A08, A09, A32. P1 described being always a designer as an occupational hazard.

- Spot on description...My children are embarrassed by my tapping walls etc. Always enquiring. A04.
- [I am] always looking, in my mind, thinking about, you know the design issue.… I'm very investigative… I drive around a lot and look at… buildings, or, whether ugly or good, you know. I find I learn a lot from the bad building, as well, because it tells you what not to do, right. A08.
- Never, not an architect. A09.
- ...always looking at things... the whole gamut of life's things...it's often (the) lateral thinking, divorced from what you are doing, that Sherlock Holmes would suddenly think of. He'd get that spark. A13.
- Absolutely… The majority of the conversations when we go on holidays are about architectural things. A30.
- I am on the go all the time. My mind is constantly going. If I feel good about it, I can do anything. A34.

- It's to do with curiosity, intelligence… healthy human mind should have those properties. A35.
- … you are always an architect. It's inescapable… it's constantly with you. A37.
- Perpetual is part of the explanation... without perpetual, you have static answers. A39.
- You do have to be constantly looking at all things…. Looking for clues. It goes on all the time. A40.

ALWAYS ON THE CASE

Representative responses included:

- Agreed...I am pretty rigorous throughout the process of design... some things work well early on...but other things require more....and so you keep working at it until you get to a satisfactory point. A06.
- We are perpetually looking for the best possible solution... A16.

  Referring to a recent completed design, A16 added;

  … we have gone back and re-explored, because we want it to be brilliant. We are not billing the client for this. A16.
- When I get a new job I don't stop thinking about it until I have worked it out. It might take 4 hours or 4 weeks. A17.
- A35 stated that she regards constant mental activity as an attribute of a healthy mind.
- A38 equated the hunter mentality with the mind of a good architect.

  Because you pick up everything that's around you and when something just slips, or it goes out of sync, like when the fish rises, you pick up immediately right?

ALTERNATIVE VIEWS

A range of alternative views were expressed which reflected different motives.

VISUALISER

A10 may have misunderstood the question as she referred to possession of a 'photographic visual spatial memory', which enabled recollection of previously experienced buildings when designing. Unlike P3, A10 made no comments about use of visualisation to design in-her-head.

SITUATIONAL

A36's response was equally oblique, but, based on a number of statements I saw A36 as being constantly the architect but one whose level of involvement was sensitive to the situation.

> My philosophy of what a good architect is: includes being a good observer. Probably not a ruminator, philosopher, more reactive, responding, reacting to site and client. A36.

A22 and A26 also observed that their enthusiasm varied with different projects.

> Some...you get excited about... then like Sherlock you think about it often. Other times you need to force yourself. A22.

A23 described how disappointments (eg. losing competitions) can reduce zeal and emphasised the need to recover.

INHIBITED BY PARTNER

A15, laughing, but also serious, described her partner as;

> … the most excited by everything about him that I have ever met... I'm average compared to him. Always looking, talking, insatiable curiosity... It used to be me. I've stopped because he won't stop. A15.

NEED TO GET AWAY FROM WORK.

Other respondents described positive benefits in not always being on the case. Their answers are indicative of an association between incessancy and reactivation, that may warrant amendment to the wording of the interview question in future research..

A20 described diverse responsibilities, and of being accustomed to switching from one activity to another. She spoke of frequently receiving ideas, when not thinking about work.

A21, who described architecture as an intuitive process involving reflection, stated;

> Architecture is such an intense profession, but it is important to not always be on the case...we've got to be careful to pull back from it. A21.

A31 referred to the subconscious and ideas emerging in one's sleep, stating about designing: Sometimes you have to leave it...Don't stay on the one thing all the time. A31.

4.4.3 Reactivation

Respondents are asked: "If you do get stuck, or can't resolve a tricky design problem, how do you deal with it?" The question of how one copes with getting stuck drew a variety of answers. In general, disengaging from designing by various degrees instead of persisting, when apparently stuck, appears to be the rule rather than the exception. Respondents may be categorized by type of disengagement, as shown in Fig. 4.4-reG, which plots Reactivation strategies against Gender.

Response categories represented in this graph are, from left to right:

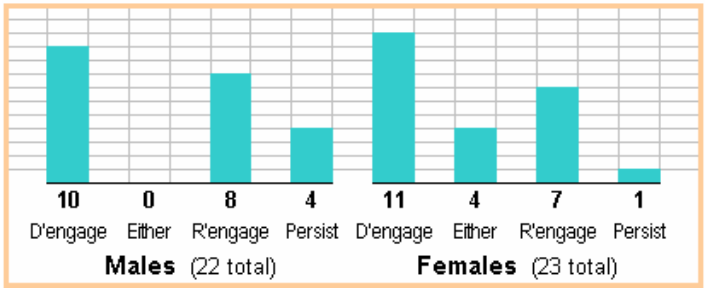


Fig.4.4-reG Reactivation by Gender

1) Disengage, means to stop designing in one of several ways, which includes the following: Disengage Passive, Disengage Get-away, Disengage Active and Disengage - Other task. The last involves shifting from the stuck task to another work activity. Eg. Other design, or unrelated office or domestic chores.

2) Either: refers to respondents who said they may either, disengage or re-engage.

3) Re-engaging, involves disengaging momentarily, and then approaching the problem again, but in a different way.

4) Persist, refers to respondents who will keep working, if they get stuck. The sense of these terms is much easier to appreciate after reading the respondent's descriptions of what they do, below.

The graph shows that discontinuing unsuccessful attempts to progress, when apparently stuck, appears to be the rule rather than an exception. There is almost no difference with regard to respondents, of either gender, who customarily Disengage or Re-engage. However in both groups there is a similar sized minority who either, Persist, if they are males, or choose between Disengaging or Re-engaging, if they are females. The similar size of these two third choices gives a tempting impression of an association. It is possible to speculate that males who keep working when they get stuck are showing greater persistence or less flexibility compared to females, who in similar circumstances are more willing to try different options.

A different pattern is evident when RAIA Award winners are compared with Others, see Fig. 4.4-reA. This graph suggests that Persistence is not an issue in relation to winning or not-winning awards.

The largest distinction between the two sub-groups appears to be associated with Re-engagement. It appears that Award winners will mostly Disengage. Few will Reengage, when they get stuck, rather than Persist or Re-engage as a matter of course. This suggests that the Award winners are more confident in their ability to come up with a solution, after a break.

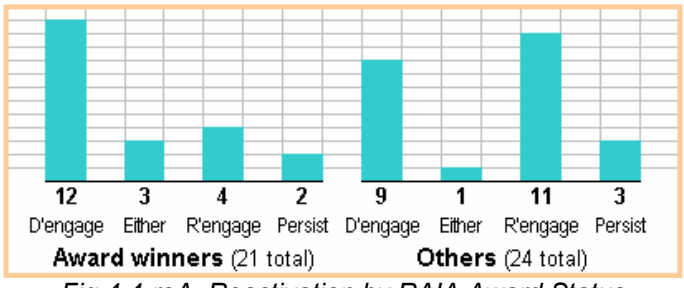


Fig.4.4-reA Reactivation by RAIA Award Status

When respondents practicing before 1984 are compared with the Later group, see Fig. 4.4-reY, below, the differentiation noted in relation to Award Status is also present. The Before 1984 group look a lot

like the Award winners. Most of the more experienced, Before 1984, practitioners also prefer to Disengage.

One difference is that the Either option, to Disengage or Reengage when stuck, is only chosen by one of the more mature practitioners. Persisting is more popular.

This suggests that the Before 1984 respondents are just as confident, as the Award winners, in their ability to come up with a solution after a break, but they are also a little more set in their ways.

A higher proportion of males in the Before 1984 group is one reason for the higher number of Persist respondents.

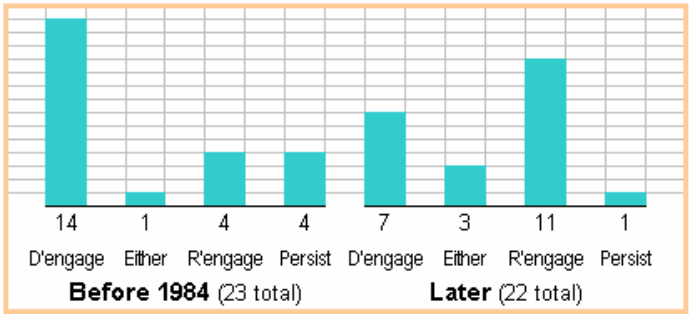


Fig.4.4-reY Reactivation by Year Commenced Practice

The details of respondent Reactivation preferences are described below under the headings, Disengage, Either, Re-engage and Persist.

DISENGAGE

Nearly half of the respondents (21/45) exhibited confidence in their capacity to solve problems, when they were stuck, by disengaging from the project in one or more of several ways. Methods range from passive activities, such as resting, through more active options, such getting away from the workplace, physical activities such as swimming, or going for a walk, non-work-related creative activities such as painting, or working on other tasks.

DISENGAGE VARIABLE

This group comprised, A01, A10, A21, A22, A29, A30. Several recommended disengaging from designing when stuck and ignoring work for a time, without suggesting any particular alternative activity. Key points, respondents in this category made, include:

- Take time out. Need to stop. Go do something else. Maybe look at related precedents. A01.
- Put it away for a while...No regular procedure...Not so frequent. A10.
- Forget about it. A21.
- Put it aside and come back to it later. A22.
- Have a melt-down, go to the movies… I lose it. I call on people. I often need that feedback. A29
- Put it aside ... The best way is to try to ignore it. The cliche is, you think of it on waking, or driving. That's what I call intuitive. A30.

DISENGAGE GET-AWAY

A large group, comprising A08, A14, A18, A19, A24, A36, A37, A38, P2 and P3 were clearer about distancing themselves from the problem, more decisively, by leaving the place or situation of their frustration.

A14's expression of the Disengage Get-away strategy is simple and direct.

> I would leave and not worry about it and come back tomorrow morning. A14.

A08 expresses the association of an idea coming when the mind is cleared.

> You've just got to get away and clear your mind and then suddenly, you know you ... might get the idea. A08

P2 stated that she believes breakthroughs come from going and doing something totally different. In her words:

> I always find that it happens after you've walked away from the job…I think that for me the breakthrough will always come. It won't come by working at it....For me the breakthrough is usually through distance, like actually going away...I believe there's an incubating process. I think there's a subconscious process, that is very valuable, which is moving away from it, and going and doing something totally different. P2.

P3's interpretation was more pragmatic, attributing the impasse to insufficient data, or fatigue and advocating alternative action.

While it was not nominated as a first choice when stuck, some respondents described travel, especially air travel or train journeys as conducive to problem solving.

DISENGAGE/ACTIVE

Several respondents recommended physical activities like kayaking, swimming, walking or bicycling as being conducive to quiet reflection or allowing the subconscious to function. Many also spoke of having a significant artistic interest, mostly painting or drawing, which they could turn to as a form of creative recovery and stimulation.

DISENGAGE/OTHER TASK

Several respondents, who clearly had demanding workloads, indicated that diverting their attention to other work is also an effective problem solving strategy, when stuck. A11 described a significant breakthrough that followed a period working on other office tasks. A20 described a pattern of working on tedious routine tasks when stuck for an answer, stating;

> You get everything else done and your brain can actually think about something else. A20.

P1 takes a break when he gets stuck, by changing from one job to another. In his words:

> I usually have a half dozen jobs going at the same time, so as soon as I am stuck on one I go to the next ... sometimes one fertilises another, or sometimes it gives me a break into having a fresh idea about another one .... doing another job ... gives me a space to work on another one subconsciously...Quite often when I swap jobs I can come up with an improvement or a better result….That's like having a coffee break, except that my coffee isn't a coffee. My coffee break is another job, and that gives me another burst of energy on the first one. P1.

His breakthroughs are referred to again later, as *resumption* discoveries, as they tend to emerge on resumption of work on the suspended job, *after the break* working on another task, not during the break.

RE-ENGAGE

One third of respondents (15/45) stated that, when stuck, they would adopt an alternative means of engagement with the project in one or more of several ways. Methods nominated included:

- Change from output activity (ie. trying to conceptualise) to input activity,

- Re-represent the task differently

- Re-consider the task differently

The term *task* is used here in a general way to mean any large, or small, sub-set of a project, that the designer may get stuck on.

RE-ENGAGE/OUTPUT TO INPUT

Changing from an output activity to an input activity typically involved browsing through magazines and looking at earlier sketches and drawings. A01 proposed, looking at related precedents. A creativity invoking approach was described by A05 and A06. A06 described two types of looking activity; searching for precedents, and exploring with the intention to get excited and inspired and thereby invoke creative activity.

RE-ENGAGE/RE-REPRESENT

This category includes representing the task in a different medium, different scale, level of abstraction or degree of detail.

P5 stated that discoveries often come when she is not working, that the process is unpredictable but is influenced by what you are doing. She stated that work that is against your nature takes you away from *who* you are. Adding:

> You've got to live a life that is complementary [for] that unpredictability to erupt... P5.

P5 has employed a variety of methods to enhance her creativity and has successfully used changes of scale and medium as well as avoidance of routine as set breakers.

A02 advocated making a model, enabling a different view and testing of ideas.

A04 proposed several actions. One option was to:

> Change the medium I am using to explore the problem, going from drafting to freehand, or from drawing to model and then back again. A04.

RE-ENGAGE/RE-CONSIDER

This category typically includes re-representation of the task, but more importantly, involves a more dynamic, active and free ranging interrogation of the main concerns. Methods nominated by the respondents included.

- Talking about the task or whole project

- Querying the project

- Taking a completely different approach

These activities may be conducted alone, in conversations with colleagues, or by 'workshopping.'

P4 described two examples of breakthroughs on major projects, made as a result of stepping back from the problem by abstracting it. He stated:

> That's my basic way of relating to the world, to actually step back from it and abstract ... if that doesn't work you have to say to yourself...I've just got the wrong model, I'll have to go away and wait until another model emerges, in my head ... That's how I do things...in everything I do...I do have to be peaceful …very rarely will an idea occur to me on the run. P4.

A04 described his process of interrogation.

> … ask myself, "why can't this be solved ... what is stopping a problem from being solved? ... what constraint is preventing resolution? ... what element can be removed?" A04.

A07 described a range of re-engagement and re-considering actions.

> … Talk about it and sometimes, just to myself, I vocalise it out loud. I draw it about a thousand times. I go for a walk. I try to take myself out of the familiar. A07.

RE-ENGAGE/COLLABORATE

Several respondents clearly prefer to work collaboratively and to resolve problems by talking about them, or collaborating with others.

A09 expressed the basic ideas:

> Talk to others...Verbalising and getting feedback are both useful. A09.

A12, who, with her partner A24, advocate collaborative practice, expressed the collaborative rationale.

> Generally it wouldn't be one person's problem in the first place. We would have all understood there was a problem, and there would be 2 or 3 people who would be involved. A12.

A16 described the particular collaborative processes he and partner A15 adopt.

> We work closely together. If it's a conceptual issue... we'll bat ideas back and forth on an hourly basis. We work in parallel and cross over and compare and contrast what we are thinking. A16.

EITHER

Respondents that were inclined to adopt either of the above options, disengage or re-engage included;

A03 described a fixation breaking re-engagement approach and also getting away from the situation.

> Generate a solution that is completely weird, to get your mind out of this place and get it somewhere else… If that doesn't work I will leave it for a minute and go and do something else, and then come back to it when my mind has been able to ease out of that place, by being somewhere else. A03

Similar sentiments were expressed by A23, A40 and P5.

- I think you're much better off to just leave it and just let it float around and attack it again from a fresh

perspective and, kind of, ask yourself, well, what's not working? Why is it not working? A23.

- I just leave it. I can't keep grinding on… I mean you work on it, but you know, you sort of look at it… and maybe you go back and you revisit the site and you might look at the information that you've already got again. A40.
- P5 described how changing scale had been effective, for herself and others, and also acknowledged leaving her work in a prominent place, after disengaging.

You see it by chance...the more you grapple with it the further away you get from solving it. You can only solve it unselfconsciously. P5

PERSIST

Some individuals stated they would persist when stuck.

A17 was frank about his manner of dealing with the problem of not finding a solution.

Just fob the clients off until I do. A17.

A26 was also frank and pragmatic.

Generally I keep going till I find something ... If time ran out I would just build it, as it was. Because, in the end... people can't wait forever. A26.

A32 also displayed persistence.

One house I am working on has a problem that prevents it being a great house. I can't bring myself to just move on. I need to resolve it. I find it hard to put it aside and come back later. I keep thinking about it. A32.

A32, like P3, is more difficult to categorise because he is a visualiser who, from his statements, is at ease designing while lying in bed, or driving and he can retain his thoughts. This is manifestly a different kind of persistence to the designer slaving at the board late at night, drinking endless cups of coffee, in order to reach some decisive point before going home.

A39 described a deeper form of persistence that was satisfied by applying different strategies.

… just keep moving through it, you know, keep going till you get it… And… you've gotta learn to know it, when you get it… you get very close to your work. So you're always looking for some sort of… mental break, that might channel your thoughts in a different way... talk to friends, go for a walk, leave it for two weeks, all sorts of things, and no one strategy. And you change your strategies according to how you're dealing with it…

CHAPTER 5

DESIGN DISCOVERIES

FINDINGS GENERALLY

The main finding from the investigation is that support was found for all three of the research hypotheses. About 86% (39/45) of all respondents confirmed Hypothesis 1, with statements indicating experience of insightful discoveries that have made a significant contribution to their conceptual designing. About 55% (25/45) of all respondents confirmed Hypothesis 2, with statements confirming experience of cold discoveries, or discoveries when they are not actively designing. Then among this second group, about 22% (10/45) of all respondents confirmed Hypothesis 3, with statements indicating that their cold discoveries were more insightful than discoveries made while designing. In their statements, some respondents referred to particular discoveries. Others referred to discovery experiences in general, when no particular experiences were recalled. A fourth and separate group, about 13% (6:45) of all respondents, are categorised as incremental designers. Two actually described their designing, or themselves, using terms such as incremental, methodical, or rational. The others included in this category were unable to recall any breakthroughs, or discoveries, or made few or no comments about discoveries in general.

An implication of the hypotheses is that a positive finding in Hypothesis 3 requires a positive finding in Hypothesis 2, which is similarly dependent on Hypothesis 1. Consequently, the hypotheses are associated not only with different types of insight experience, but also can be interpreted as different levels of insight experience. By this characterisation, respondents whose statements confirm Hypothesis 3 may be categorised as Insightful level 3, or Insight level 3 respondents. These respondents must also have confirmed Hypotheses 2 and 1. Similarly, respondents whose statements confirm Hypothesis 2 may be categorised as Insightful level 2, or Insight level 2 respondents. They must also have confirmed Hypothesis 1. Continuing, Insight level 1 respondents have confirmed Hypothesis 1 only. Finally, Insight Level 0 includes both, respondents who have affirmed that their designing tends to be rational, or incremental, and those who have no recollections of insightful discoveries.

The distribution of the 45 respondents, by Insight level, is shown in Figure 5-L, at right.

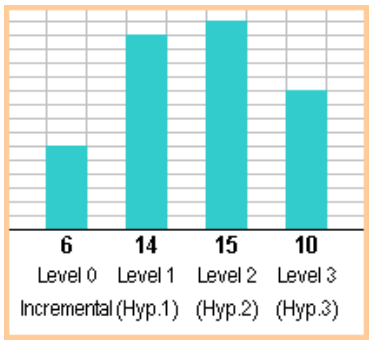


Fig. 5-L Insight Level distribution

Because insight levels are cumulative, 15 Level 2 respondents have confirmed two Hypotheses, and 10 Level 3 respondents have confirmed three Hypotheses. To avoid repetition, in the descriptions of the results that follow, respondents have been grouped and are described in the sub-chapter that corresponds to their highest insight level. This means that the first sub-chapter, 5.1 Insight experience Hypothesis 1, describes the Insight level 1 respondents. Then sub-chapters 5.2 and 5.3 describe the Insight level 2 and 3 respondents. Level 0, incremental designers are discussed in sub-chapter 5.4.

It should be noted that, while assessments and observations have been made of insightful designing, it is not proposed or even suggested that insightful designers, of one level, or another, are better, or more creative than designers whose conceptualisations are achieved rationally, or occur in incremental steps rather than discontinuous *leaps*. There may be many reasons for their different behaviours. For example, insightful individuals could be slower at recognition, or at making judgements, but by necessity, persist in some manner until a realisation is achieved. Regardless of insightfulness, all of the respondents in this study can be regarded as skilled, accomplished and creative. Whether individuals can become more insightful, or can become more creative, or productive, if they became more insightful is an issue of interest. However this is not a simple matter, as other factors, such as motivation, appear to be very important as well. These issues are not explored in the present study, which is focused on exploring and assessing the presence and features of insight experiences.

5.1 INSIGHT EXPERIENCE HYPOTHESIS 1

Hypothesis 1 proposes that unexpected discoveries during the conceptual phase of a design project include both; a) Insightful discoveries, resembling Gestalt insights, or presenting indications of what Gestalt theorists describe as productive thinking, and b) Incremental discoveries which can be attributed to normal cognition, or reproductive thinking.

More than 85% of respondents experienced insightful discoveries, but many of these also reported discovery experiences that confirmed Hypotheses 2 and 3. There are 14 respondents who reported discovery experiences that support Hypothesis 1 only, categorised as Insight Level 1 designers. The second feature of individuals in the Level 1 category is that their design discoveries are typically *hot* discoveries. Even when delayed, their discoveries occur to them in the setting and actions of designing, while they are in the mental state of arousal that accompanies designing, or soon after. For individuals who best fit this category it is unusual, for some almost unknown, to experience discoveries when they are doing something entirely unrelated to designing, like having a shower, walking or driving. This Level 1 grouping also includes respondents who have reported the experience of discovery very soon after resuming designing. This is described as a *resumption* discovery rather than a hot discovery, but for this thesis at least, it is categorised as a Level 1 experience.

The respondents, listed in Fig. 5.1.L1 below, made statements indicative of insightful designing that support Hypothesis 1, but which are not strongly supportive of Hypotheses 2 or 3. The Insight, or I. Rating, displays each respondent's score for Hypotheses 1.2.3 respectively. The method of measurement is set out in 3.3.2 Respondent Table Coding and the details are included in the Respondent Tables in Appendix 2 – Respondents. Neither the extent to which respondents are insightful, nor the frequencies of different types of discovery experiences have been systematically measured. It is proposed that the respondents have had the experiences they describe, at least once, or more often, when they say so. Some respondents suggested they have a typical insight experience, while others were more forthcoming about particular experiences.

In the figure below, the respondents are listed in two columns to show RAIA award winners and other respondents separately. In the description that follows they are ordered according to the qualitative characterisation of their experience, based on the key terms, *clarity, fluency, recognition* and *idea*, as described in the Comment column. Respondent gender is shown by blue or red text.

Insight Level 1 respondents - 14 total

		RAIA award winners			Other respondents		
		ID	Rating	Comment	ID	Rating	Comment
	Male=blue	A21	4.1.1	Clarity + Fluency experience	P3	5.3.1	Clarity - Sudden experience
	Fem.=red	A11	3.0.0	Clarity + Fluency experience			
		A30	5.3.1	Fluency - Sudden experience	A26	4.1.1	Fluency - Sudden experience
		A22	4.0.0	Fluency - Sudden experience	P5	4.2.1	Fluency experiences
					A15	4.2.1	Recognition experience.
					A34	4.2.1	Recognition experience
					A35	3.0.1	Recognition experiences
					A27	5.2.2	Idea - Sudden experience
					A17	3.2.1	Idea experiences
					P1	3.1.0	Idea experience
					A12	2.2.1	Idea experiences.

Fig. 5.1-L1 Respondent Discovery experiences by categories - Level 1 Respondents

For economy, the descriptions below limit detailed discussion to two of the most informative and different respondents, A21 (Clarity experience) and A30 (Fluency experience). Key statements by these respondents that have a bearing on one of the Gestalt concepts associated with insights, described earlier, (*preparation*, *fixation, incubation*, *restructuring and "aha!" factor)* are presented. Statements that have a bearing on Hypotheses 2 and 3 follow the Hypothesis 1 statements, so that the entire discovery profile for these two respondents can be viewed at once. Key experiences of other Level 1 respondents are also presented but in a summarised form. Refer to the DVD, Appendices for more comprehensive details of each respondent, in the Respondent Detail sheets. These show a categorical breakdown of all respondent discoveries.

5.1.1 Insight Level 1 - Clarity experiences

The term, *clarity*, is used to mean an individual achieved a sense of understanding of a design situation, or issue, or some vital aspect of it. I am differentiating clarity and fluency because some respondents have described one, the other, or both. The two experiences could be associated, at least to the extent that clarity may lead to fluency, or that on some occasions the experience of fluency may have displaced an earlier sensation of clarity.

The incident described by the first respondent, A21, appears to have begun with a resolution of necessity, to get started, after being stuck for a long time. A21's gambit, led to a growing experience of clarity, bringing confidence. Then fluency began to build over a long session of careful drafting. This example contrasts with a very different spontaneous experience of sudden fluency, working freehand in a short time, described by A30, later in Insight Level 1 - Fluency experiences.

Respondent A21 **I.Rating: 4.1.1**

Male architect. Commenced practice mid 1980s
Current status: Partner medium city practice
Awards: RAIA Sulman Awards, and others

INSIGHT EXPERIENCE - HYPOTHESIS 1 SCORE 4

A21 described an incident from his graduate student days:

> … we'd worked through a couple of projects and things had gone very well and I had done well and then we got onto a project … I just had a huge block, probably… the biggest block I've ever had and I haven't really had many… but I had a block and you know, you work in your studio with very talented and productive people and they're all producing a lot of stuff, you're sitting there and you're not doing anything and… we had the mid term jury… [and] I had nothing… Eventually it got so late that I had to draw it up basically…
>
> … So I had something which I thought was crap… I was being so hard on myself, you know and I thought, "Well I'd better just draw this up."... That brought a certain calmness. And then what I did was, I put on a set of headphones and I listened to Vaughn Williams, over and over again, and I just put myself into a slightly peaceful state… Somehow it happened. Even though I was in a very distraught state, I managed to become a little more peaceful, listening to this music and draw. And draw…with a little more care and a little more detachment, right? And I drew it, right? And then I thought, suddenly, "I had broken through", right? And I thought, "Well, I can make this so much better". (laughs) I suddenly understood it through the process of relaxing and drawing, but I suddenly realized, "I can do this so much better". So I completely re-did it, you know, and re-did my entire presentation.
>
> … I didn't sleep for two days, And I constantly listened to this music and just peacefully did it all and, you know, it was fantastic. Everything was fine at the end. The process is not an ideal one, but it's an extreme example of what you're talking about and once you do that, then I think you kind of know how to handle it, if you're lucky. A21.

Preparation *1*

The makings of a design were prepared when A21 began experiencing a block. He was unsatisfied with what he had, but clearly had no better ideas, shortly before the mid-term submission.

Fixation *1*

A significant insight into A21's fixation and discovery of a way through it is evident in the following statement, which fleshes out his advocacy of detachment:

> In the design process there will always be setbacks, but you've always got to believe things are going to work out well and I think you've got to follow your intuition. You've got to pull your intellect out of it a little bit. Not see it as a problem. And just let it have its own life, you know. And so there's a sense of non-attachment to it, in, if you have too much attachment, in my view you will stumble and you will get frustrated and you will sometimes be stuck.
>
> …I often compare the act of design to launching a boat off the shore. You give it a push, right, so your initial interest or… your preconception about it, or your first idea, is the launching of it, right. What you then do is you get in the boat and you just follow it. It needs to find its own life, you need to detach yourself from it in a way … you can't be too deterministic about it.
>
> … The other thing is to understand that there is no right path, you know? I can launch it in that direction. I can launch it in that direction… what's actually important is to launch it and follow it. So if you're a bit more wilful and deterministic about things I think you will have periods of great frustration and stumbling. Whereas if you're more prepared to follow its path, trust your intuition, and see it as an explorative process, then I think it's less likely to happen.
>
> … the times I can think that I've had major blocks have been where… I'll have launched it and thought, "oh no! that's not good enough", launched it over here, "oh no! that's not good enough", launched it over here, "oh that's not good enough". Now, of course, it's never good enough. It's like every time you draw a line it's the wrong line. The point is you can't draw the right line first. You have to draw the wrong line before you can find the right line. And that's a fundamental thing… I see people go through crises because they can't wrap their head around that… we talk about it and it's important to articulate it, but it's something one needs to experience. A21.

Incubation *1*

While A21 does not refer to *incubation* by name, he refers to several aspects of his experience that indicate a familiarity with incubation-like processes. In relation to Creative Catalysts, A21 states:

> I actually think it gets solved much more through the opposite. If you've got a complicated problem, you know what I do? Put it out of my mind. Try hard to forget it, completely forget about it and then respond spontaneously to the problem. A21.

Elsewhere, during his description of process, A21 refers to ideas percolating away:

> I have certain things I'm interested in which may be… a way of making architecture… it's almost like research, an area I'm interested in… carrying around and thinking about and I might sketch with and so on. And there might be several of those ideas that I've already got percolating away, there's no site, there's no brief, it's just architecture. A21.

A21 made references to the value of following one's intuition, in the manner of regarding the project as having a life of its own and in viewing designing as an explorative process. That such a state of mind may be conducive to the *percolation* process, or a form of latent preparation is referred to again. in Chapter 6.3.2 Deeper exploration of available data.

Restructuring *1*

The Columbia project is significant for two restructurings. 1) Features of the design which only became evident as the drawing progressed. This illustrates A21's point of needing to draw the wrong line in order to draw the right line, and 2) A second restructuring is related to the methodology of designing. The desperation of little time left and nothing else on hand evidently drove A21 to start drawing-up what he had. But his decision to adopt a detached, less deterministic, approach appears to have been the significant extra, that precipitated a breakthrough. This sequence of events also became a rite of passage in A21's development as a designer. The success of this flexible approach enabled it to emerge as a strategy, evident in his observation that:

> … once you do that, then I think you kind of know how to handle it, if you're lucky. A21.

"Aha!" Factor *0*

The example A21 describes was emotionally rewarding, in providing a sense of relief, and did not involve a sudden *aha!" experience. A21 says:

> No it wasn't like "boom!" But it was a process of a few days, really a week... things were moving forward

rather than backwards. I was moving up rather than down and maybe, you know, after a week everything was okay. A21.

That point is reinforced later when describing ideas coming unexpectedly:

… often it's really by being in a certain general mind frame… like I'm interested in something and therefore I look at things in a certain way and that develops them. So, rather than suddenly: "Oh there's a shock. I've suddenly got an idea out of the blue". A21.

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2 SCORE 1

Importance *1*

The importance of *cold* discoveries was affirmed by A21, but qualified by the observation that he probably experiences more discoveries when designing than when not. Ideas A21 expressed that bear on frequency are:

These things happen a lot… I might be somewhere and I might turn my mind to a particular project and think about something… and something might come to mind, or I might be looking at something like, you know, rock formation or something and it might start to stimulate thinking about one of these agendas… things can trigger things and so these things happen… but also things happen as one explores and starts sketching… Things rarely happen out of the blue... you know, "nothing exists in the void", is my feeling… It's more stimulated by something, or it's a general disposition my mind might be in ... and it's consistent with this idea that *things transform*, they don't just appear… there's a lot of spontaneity in these ideas and probably most of the time that happens when I'm actually working. You know that's probably when these things come. A21.

Several points can be drawn from these remarks. The first is that discoveries can happen both, when A21 is not designing and when he is, although the latter is more common. The second is that his discoveries rarely spring from nowhere, or out-of-the-blue. They are more likely to be stimulated by something external, or the mental stimulation of exploring and sketching.

No distinctions were made between discoveries from one situation or another. However, in the following observations, there is a suggestion of greater affinity with discoveries achieved while he is in full flow designing, than with discoveries at other times. These comments were made after I asked about experiences where a significant idea has, more or less, landed on him.

… there's a lot of spontaneity in these ideas and probably most of the time that happens when I'm actually working… it just happened briefly... I suddenly walked into the meeting room and a couple of clients were there and I didn't even know what… they were talking about. I'm instantly projecting things into it ... I didn't know anything about it... It was totally spontaneous… but the point is that it's not from a void, because it draws on all of the things I know and are used to... and what's interesting is… I'll draw that and then, you know, someone will say, "oh well that won't work because of this"… Every challenge can become a positive thing. We can make it more clever you know, we can do this, or we can do that … you know the whole thing's moving very quickly. You can cope with anything. You push it here, it will move over there… so I think the spontaneity, or the insight... the closest I experience to that, is in the immediacy of actually working. It's when my mind and hand are kind of one. A21.

It is unmistakeable that A21 associates his most significant, spontaneous and insightful experiences with the immediacy of actually working, when his "mind and hand" are as one.

Hotness-Coldness *0*

Proximity to hot time - The revelations in the Columbia project and other statements indicate that A21 regards hot time as his most productive time.

Nature of cold time - The emergence of Cold discoveries, when A21 is not working at all and not influenced by external stimuli, appears to be an unusual event. No mention is made by A21 of ideas emerging in circumstances commonly associated by other respondents with internally cued discoveries, eg. while in bed, after sleeping, or in the shower.

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3 SCORE 1

A21's statements do not support Hypothesis 3.

SUMMARY A21

A21 gave an articulate account of a form of discovery that is not marked by dramatic big idea discoveries, but which shows unmistakeable signs of being insightful. The events described occurred

in the 1980s and are significant, not only as an example, but also as a turning point in A21's designing. A21 is classed as Insight Level 1 because he clearly regards *hot* time as his most productive time and made no mention of ideas emerging without the stimulus of design activity.

Respondent P3

Female Architect. Commenced practice: Mid 1980s
Current status: Kitchen designer, active in development of Australian kitchen design standards.

P3 did not refer to any breakthroughs in her regular kitchen projects. Instead she described the resolution of a conflict encountered in a non-routine project, the conceptual planning of the fit out of a recently purchased house, P3 shares with P4. In this case P3 is the designer. The conflict she describes was resolved unexpectedly by a classic "aha!" realisation in the middle of the night, that involved a complete restructuring of previous intentions.

> … in the middle of the night, one night I just woke up and I said, "Right, we are going to have downstairs.. I don't want to go up two flights of stairs.

P3 is marginally a Level 1, rather than Level 2 designer because of uncertainty over two factors, the nature of her professional work and her Action style. During the interview, P3 referred to the operation of a sub-conscious process, but this was not so apparent in her regular kitchen projects where she designs in collaboration with clients. The kitchen design process is systematised and individual breakthroughs are not common.

P3 also described her ability to visualise and referred to patterns of thinking about projects systematically, at other than scheduled work hours. This left little room in her day for unambiguously cold discoveries. The clear cut example of a cold discovery is associated with a one-off project, the recently purchased house. This is much bigger, more complex, less routine and literally *closer to home* than the kitchen designs and, it is likely, these factors have contributed to P3 waking up in the night with a realisation that has resolved a bothering issue. This suggests that if more of her regular work was non-routine, or as challenging as the house project, she could experience more cold discoveries, but there is insufficient evidence to make that claim with certainty.

Respondent A11

Female Architect. Commenced practice mid 1970s
Current status: Partner/Director large city practice

The first breakthrough described by A11 involved a group of town houses in a country town. A preliminary design had been completed and approved, but the investors feared the design was too different looking for the country and wanted a more conventional form. A11 needed to develop a solution by the next day. Her main actions were to, 1) calm herself and focus her thinking on the facts of the situation, namely topography of rural town and country building forms and 2) look through information about this subject she had researched earlier. She realised the essence of the solution was a different roof form. Through a combination of sketching, then taking a break to do some unrelated paperwork, then looking at a model of the project and thinking, she managed to produce a design that met her requirements.

> I actually… thought about it, did a couple of sketches for a couple of hours. Then I did some of my paper work and [committee] work. And then I just sat down quietly for a couple of hours. There was no one here, and [I] just, sort of, sketched and then thought about the country, country topography, of country towns and built topography and came to a conclusion that way. So it was really, just working through it.

A second example involved a master plan for a Sydney Council. On one part of the site the client requested a very high façade, against objections by A11 over a number of weeks that it was inappropriate for the site. A11's response was to talk through the matter with a colleague:

> … our solution came back to what we had started with originally, which was a 3D grid of water and air, and built form over the whole site and so we said, "yes let's go back to that, let's go back and express these little tall little buildings in a very abstract way on the site, and that way we can give them their emphases and still not be at odds with what we said we were trying to do". And so, I think it was really the same process, discussion, going back to our original aims.

In so doing A11 and her team achieved what she describes as:

> … an abstract expression [on this part of the site] in order to fulfil the client's request [without contradicting] what we were trying to do in the first place.

A11, who has the lowest "I" rating in the Insight Level 1 group, is a methodical designer who likes to work collaboratively. Her realisations are not as clearly insight-based as many other respondents have described. However A11's actions in the first case exemplify a well prepared mind resolving major necessary changes to a design, under extreme pressure of time, by calming herself and allowing the solution to come to her, rather than vigorously searching for it. In that sense both the behaviour and the discovery can be regarded as insightful. The second case has similarities, but as it involved collaboration with a colleague, A11's personal experience of insight is less definable.

5.1.2 Insight Level 1 - Fluency experiences

Respondents in this category did not experience their discovery by recognising a particular fact, or idea, or sense of revelation. The term fluency is used to mean that individuals experienced a succession, or flow of ideas. Instead of, for example, sketching and re-sketching and working towards a design by trial and error, the first respondent described below, simply transferred his design from mind, to paper, by drawing in a relatively continuous manner with few changes or corrections.

Respondent A30 **I.Rating: 5.3.1**

Male Architect. Commenced practice early 1980s
Current status: Leads a medium to large city practice and maintains a small domestic practice.
Awards: RAIA Sulman and Wilkinson awards.

INSIGHT EXPERIENCE - HYPOTHESIS 1 SCORE 5

A30 described the design of his first house, one of his best known designs.

> On every project there are so many problems and so many breakthroughs… the first house I designed… the house that won the Wilkinson [award], I designed that lying on the beach… I drew it in my sketch book, a section of it, and I drew it and I thought, "that's it!" … just drew, came from nowhere, just drew it… practically the first time I tried to draw what I was thinking about... It was a Saturday afternoon… I got off the beach and I went straight to the office. And these are the days of drawing boards still, of course, and I sat there and I tried to draw it and I couldn't… so I enlarged it on the photocopier to scale… put a piece of tracing paper over the top and traced it and that's the section of the building. A30.

Preparation *1*

There may be more, but I can think of two levels of preparation in the statements made by A30. A project based level consists of what A30 calls facilitation, which can be interpreted as the outcome of preparation. He says:

> … you act as a facilitator, you go through the whole of facilitation and the solution lies beyond it… I think, that in this realm, beyond the facilitation realm, is actually where the intuitive answer lies. A30.

At a deeper level, the preparation for this house started long before A30 met the client. He describes the building as a culmination of years of thought about architecture. I asked whether the drawing had followed forethought or planning, or if he was half way through drawing it before realising it was significant. This drew a strong and revealing response.

> … the whole idea of the house is, it's a derivation of the steel works… the client… wanted a house that was a derivation of its place and so the clarity is there, intuition is there, context is there, interest in the landscape is there, interest in the object… All things that I've just talked about were all there in that project and they all just went (foomp) onto the page. So I probably had been thinking about it, all of those things for, you know, the 30 odd years at whatever age I was in those days that it happened. A30.

Fixation *1*

No statement was made about fixation, in relation to the Wollongong house. However A30 was clearly accepting the reality of fixation when acknowledging that the progression of his work tends to combine periods of no progress, which he described as complete depression, followed by sudden rapid progress.

Incubation *1*

When I asked A30 if he could recall the extent to which he had worked on the problem before, he was unable to give an exact answer, but offered a statement that is consistent with an incubation-like process:

> … I'm a great believer in… things tick over in your mind and they work on a subconscious level and all of a sudden it will just come to you. A30.

Restructuring *1*

The production of the drawing on the beach was a restructuring in being an externalisation of many earlier thoughts. The word *drew* emphasises that A30 was not designing by sketching. His action was a direct transfer to the page of what appears to have been an already formed system of ideas.

"Aha!" Factor *1*

The word *drew* used by A30 signifies that his action involved the realisation of a gestalt. This is demonstrated by the failed attempt to draft the design at his drawing board, back at the office. It was necessary to make a scaled photocopy which could be traced whole, with all relationships preserved.

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2 SCORE 3

When asked how often design ideas come to him unexpectedly when not designing, A30 said "Lots." While no examples came to mind A30 was willing and able to describe himself, and the experience:

> … it is also because I'm, you know, a complete obsessive… [I] think about architecture all the time, probably. Oh, not all the time, but… if you're thinking … driving along in your car thinking, you know I can't stand the fact that that lettering on the speedo is like that, then if you're thinking about that, you're thinking about architecture and you're thinking about that all the time… A30.

Importance *2*

It is probable that cold discoveries are important simply because A30 is intensely involved in his architectural work. There is no particular reason to doubt what he says about being intuitive, mentally active and making unexpected discoveries, when not designing. As A30 doesn't distinguish work generated discoveries from non work generated discoveries it can, at least, be deduced that *cold* discoveries are no less valuable to him than *hot.*

Hotness-Coldness *1*

It is more than likely that A30's cold discoveries cover a wide range of coldnesses and that some non-working situations, like his regular flights between Sydney and Melbourne have become de-facto working situations.

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3 SCORE 1

I asked A30 how the non-work ideas compare with discoveries made while working, and also whether he had noticed any patterns or consistent features in the non-work experiences. Neither question prompted answers that support hypothesis 3. A30 observed that design breakthroughs at work tended to be made with other people and the group experience made one feel enriched. The second question, about patterns in the non-work experiences, received a basic "no".

SUMMARY A30

This account by A30 presents clear indications of insightful designing, by an architect whose manner of designing combines both rational (*facilitation*) and intuitive processes. He has been classed as Insight Level 1 rather than Level 2 because of the extent to which his design thinking permeates his non-working hours. This suggests that his discoveries are precipitated by design thoughts. The order of experiences for the classic Level 2 respondents tends to be the reverse. Their cold discoveries precipitate design thoughts in a previously resting, or idling mind, or a mind preoccupied with different matters.

Respondent A22

Male Architect. Commenced practice: Early 1990s
Current status: Partner with A23 in small near city practice

A22 was able to recall a recent breakthrough in the design of a competition entry for amenities blocks in a major public park. A design had been developed and was being presented for submission, but both A22 and his partner A23 were unsatisfied with it and felt it couldn't win. They resolved on a Friday

to try and fix it on the weekend, before it was due on the Monday. The solution involved modification of one design element, a screen in front of the building and a different approach to the presentation. They won the competition and their design has been built.

The breakthrough in the design involved changes to the materials of screens covering the building facade. On the Saturday morning A22 started with the detail:

> … it was one of those things where I just started drawing a 1:5 detail in sketch form. It just came very quickly and very naturally and as soon as I drew it I felt confident… I suppose the big breakthrough was actually to combine those 2 materials [proposed the previous night] to make one screen and suddenly, that's what gelled.… that 1 to 5 detail captured it all. A22.

Respondent A26

Male Architect. Commenced practice early 1980s
Current status: Partner with A25 in small practice

A26 described a recent design for a house, inland on a mountain. Initially he had produced 4 or 5 designs without any being fully satisfactory, either to himself or to the client. The client, reflecting A26's unenunciated thoughts, had described the leading contender as "a bit boxy." As A26 put it:

> ... it needed something on where to go next and that's one where I've designed it in my head one night, lying in bed, woken up thinking… "I can do that!" and designed everything. 'Cause I'd done so much time on them, I knew how they'd go together and came up with a twisted light metal pavilion roof on the big base building and got up and drew it. And that's the one... I was talking about, that's just been approved. A26.

This discovery is consistent with incubation. After working on the project, A26 went to bed thinking about it and later awoke with a concept he could apply. I asked A26 if the idea came to him suddenly and he replied:

> Well, yes, but no… it's like birth isn't it, nine months pregnancy and then it happens overnight. A26.

A26 awoke with a whole solution (ie. a gestalt) in mind and, as he said:

> … then I just came straight down and started drawing. A26.

The problem solving example, just described, involved a recent *cold* discovery, realised on waking from sleep. However A26 is included in the Insight Level 1 category because this is an unusual occurrence. A26 suggests his problem solving discoveries are more likely to be outcomes of intentional thinking, rather than actuators. Prior to recently commencing a home based partnership, A26 adapted his daily routine to increase his discovery rate outside of his normal office hours. Referring to when he commuted between the northern beaches and the city each day, he said:

> … normally what I used to do, I would design something I generally liked, at the office say, or at home, in the morning and then I'd print it out and I'd sit it on the passenger seat. And all the way in I would just look at it and think. Get a hell of a lot of quiet thinking going and then get all these ideas. Sometimes you'd have to sketch them up in the car… A26.

Respondent P5

Female Artist-Designer Commenced practice late 1950s
Current status: Sole practitioner - over 60 one person art shows in Europe, USA, Asia, Africa and Australia. P5 has also carried out commissions, for graphic, textile and stage design.

P05 provided indications of experiencing insightful discoveries with positive statements in relation to restructuring, fixation and incubation. P5 had some initial difficulties recalling a conceptual breakthrough, possibly because her style of working is not self conscious and partly because of some uncertainty over what constitutes a discovery, or breakthrough. However she was able to provide two quite different examples of significant discoveries. The first about a series of large drawings completed in Germany and the second a recent development in her painting, involving use of enamel paints, which led to a series of paintings and a subsequent showing in a city gallery.

5.1.3 Insight Level 1 - Recognition experiences

A recognition experience typically involves the designer encountering something seen, or thought before and perceiving in it, something that was not appreciated before.

Respondent A15

Female Architect Commenced practice early 1990s
Current status: Partner small near city practice

A15 described a house project in which an idea emerged shortly before a progress meeting with the two clients. The initial condition was that a set of plans had been developed, the clients were expected to be happy with that but, in A15's words:

> … it wasn't actually a design it was just a default. Plans wrapped in this concrete and glass… 3 boxes… concrete slabs, with glass all around… It was just a series of those and it just didn't seem to me to be a strong enough idea, to be unique and I want something to be quite different... A15.

The solution derived from a magazine image of a fence. A15 liked the brush-railing form in the image and, some days earlier, made a sketch of it, one of over one hundred options considered during the designing. No particular connection between the sketch and this design had been recognised. At the time of the meeting about a month of development of the design had occurred, with no particular resolution of the exterior.

On this day the sketches were reviewed again to see what could be developed. A15 and A16 both liked the fence image and so A16 made a 3D computer model of it. Then when viewing the completed model A16 asked for it to be rotated 90 degrees and once that was achieved a screening solution for the façade was recognised.

Respondent A34

Female Architect. Commenced practice early 1990s
Current status: Leads small near city practice

A34 combines both rational and intuitive processes in her designing. She described a recent project, a master plan for development, west of the city. This is an area of large suburban and semi-rural blocks considered suitable for conversion to housing. The project was complicated by the fact that there were a large number of stakeholders with conflicting wants and needs. A34 was distressed by the project and some of the people involved, but persisted and:

> … by reading the planning, by looking at the history of that site and the subdivision plan and saying "how can we do this", and looking at, like, 10 options, but one option in particular, like, just (click), the light come on and the penny dropped… and we said, "This is it. This is a really good solution"…

The solution appears to have been the outcome of close analysis of the site, its history and the planning requirements. The chosen option embodies restructuring to the extent that, based on her research, A34 was able to reinterpret the goals.

To the question of how often design ideas come unexpectedly, at times when not actually designing, A34 described how ideas may be triggered by external factors and emphasised the need to be receptive. Discoveries that arise internally and precipitate thinking about design are not mentioned at all. This suggests that A34's design thinking is primarily a conscious and directed activity. A34 did not distinguish between working and not-working discoveries.

Respondent A35

Female Architect Commenced practice early 1980s
Current status: Sole practitioner

A35 described two examples of discoveries, both from the late 1980s. A35's description of the first example, when she was studying Social Ecology, suggests two distinct recognition events. The first was a recognition of inadequacies in her current progression of study and the second was recognising that events in her own life, in conflict with her work, could be regarded as a model and therefore her life and study could be brought into some form of productive alignment.

The second was equally personal and also involved recognition. A35 was aiming to develop an improved way of working and discovered the essence of the new way was already present in the way she was approaching a non-professional primary school teaching project. A35 had been applying her knowledge of social ecology, experiential learning and collaborative design in her course and found the technique enabled the young children to read plans and to understand concepts associated with planning, materials and styles. A35 realised the lessons she was learning from teaching young children could be applied more broadly. She went on to plan other teaching using this method, in high schools and elsewhere, for several years, and has since applied it in collaborative professional work with adults.

5.1.4 Insight Level 1 - Idea experiences

Idea experiences are typically classic "aha!" situations, where a particular discovery is made that may be a solution to a problem or a generator upon which a design can be based. They are much less common among Level 1 insightful designers than Level 2. Respondents' experiences below are described in summary form. Refer to Appendix 2 – Respondents, for the comprehensive descriptions.

Respondent A27

Female Architect. Commenced practice: mid 1990s
Current status: Partner, small near city practice

A27 recalled two experiences of decisive "aha!" type discoveries, one early experience from her student days and a recent experience.

A. Early experience - dream led to a solution

> I can remember a final project at University, having a dream where I resolved a problem … I thought I had come up with a concept and even though the dream was different I think {the] feeling that I had solved something stayed with me and I sat down and... came up with a solution, albeit it might have been something very different. I think that you do have those flashes of inspiration. But it's probably the fact that it's living with you day and night and these problems are, you know, going round in your head and it's a matter of, if the timing's right for you, you sit down and have a good look at it. A27.

B. Recent experience - detail idea in shower was exciting but wasn't used

> … the other day I was trying to solve… I can't even remember what it was now, but I remember rushing out of the shower saying to A28, I've thought of a way we can do ... it was a construction detail, a roof or something and I drew it and, and we talked about it, and in the end it... wasn't the answer, but it was terribly exciting ... that's fresh in my mind. A27.

Respondent A17

Male Architect. Commenced practice: mid 1980s
Current status: partner small near city practice

At first glance it does not appear that A17's designing includes insight experiences. His recollection of discoveries was mostly of incremental steps. However there are definite signs that his designing includes both incremental and insightful progression and that this may be associated with the types of project he is working on. His most common work tends to be on urban sites and substantially governed by local government envelope requirements. The exception he raised was an exhibition design. He said:

> … when working on exhibition designs sometimes you need ... a big idea and… finding that big idea… is quite good and revealing. A17.

He described the generation of ideas for two such exhibitions. The first idea, A17 developed for an exhibition presenting a history of rock & roll music. The principal idea was the exhibition's three dimensional shape, an evocative sculptural form, resembling the inside of a human ear. He recalls it occurred at the office and thinks he was drawing at the time. The second idea, was for an elevated pathway to a tall artefact, to be erected inside a museum A17 was designing for a country town. The eventual idea, of a three dimensional spiral, came to him while driving.

> I just thought… that a 3 dimension spiral is probably… the nicest way to get to that sort of thing. Now…

> that's kind of a diagrammatic idea, that I came to without drawings and then tested it and seemed to be quite a good way of solving that problem.

The insightful side of A17 is evident in the fact that he considers himself to be an intuitive designer and is accepting of the notion of ideas coming to him, as opposed to searching for them, or tracking them down. I asked A17 how the non-working ideas compared with those made while working and his answer suggests they are seen as two parts of the one process. The following reply suggests a combination of active cognition and a more passive cognition that could be regarded as a form of incubation.

> … you do a little bit and then you go and do other stuff… and so you've still got the drawing activity in your mind, and I think that little bit of distance is probably good, to kind of clarify, and then you come back and you draw some more, and then you go out and you do something else. So, it's sort of a constant, I mean it's kind of a consuming process until it's worked out… really thinking about it, it's probably half and half, you know, you draw a bit, and then you think a bit, then you draw a bit more, and you think a bit more and sort of come together that way. A17.

Respondent P1

Male Graphic Designer. Commenced practice early 1970s
Current status: Partner in small practice, with P2

P1 described a recent design of a logo, required to cover a variety of activities undertaken by the client company, a manufacturer of products for both human and animal consumption. The logo was needed within two days, when P1 would prefer a month for a job of this kind. The effect of other commitments meant that only four hours was available. In fact he managed to come up with a successful concept comprising four variations, reflecting all of the required elements of the client business, in two hours of actual work time.

Statements by P1 conveyed fewer indications of radical restructuring in his design discoveries than the other four preliminary study respondents. However there were positive indications in what he described as his general pattern. It was unusual for ideas to emerge without preparation. He did not persist with a task when stuck. Instead he switched to another of several simultaneously running jobs. He found that solutions were likely to emerge quickly when he resumed designing on jobs, where he had previously been stuck.

Respondent A12

Female Architect. Commenced practice mid 1980s
Current status: Partner of A24, in small-medium city practice

A12 viewed her design approach as looking for a generating idea, which might be associated with section or plan. Once an idea with scope, to be inspiring and to produce a building from, is identified , she would try to develop it. A second aspect of process, collaboration, was also described.

> … we like to sit around in a group and workshop ideas… we like to build the idea together, the concept together… We feel very strongly that people should feel part of the process… A12.

A12 indicated that she has often had experiences of working out ideas, or conceiving something. While these may have been insightful, her recollection of particular experiences that she could describe in detail was not extensive. This was complicated by the collaborative mode of designing practiced, initially in earlier employment, particularly when working with Renzo Piano in the late 1980s, later with her partner A24 and then, more recently, with the staff of their city practice.

Although A12 found it difficult to recall particular instances of cold discoveries she appeared to be enthusiastic about their importance in her creative work. Two factors could have influenced her judgement, recollections and likelihood of making cold discoveries, 1) the method of collaborative design practiced with her partner A24, and 2) being mother of a young child.

In her answer to the question of how ideas that came when not working, compared with those made when working, A12 did not see a significant distinction and therefore did not support Hypothesis 2.

5.2 COLD DISCOVERY EXPERIENCE HYPOTHESIS 2

Hypothesis 2 proposes that among some designers, unexpected discoveries when they are not actually working on their design, described as *cold* discoveries, are important in their designing.

A majority of respondents (25/45) affirmed that *cold* discoveries, by their frequency and value, make a significant contribution to their designing. Responses were mostly clear cut and brief. Common statements about frequency included: *a fair amount, reasonably often, quite often, very often, lots, always*, or *all the time*. Respondents were not specifically asked how important are the *cold* discoveries, but many offered comments on the discoveries that reflect their value.

The following respondents, listed in Fig. 5.1.L2 below, made statements indicative of insightful designing that support Hypothesis 2, but are not strongly supportive of Hypothesis 3.

Insight Level 2 respondents - 15 total

		RAIA award winners			Other respondents		
		ID	Rating	Comment	ID	Rating	Comment
	Male=blue	A38	3.3.1	Clarity experience			
	Fem.=red	A29	5.4.2	Clarity +fluency - Sudden exp.			
		A39	4.4.1	Clarity + Fluency experience			
		A19	4.3.2	Clarity + Fluency experience			
		A20	5.4.1	Fluency - Sudden experience	P4	4.3.0	Recognition experiences
		A03	5.4.1	Idea - Sudden experience			
		A25	4.3.1	Idea - Sudden experience			
		A02	4.4.2	Idea experience	A37	4.4.2	Idea experiences
		A14	4.4.1	Idea experience	A09	4.4.1	Idea experience
		A32	4.4.1	Idea experience	A36	4.3.1	Idea experiences
		A06	3.2.1	Idea experience			

Figure 5.2-L2 Respondent Discovery experiences by categories - Level 2 Respondents

The discoveries described below were recalled by the respondents as examples of breakthroughs or discoveries in general. They are not necessarily cold discoveries. As in the previous sub-chapter the descriptions below limit detailed discussion to two of the most informative and different respondents, A39 (Clarity experience) and P4 (Recognition experiences), while the key experiences of other Level 2 respondents are summarised form. Refer to Appendix 2 – Respondents, Respondent Tables, for a categorical breakdown of all respondent discoveries.

5.2.1 Insight Level 2 - Clarity experience

Respondent A38

Male Architect Commenced practice mid 1960s
Current status: Leads small practice

A38 prefaced his account of a conceptual breakthrough by describing the moment before the point of insight, referring to a recent incident.

> I could probably think about every job I've done at different stages and of where you actually somehow realise that suddenly it's all going to go together, it's the moment before that happens that's the really good time… sometimes it comes to you instantly you arrive at the place. You see exactly what has to be done. A38.

He then described an inspection of land on a point jutting into a Sydney waterway, where his realisation was sudden.

> … we got out of the car… 250/300 yards from where it would actually meet the water line and it falls over and runs down to the water and I just saw it straight away. The sun was there, the silver light was coming off the water, but half of the viewscape down the street was obscured by [old wharfage] and I said… "that wharfage all has to be removed so that when you come down [to the point] it is absolutely flooded with the light, of the water at the end of it, then as you get to the water level, whatever else is there is revealed, and it comes therefore to be a quintessential Sydney street… A38.

The above example is, arguably a case of intuition, rather than insight and doesn't appear to be a cold discovery. I asked A38 how often design ideas come to him unexpectedly at times when not designing. His reply suggests that although answers might come to him suddenly, like the above example, they are unlikely likely to be entirely spontaneous, without forethought, or *out-of-the-blue*. In his reply A38 referred to the state of mind early in the morning when the mind is in a "strange state of flux, " when it is easy for your mind to "slip cogs " and which he described as reverie. He continued, describing reverie and his own deliberations.

> … when you're thinking or relaxing… really your mind never stops working on things, … I'm working on things all the time, not deliberately but, you know, you've got things to solve, they're always there… It's not just a question of, "well now I'm going to sit down and I'm going to solve this problem." It's not like [that]… you usually do that at the end, it comes out because you've been thinking about it for such a long time. A38.

I asked A38 if he had a recollection of an idea or revelation coming to him when he was not working and he replied:

> … if I really sat and thought about it, I'd say probably with every job there've been times in those jobs when that's happened, when you're a bit sort of caught up and, and you just need another sort of mindset to shift things around and turn it 'round, but I can't give you any formula's, or I can't give you any instances about it. A38.

Respondent A39 I.Rating: 4.4.1

Male Architect: Commenced practice late 1970s
Current status: Partner with A40 in small practice
Awards: Many RAIA and other awards

A39 is thorough in his investigations of the requirements of a project and works intuitively, trusting his creative process. He observed that years of practice have brought him the ability to work more quickly and efficiently. This appears to have been matched by an increased work load and an imperative to create great architecture, so that his work is always a struggle.

> It's still a struggle and I take it really seriously. I don't ever produce a building that I don't believe in, ever… I don't ever do something for money. And I don't ever think, "oh we'll just get that out of the way and move onto the next one"... There has got to be substance in everything that's done, you know, everything. And I mean real substance, not just superficial substance… There has got to be an explanation and a logic, and an honesty, and a tradition with everything that's done, in different creative ways, but in the magic, in the way of magic, you know? So there's no formula. A39.

Concluding the discussion of his design process A39 made a point that reoccurs through the interview:

> … my key to what I believe to be the best architecture… is knowing when it's right, knowing when it's got enough depth to it that it can proceed all the way to the end, with continual progression, continual flowering, continual personal ambience of the building, continual answering a question… the key, for me, to a great work of architecture is knowing when it's the answer, or when it has the substance of the answer. A39.

INSIGHT EXPERIENCE - HYPOTHESIS 1 SCORE 4

A39 described a recently finished house

> I was working with a colleague… we were struggling with… the south facing site… It was a wet damp site near a creek… visually it was an attractive site, physically it was a disaster… it was almost a site for no occupation… there was one very obvious position on the… one acre site … that was very beautiful and had a big prospect and good connection with forests and nice working scale for a building… but it wasn't where the winter sun was, and we knew if we put the building there, no matter how beautiful… in winter, it would be a cold building… that wouldn't encourage lifestyle. A39.

The solution, which involved elevating the building, providing a jetty to access it, and other measures to bring light into the building, came after re-visiting the site.

> … the jetty stretched out to the sun… the wet ground could always be under the building rather than sitting the building on the ground… [devices] on the roof to catch the light with these big fins and… bounce it into each room. Those… imaginative and creative responses to the decision to go in that direction, start to compile or compose a work of architecture. A39.

A39 emphasised the importance of the site and studying the problem to find a solution.

> … the more you study a problem the more a single answer will solve it, you know? The less you study a problem, in all it's aspects, not just in it's physicality, but in emotions… the more stranded your idea will be, in terms of solving the problem, I believe. And that comes with intuition and skill and time. A39.

Preparation *1*

In the summary above, A39 describes the struggle with a particular problem, a difficult site. He strongly affirms the value of preparation, or studying all aspects of a problem in order to find a single solution. In this case that involved re-visiting the site.

Fixation *1*

It appears that prior to re-visiting the site A39 was fixated on what appeared, at the time, to be the obvious location for the building

Incubation *0*

While it is evident that A39 is a reflective man there are no direct references to incubation in the cold house example or throughout the interview.

I asked A39 if he could remember anything of the thoughts that were going through his mind as the design of the house crystallised?

> The main thought… going through my mind was that unless we (and that usually is the case) … unless we arrive at a building that solves this site and solves their needs, as a family of five, and is comfortable, and is a major work of architecture, then… we're nowhere down the track… We're not solving the problem in our way. A39.

This indicates a strong and persistent motivation to realise great designs but it is not clear evidence that incubation is a part of A39's experience.

Restructuring *1*

Revisiting the site prompted a reconsideration of siting and detail design to reassert environmental comfort goals. This is a restructuring. But, arguably, a more important restructuring was the recognition that the earlier developing design was unable to meet a critical goal of providing a comfortable building that encouraged lifestyle and that the answer could be found at the site..

"Aha!" Factor *1*

I asked A39 how quickly the discovery of a solution to the cold house problem came. In this case "gradually" he said. However one of his best known works, a multi prize winning sporting facility, answers came immediately and this, he added, is typical of his best works. Referring to the sport building:

> it was [a] revelation… As soon as we did [it] I knew that, even though it was an incredibly simple building, it was a new formula for thinking… A lot of people have identified that… a roof that acts physically as well as emotionally on the building… separate modules… repetitive form and self-explanatory structure and all these things… have been done in bits and pieces, but never, never in the same characteristic as [this] building… the actual idea came as a very fluid bit of thinking… and quite often… the great ideas do come in that way… The struggles are always wonderful buildings, but the great buildings are the ones that usually … I can't say it across the board, but usually you don't struggle with them. A39.

In relation to the revelations that lead to a work of architecture A39 added;

> As I said before, you don't know when these things are going to come to you, but what's really important is to identify when they're there. A39.

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2 SCORE 4

Importance *2*

A39 described his discoveries as occurring all the time, night and day.

> All the time. Night and day. I wake up at two o'clock in the morning with a solution. That Paris thing was two o'clock in the morning… I just woke up and there it was. A39.

Cold discoveries are regarded as being of the same value as work based ideas, see Hypothesis 3.

Hotness-Coldness *2*

A39's frequent non-work discoveries appear to take place across a wide range of conditions and circumstances including times when he is not thinking about work.

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3 SCORE 1

All as one: The question of how the non-working time ideas compare with discoveries made while working brought the following response:

> I don't see them as being radically different… I see it all as one... you might think that there's something romantic about coming up with an idea at two in the morning and so on, but it's not, it's just me still working… I don't wake up and go, "I've got it!" I just wake up and say, "Oh right. So that will be like that." You know? And for some reason, and that's the way to do it, that's the smart way to do it… Maybe it's the freedom of no phones and nothing going on that allows me to do that. But equally so, I can sometimes do it in here… it all blurs into one, really, for me. It's not like, you know, that was a good idea and that wasn't, or anything. It all blurs into one. A39.

SUMMARY A39

A39 described instances of two unrelated forms of breakthrough, 1) A clear restructuring, that led him to re-site a building, achieved on re-visiting and re-experiencing the site after acknowledging the current design was inadequate, and 2) An apparent cold discovery, involving sudden realisation of an idea for the roof of a significant public building. While the respondent insists that he works all the time, the latter example and a third report of waking at 2.00 in the morning place A38 in the Insight Level 2 category.

Respondent A29

Female Architect Commenced practice late 1990s
Current status: Leads small near city practice and has won an RAIA residential award.

A29 is youngest architect interviewed in this study and, although she has had early successes, is less self assured than most respondents. However her fears seem to be balanced by a curiosity and excitement at her ability to come up with solutions when they are most needed. She described a breakthrough in the recent design of a house.

> I think I went down to the site and it just come up, like in one afternoon, how the building should be and it sort of … yes just out of nowhere, from being plagued with self doubt, like I was saying, you're thinking that you've got no solution, it's never gonna come and then all of a sudden … I don't know what it is, it's a bizarre thing. I always find it comes in about one afternoon and that's it for the whole … that would be it. A29.

A29 had been working on the project for several weeks before the breakthrough came but was plagued by doubts. Self-doubt in A29 appears to be a form of fixation which must regularly lead to

complications, such as uncertainties about whether a crisis, when she gets stuck, is due to bad design or self doubt. In this case the doubts appear to have been warranted. After a visit to the site A29 realised that her initial design was not feasible and within a few hours had realised a new approach.

A29 described the restructured solution as coming suddenly.

> Just suddenly, yes… I think I went to the site in the morning and by lunchtime I started drawing it… I just started drawing it and realised … it was like the whole thing came out of nowhere, not out of nowhere, but you know what I mean. I sort of worked out that the pool was like that and the living was here and the dining, blah, blah, blah and it just sort of fitted together … and then you spend another month trying to work out how it actually works. But essentially the concept was just … all at once… A29.

The above revelation was not described as the result of cold discovery. However A29 briefly described another realisation which occurred to her while she was at dinner with a mentor. This example also involved realisation of an achievable design approach, rather than particular ideas.

Describing design ideas that came unexpectedly, when not designing A29, referred to solutions, or resolutions:

> Oh all the time. Sometimes in the night… in the middle of the night… or in the morning, I might wake up and have resolved something which had been really bugging me. I don't know... I think I love that part of your brain… Dad used to always say to me, "you're working on it now, just let it go", or "you're already working on it, you'll find the answers", and I would say, "what do you mean? I need the answers now". But then you leave it and you go to the movies, or whatever and then that morning you'll wake up and you're like, "Oh! Actually, how about doing it like this? And it's almost like your brain is already working overtime to resolve a problem. A29.

A29's statements suggest that the first example is reasonably typical of her discoveries in being resolutive. Some can resolve by revealing a missing part, giving completeness to a design. But others, such as the example, involve a clearer understanding, such that both the weaknesses of the old solution and the way forward are revealed at once.

When asked about differences between working and non-work discoveries A29 noted that the first tend to be more relevant to what she is currently doing, whereas she also experiences what she describes as *random* discoveries at any time. What I am sure she meant is not entirely random, but rather *unprompted* or *unrelated* to her current intentional thoughts or actions. These unprompted discoveries are, in all probability, generated internally, so that, like a radio news flash, they cut across whatever she happens to be doing. In A29's words:

> … the only difference, I would see, is that when you're drawing… it's a progression, like you're actually drawing and… the design is evolving… you know you're on the way. Where actually… it's quite a random thing when you're out. I've even been in a conversation with someone and I've just gone, "oh okay." And they're like, "what's wrong?" Oh nothing I've just worked out this window that I've got to do… I find those are weird. When you are actually intently listening to someone else, like some other conversation… and your head's just going, "how about doing the easement over there?" A29.

Respondent A19

Male Architect Commenced practice early 1980s
Current status: Partner with A20, medium/large city practice

A19 left no doubt that he was familiar with insightful discovery experience. One project, a house in Queensland, which he is pleased with now, but which required three months to resolve instead of two weeks, as originally expected, is referred to several times during the interview. No particular discoveries are recalled. But it is clear, from the way it is described and the conclusions A19 draws from it, that the project can be regarded as representative. Early in the interview, when outlining how he goes about conceptual design, A19 described an experience, or as he put it, a point of elation or frustration, where one can be frustrated in spite of having, "all the information on the table."

> … one of the last houses that we did up in Queensland, where I'd been in practice for nearly 20 years and, I'm very pleased with the end result of that house, but I said to the client, I should have this done in two weeks… after having it "all on the table", it took me 3 months to get to the solution, because you just simply draw it and you think this will work and you put it all together and it didn't… I suppose your experience tells you that you just haven't got it, you know, you haven't quite got the thing right. And so

what should have been elation was frustration. A19.

The Restructuring event is described as follows

> … quite often you'll find there's something else you did that you might have rejected. I mean, you might go through that once, twice, 20 times but I guarantee that every time you've done it, if you've done it 20 times it's either something in the first 2 or 3 ideas that will actually then come through at the end and be right, but there's something that's blocking it, something that's not correct. And like the house that I was talking about… something in there was right but something was wrong, I didn't realise what it was until I got down to there. A19.

What can be inferred is that A19 reached a point where he was fluent with the project and, as he puts it, capable of understanding the project all at once and could then see in the earlier solutions, the vital elements that had been overlooked.

Statements A19 makes about his designing, that he is steady rather than fluctuating and his description of becoming totally fluent with a project such that all things are understood at once indicate that individual "aha!" discoveries are neither a significant factor in the example, nor in his designing generally.

5.2.2 Insight Level 2 - Fluency experiences

Respondent A20

Female Architect Commenced practice early 1980s
Current status: Partner with husband A19, in medium/large Sydney practice, joined after previously operating a distinguished small partnership together, winning many RAIA awards over two decades.

A20 described the design of a small house built for a minimum budget, which came together suddenly. Everything needed to be right for the design to work for the budget and still meet the clients' needs, but the early concepts were unsatisfactory. Some time passed between the failed attempts and the successful one, apparently spent doing some filing.

> … we'd been working on all these different concepts and whatever, and none of then jelled, and then just one time I sat down and, sort of went bam, bam, bam, that's it! (laughs) I couldn't believe it. A20.

A20's statements indicate an acceptance that her way of designing involves unnoticed mental activity going on while she is doing other things. She stated that some of her most valued discoveries occurred when she was not working.

> … you'll be out hanging the clothes on the line, or something and ... it strikes you that there's a solution for something and then that just snowballs and pulls everything together, and I find that happens a lot for me… I think I do solve more things when I'm actually drawing. But... some of the best things that hold a project together, that people get most value out of, or [are] most memorable, [come] when I'm not really working on the drawing board. A20.

The two events most strongly associated with discovery are when she is not at work and when she is working accurately, drafting, rather than sketching. Referring to sudden ideas she said:

> … eureka sort of ideas. Yes I do get them when I'm not thinking about work, but I also get them on the drawing board. I never get them, sort of working like, really sketchy sketchy. I really ... when I'm down to, you know, fine pencil and working on things, that's when those sort-of things come to you. A20.

Ideas come to A20 in many different settings. One point of interest is that A20 makes little or no mention of her discoveries being prompted or cued by externalities, apart from drawing. This could indicate that her cold discoveries are mostly generated internally. They cut across whatever she happens to be doing, typically during mundane domestic or office activities and perhaps during non-mundane activities too.

Although A20 described getting some of her most memorable ideas when not thinking about work, she is classed as Insightful Level 2 because she also describes her working and not working discoveries as Interchangeable.

5.2.3 Insight Level 2 - Recognition experiences

Respondent P4 **I.Rating: 4.3.1**

Male Architect. Commenced practice: early 1970s
Current status: Partner in medium size mid-city architectural and planning practice that has won many RAIA awards

INSIGHT EXPERIENCE - HYPOTHESIS 1 SCORE 4

P4 described two insightful discoveries and referred to a preparation approach that may also be regarded as a fixation management technique. A) Occurred during conceptual planning of a development site, to relocate one level of underground carpark to a deck level above the retail (like the Double Bay Cosmopolitan) with a veneer of residential at front, instead of digging a second basement level. This significantly reduced the cost of parking. B) Involved a regional planning study of a proposed freeway. While drawing up a relationships map, P4 realised that far from being an intrusion or a barrier this object, with cycle ways along both sides and frequent openings through it, was actually like a zip, knitting the neighbourhood together. It could be a safer and more effective access way (eg. for children) than what was there before. The study then fell into place around this different model.

Preparation *1*

P4 disclosed that typically when starting conceptual design he makes a point of developing three *fishing solutions*, which he states is aimed at *getting to the nub* of a problem. Both projects referred to had been the subject of extensive preparation.

Fixation *1*

P4: did not directly refer to fixation. However, in the process of describing two insightful discoveries he also referred to what may be regarded as fixation management techniques: P4's *fishing solution* approach could help to minimise fixation. Casting the multiple alternatives as rejectable, exploratory models, with the focus on finding the *nub,* may also increase his preparedness for new options, more than would a more intentional effort.

A technique P4 described, of shifting focus, by 'stepping back and abstracting', often combined with sketching could also be regarded as a way of prompting a fresh view of the current task.

Incubation *0*

Both of the unexpected discoveries could have been consistent with an incubation process. However this is not stated and P3 does not refer to incubation when describing his designing.

Restructuring *1*

The idea for A involved the analogy of the Double Bay Cosmopolitan Centre:

> …just happened late one night when I was going through version 49 of this thing and still couldn't make any money out of it....but that was just recognising another model... I drive past that model every morning. P4.

The idea for B involving a reinterpretation of the goal, came while drawing up mud maps for the report:

> I suddenly realised, as I looked at the mud map, that the thing wasn't a wall...It was quite sudden, absolutely sudden. P4.

"Aha!" Factor *1*

Both A and B involved sudden recognition. A)The analogy of the Cosmopolitan retail centre, and B) That a freeway could be designed to facilitate different kinds of movement.

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2 SCORE 3

Importance *2*

P4 stated that he completely relies on ideas just coming to him. This tends to occur in the work setting, but not necessarily when he is working.

P4s method of conceptual design is to approach designs indirectly, by playing around with the components. In that playing a pattern is seen. P04 adds that such a pattern; 'absolutely doesn't come

before the problem' and it comes while the ingredients are in play, not afterwards.; 'the material has to be there.' In the interview P4 observed the contrast between himself, needing to externalise his thoughts and P3 whose visualising skill and memory enables her to generate solutions at all times, without externalising.

Frequency: Many of P4s best ideas are generated by his indirect method.

Value: The indirect approach is fundamental to P4s designing.

Hotness-Coldness *1*

P4's experience (like P1) suggests another class of discovery that is neither hot nor cold, based on a level of detached involvement and degree of immersion in the materials of the situation, without necessarily working.

Proximity to hot time - Breakthroughs tend to occur after 'stepping back and abstracting.'

Nature of cold time - Breakthroughs rarely, if ever, occur when P4 is completely removed from a project. They occur when the ingredients are "in play," or when "the material is there." P4 appears to need the stimulus, or familiarity of seeing his sketches or notes, being at one of his regular places of work, or having his sketchbook and pen.

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3 SCORE 1

Not discussed

5.2.4 Insight Level 2 - idea experiences

Respondent A03

Female Architect: Commenced practice late 1980s
Current status: Leads small near city practice
Awards: RAIA Regional Blackett

In general, A03 attempts to approach each design afresh. An important part of A03's designing is developing methods of passive environmental technology that utilise opportunities without ruling the design.

> I don't bring a predetermined way of achieving a solution to each design… I like to be informed by the client, the site, the program and for that to evolve… in a sustainable way that works…. to get quite strongly into the brief and what it is the client is trying to achieve by the brief - physically, but also the feel of what they want from that place… A03.

A03 described a *cold* discovery when designing a northern beaches house.

> … it was a curved plan, well it was kind of curved, with an arced thing... I had an idea and I was mucking around with it and I am pretty sure that I was swimming one day when I… came up with this notion of capturing the north easterly breezes and the curved way of dealing with how to get the courtyard... because I had some different linear things and then finally this idea kind of evolved. A03.

A03 confirmed dissatisfaction with earlier solutions, going for a swim then walking, then thinking "Ha!" and then implementing a solution. That this was no isolated incident can be judged from her affirmation of an incubation-like facility.

> I just believe that your mind is a very powerful instrument and you've got to feed it well and then you've got to let it think things through on its own and if you do that, then suddenly things will emerge that answer, sort of, problems. A03.

Referring to cold discoveries generally, A32 described their frequency as "a fair amount" and explained that her professional life involves a lot of meetings and travel, as well as designing and:

> … often it's doing those things that certain ideas will come up, but at the same time I think, because I do let my mind percolate with ideas... and I am at these other things, that when I do sit down to design, I can bring to bear a lot of... that percolation, I suppose, to bring something out ... A03.

This explanation reveals that the *percolation* process can lead to discoveries while working or not working. This is a likely reason why A03 makes no distinction between hot and cold discoveries, and

instead associates the properties of discoveries with other factors, such as gestation time, the nature of the problem and other problems that might be on her mind at the same time.

Respondent A25

Female Architect: Commenced practice early 1990s
Current status: Partner, small practice

A25 described how her work has changed from a rectilinear Miesian approach to greater emphasis on spatial quality and using the space as plastic form to be sculpted. She described a breakthrough that occurred when designing a warehouse-to-showroom conversion.

> It's… just a plain warehouse and it was, "how do you make this incredibly plain… space become exciting and interesting?" And it was sort of, like, working and working and working and then it was just simply having the idea of creating a tall, two storey volume and taking all the roof sheeting off the existing building and putting in a skylight. A25.

An early morning "Aha!" led to the complete breakthrough.

> … with this project, it was like, you know, 3 o'clock in the morning, I thought, "Oh we could do this". Got up, went and drew it and that was the initiation... it ended up being quite different, but it started the whole thing going. A25.

Two different patterns of cold discovery were discernable:

- Externally cued - eg. Things seen, when driving, that might solve a current problem, or can be kept for future reference.
- Internally cued or generated - eg. Cognitive activity after a design session, or earlier intentional problem solving, continuing after going to bed, before falling asleep.

No particular qualitative distinctions, between hot and cold discoveries, were made by A25.

Respondent A02

Male Architect Commenced practice: mid 1970s
Current status: Sole practitioner

A02 combines two different sets of attributes, professional architect-builder and artist and these are associated with his city office and a beach house a few hours drive from the city. Neither place is dedicated to one role, but clearly the city office is more the place of professional practice and communications and the beach house is more closely associated with A02's more creative and artistic side.

A02 described a breakthrough in his method of presenting the design of a house in an attractive rural setting.

> [I] did a painting of part of a garden wall, which I was going to have jutting out into the landscape and I actually painted the wall on an oil painting and then that's how I sold the design to them, in terms of a feeling, rather than a set of plans almost, so that was… narrowing it ... it's very much… textures and colours that excite me. A02.

Part of the significance of this discovery is that it was more likely to occur while at A02's beach house, which is a place of painting. The preparation took place in both locations, in town, where production of the design lacked the *piece de resistance* and then the beach house where, it appears, one painting led to another. It is not clear that the painting example was a sudden, or "aha!" discovery.

When asked how often ideas come when not designing, A02 replied:

> Very much so! That's when most of my design ideas come, when I am actually not concentrating on that project… when I'm driving my car, that's when I have a lot of design ideas, because it's such *white noise,* to drive a car, especially on the freeway. A02.

A02 described the usefulness of his south coast beach house and use of multiple notebooks, to capture ideas that come while not concentrating on projects. When asked if he owed any significant ideas to those things, A02 replied:

> Oh, very much so! It's a very quiet time... it's a very peaceful place to be. I try to work down there a day during the week, if I can… it's a really good place to do design. A02.

A second aspect of value, associated with the passage of time, is evident in the following reply to a question I asked about breakthroughs:

> … it's really, in terms of sketches you've done, or ideas you've had. I tend to know if they're the right idea or not, only after, sort of, not actually looking at them… thinking about them, the way they feel, when I'm say in the car, on the beach or whatever, and then I'll go back look at it and say; "well yeah, that's totally wrong," and do it a totally different way. I tend to know what it feels like if they're right or wrong, I suppose. A02.

A02's statement that he tries to get to his beach house, to work during the week, suggest that some discoveries he makes there are better characterised as in-between hot and cold. However A02s statement of how he is better able to evaluate or decide matters after getting away from his work suggests that a definite form of cold discovery experience is associated with the total experience of time away from the office. The driving is also a valued part of that experience.

Respondent A14

Male Architect: Commenced practice mid 1950s
Current status: Leads small near city practice

The oldest respondent and one of Sydney's best known architects, A14 maintains an active practice in which he continues to innovate, with the assistance of two young graduates.

As many of his projects have been and continue to be, individual houses, he has developed expertise in various aspects of domestic building, such as the combined use of different materials and forms. These include the use of timber and glazing, roof forms and means of day lighting and providing cross ventilation, which can be studied as themes in his work.

A14's designing is the outcome of both practical and intuitive components.

A. the practical:

> I suppose I'm practical, I try to work with the cost of the thing… I try to always get a very detailed survey first… I work with reality… I like to know what's there… rather than throwing my arms around saying "we'll do this!" A14.

B. the intuitive:

> I'm not even sure how I design… designing from the inside out, I tend to do that. Of course I do take notice of what the outside's going to look like as well... I also tend to draw my way around things… I'm not one of those architects [who] gets the whole thing in his mind and then suddenly puts it on paper, I guess I work around things. A14.

A14 described a recent incident where he thought of building a bridge for a project involving an addition to one of his earlier houses. The bridge enables the new work to be free-standing but still spatially linked to the older building, in spite of a driveway which divides the land into three separate "sites." A14 had spent a day or more on the project (preparation) when he was asked to come to the site. He knew of the siting problem and the solution came to him while he was at the site, or soon after. A14.

It is likely he was fixated on the earlier inferior siting, until being in the 3 dimensionality of the site enabled him to recognise that bridging the driveway was a plausible option. While the combination of preparation and seeing the site may have been sufficient to prompt the bridge discovery, without incubation necessarily contributing, late in the interview A14 does refer to unconscious workings:

> If the problem's unsolved it doesn't disturb me. I do tend to think, well, you know, "I'm going to rely on fixing that tomorrow." And often I do, yes. So I guess it's unconsciously working away… rather than consciously trying to beat it out of you, you know? A14.

A14 affirmed that design ideas come to him unexpectedly 'quite often, and often in the shower', when not designing. He also indicated that he is not in the habit of consciously thinking about designs once he leaves the office, which suggests that his after hours discoveries are genuinely *cold*. He valued them as another source, but did not distinguish cold discoveries from hot discoveries.

Respondent A32

Male Architect: Commenced practice early 1980s
Current status: Partner, small near city practice
Awards: RAIA Housing Commendation

A32 described the conceptual realisation of a townhouse development on a site east of the city. In this case the breakthrough came after recognising a layout feature of other buildings in the street could, with a substantial reorientation, be applied to the subject site.

> This one was incredibly difficult… no views, very tight sort of urban situation and we had the council briefing us that they wanted a street wall building to continue what [other architects] had done a couple of doors down… one block on the street and… a secondary block in behind, with some sort of courtyard between… I spent an enormous amount of time trying to work out how on earth I could fit the right number of apartments and get them all to be north facing and to be naturally ventilated… and what I did was [I] looked at the… Victorian terrace houses very closely on the other side of the street. And where they were going around the curve, the Victorian terrace house builders had simply got exactly the same house plan and instead of butting them hard up to each other and just continue on, they were slipped a little bit and the next one was slipped a little bit more, so that you eventually got a curve, but nothing changed… so what I did was… angle all of the apartments…and they were each slipped on each other but didn't go around a curve, just formed a staggered sort of serrated profile [enabling] every one… to be north facing. A32.

It is not entirely clear from A32's descriptions that the discovery in this instance was necessarily a cold one, but A32 affirmed that discoveries when not designing were frequent and both externally and internally cued.

> It happens all the time. It's like you'll be driving down the road and… half the time I won't even know I'm thinking about a problem, but suddenly the answer will pop into my head… I may walk past something and see a detail. I saw one the other day and I don't really know what it was, but I walked past something and I instantly saw the answer to a problem I'd been mulling over for a long time. And it was totally different to what I was looking at… but whatever it was, I was looking at, just triggered… the answer for me… because we've got probably about 30 different projects on the go at any one time, my head's full of all of them and so I'm not working in any logical sequence. I'm not focusing on the latest project… it might be some other project and an idea might just come to me and I didn't even know that really needed to have an answer for, but certainly it will come and I'll go and be able to talk it through with the project architect… it just happens like that. A32.

Respondent A09

Male Architect: Commenced practice late 1980s
Current status: Partner, small near city practice

A09 described how his view of designing had developed, from an earlier structured way of working, based on a functional response to the client brief and the use of grids and geometric forms, to recognising a greater need for an underlying guiding philosophy. His aim is to be people friendly, to be more connected to everyday people, to accommodate their way of living. This approach stems from an earlier observation that occupants do not live in a house the way one might imagine. When starting a design he likes using words rather than images. He likes to pin everything up together, so that he can see it all at once and bombard his mind with lots of triggers or stimuli, before doing any sketches.

Two discoveries were described by A09. The first involved decisions about openings and the openness of the building spaces in a house, and the second was a discovery he made about his way of communicating with clients. The second example appears to have been the more insightful, mainly because of some haziness in A09s recollections of the first discovery. While neither appear to have been classic, "Aha!" discoveries, other indicators of insight driven design were present. A09 affirmed the importance of preparation in relation to discovery, stating:

> I might have a revelation, in terms of how to solve a particular thing, but only because it's been something that I've been working on, you know, recently. A09.

When asked about ideas coming unexpectedly when not designing A09 makes a relevant statement:

> I think, when you have a problem, it's sub-consciously. I still have that problem in my mind. A09.

In a statement in which he associates swimming, or riding his bike with his creative work, A09 makes it clear that *cold* discovery, primed by analysis and discussions with his colleagues, is a significant factor

in his designing. One reason why he relies on cold discoveries, is that he finds it difficult to do his creative work in the office.

> The stuff that happens in the office is a lot of the manual sort of things, of actually having pretty much an idea of what you're doing and then it's a case of actually just developing it, or if it's other sort of work, like it's project management type work, then that sort of stuff can be done within the office. The more creative stuff, I find it, yes, it does occur outside the office… generally when I'm working on things it's always on my mind so … where I'm actually doing it is not really that relevant, because I'd probably be thinking about it all the time any way. A09.

As with some other respondents, (eg. P3 and A32) distinctions A09 makes between work as a place and work as an activity, and the resulting levels of thinking intensity, are sometimes unclear. This suggests that levels of coldness may be a suitable object of future study.

Comments A09 makes about discoveries include little to support the comparative evaluation of *cold* and *hot* discovery or Hypothesis 3.

Respondent A37

Female Architect: Commenced practice early 1990s
Current status: Designer small city practice

A37 acknowledged getting stuck and breaking through in all her work. The project she described, a current one, involved conversion of a building in a densely built up city location into a residence. A significant aspect of the project, and the subject of the breakthrough, involved the provision of large openings in the roof. :

> … exploring how to develop… ideas of privacy and secrecy and then also how you get light into the interior… there was a bit of a breakthrough when I understood the notion of the roof and aperture and cutting and that kind of led to a whole lot of other things. A37.

Two types of restructuring are evident in A37's description. 1) Realising the roof was the logical place to think about lighting the centre of the building and 2) Realising this required significant rethinking about roof structure, in a building with limited structural options.

When asked how often design ideas come unexpectedly, when not designing, A37 replied.

> Like often, but they're not a clear thought, it's like, it's just something I'll associate. Like that water image. You know I thought of water ballet, and then I thought, what the hell's that got to do with the project you know, and then, when I sat down and I went, swimming pool, water, building, hmm, and you know, stage, and I made the associations. And the next minute there was like a … A37.

A37 describes her cold discoveries as not clear thoughts, but rather something she will associate. It is clear that these associations are often useful and find their way into her work, typically by first being represented on her Project board. These discoveries are clearly valued by A37, but because of their informally associated nature it is not entirely accurate to describe them as insightful. However as A37 shows many indications of being an insightful designer it is probable that the cold discoveries, even if not insightful, actually facilitate, or prompt insights.

Respondent A36

Female Architect: Commenced practice mid 1980s
Current status: Designer large city practice

A36 described two breakthroughs that were inconclusive for the purposes of this study. The recounting of a third example, during the design of two international water sports venues was more informative. Conceptual design of the centre design was well advanced, but there were problems reconciling the specific requirements of the separate entry approach

> … we had two venues side by side and we were trying to give them each their own entry and we decided that actually we'd share them. So that was like just looking at it from a different way. A36.

This initiative, involving a reinterpretation of goals was first proposed by A36 and has later adopted by the clients.

> I was just scribbling on paper, probably yellow trace, trying to solve one problem… put down the basic important things, forget about all the peripheral and step back from the detail, go back to the bigger picture and then also say, 'what's wrong with having a common you know.' Like, stop assuming that all the requirements that you put on to this design were actually necessary. A36.

No direct statement, of frequency of cold discoveries, was made by A36. However cold discoveries were frequent enough to be useful as is evident in the following statement:

> Just before I go to sleep… one thing I quite like to do is, if I've drawn a plan… I actually like to just take it home and just stare at, look at it. I mean not look at it for any particular reason, just look at it, and I'll often put it beside my bed and just as I'm going to sleep I'll just look at it and sometimes things come to me then, or the next morning or that… yes I will just contemplate a design. A36.

When asked how the unexpected, non working ideas compare with discoveries made while working, A36 replied that they are similar.

Respondent A06

Male Architect: Commenced practice mid 1980s
Current status: Leads small near city practice

A06 recalled a breakthrough where it became necessary to re-think and abandon earlier design details for part of a recent house… The change involved a glazed ceiling over a central corridor. A06 became very concerned about heat gain problems in summer. Various options were considered but:

> In the end that whole process ended up with me abandoning the glass roof and the space was turned into a dramatic space in a different way, it's been lifted up as a high roof running the length of this corridor, with the window at the end… In summer there [are] overhangs and things to cut out the summer sun and the heat and you still get to look at the trees and the sky, but in a very different way. A06.

Several options were tried before the eventual solution, drawing on ideas from other projects of A06, was devised. Descriptions of the resolution suggest the process was relatively methodical and involved incremental steps.

Cold discoveries appear to be of moderate importance to A06. He is familiar with the experience of ideas coming to him when not working.

> They always come to me unexpectedly when I am not designing. I find that it's when you stop thinking about a problem that you are most likely to come to some understanding of how to resolve it. A06.

These experiences are sufficiently frequent and valuable for him to adopt behaviours to induce them. When asked about his reliance on ideas just coming to him A06 said:

> In a sense always and never… yes, you… do expect them to come, but you also know that you've got to do something for that to happen… I stimulate myself, or do something, or think about a problem to generate those ideas, but then also I'm expecting those ideas to come, rather than not come. A06.

There was insufficient information to assess A06 in relation to Hypothesis 3…

5.3 COLD DISCOVERY INSIGHTFULNESS HYPOTHESIS 3

The third hypothesis, that cold discoveries are more likely to show signs of being insightful than hot discoveries, made during active design sessions, was affirmed by a little over one quarter of the respondents. (12/45) These respondents distinguished cold discoveries from hot using terms that are associated with insight, such as, *stronger*, *potent* and *innovative*, and those that come while working, as *more controlled*, *practical* and *predictable*.

The following respondents made statements that support Hypothesis 3.

Insight Level 3 respondents - 10 total							
		RAIA award winners			Other respondents		
		ID	Rating	Comment	ID	Rating	Comment
	Fem.=red	A40	5.4.3	Clarity experiences.	A05	5.4.3	Clarity experiences.
		A23	4.4.3	Clarity experience.			
					P2	5.4.3	Recognition - Sudden
		A13	5.3.3	Idea experiences	A07	4.4.3	Idea experience
	Male=blue	A04	2.3.3	Ideas experiences.	A16	4.4.3	Idea experience
					A31	4.4.3	Idea experiences
					A33	3.4.3	Idea experiences

Fig. 5.3-L3 Respondent Discovery experiences by categories - Level 3 Respondents

As before, respondents are grouped to show RAIA award winners separately and to reflect different qualitative experiences. In the description that follows they are ordered according to their qualitative experience as described in the Comment column. A sudden recognition discovery by one respondent (P2) is described in detail. The key experiences of other Level 3 respondents are in summarised form.

5.3.1 Insight Level 3 - Clarity experiences

Respondent A23

Female Architect: Commenced practice early 1990s
Current status: Partner, small near city practice

At first A23 was unable to think of a particular example but then recalled the competition entry for amenities blocks that her partner A22 described in an earlier interview. Her descriptions of the problem and events that led to solution are, mostly the same as A22's, although her recollection places more weight on the realisation of the problem than on the development of a solution.

> … it was a realisation and we'd both come to it within 24 hours and just hadn't had time to discuss it until we got home on that Friday evening, And we both agreed that if we didn't… change the elements, that we felt were really not working [it was] dead in the water… But actually realizing there was a problem was probably more important. A23.

I asked if that was the insight and A23 replied:

> Exactly. Yes. Knowing what's wrong with something is as important as knowing what to do. A23.

A23's statement, when asked how often design ideas come unexpectedly, at times when not designing, suggests she has frequent experiences of minor revelations when not designing, but that she does not expect big ideas to emerge in that manner.

> Oh, quite often. It might not so much be ideas like... its not like a light bulb comes on in your head or anything… a lot of the projects we do are kind of large and complex, so they're not resolved by one single idea… A23.

However when I asked how these ideas compare, with discoveries she might have when working, there was a shift to bring out an important point, that the non-work experience is characterised less by the production of ideas, or specific design moves (ie. light bulb experiences) and more by development of clarity of thinking, understanding or revelation.

> Well, I think a lot of ideas, or clarity of thinking, probably comes when you're not actively trying to make it come. I think it comes when you're kind of relaxed, basically. A23.

I noticed the term clarity and asked about that. This led to the following reply which associates the clarity discovery with critique:

> I think it's more insight, less ideas, more insight. I mean if we've got a deadline we'll produce something, within that deadline, which is based on our skill and experience and our repertoire of, you know, stuff that we've done. But I suppose, when you look at something and you know its kind of lacking something, its not quite working in some particular area or aspect, that gets down to your ability to critique. Quite often the solution, all the way forward through that, might come when you're not sitting in the office, or when you're doing something else in the office, that's unrelated to that, or at home and then I'll write myself a note, to try something or do something. But I think a lot of, kind of, design is less ideas, its more insight and critique than, you know, "Eureka!, I've got the solution". A23.

Respondent A40

Female Landscape Architect: Commenced practice mid 1980s
Current status: Partner with A39 in small practice
Multiple RAIA and other awards with partner

A40 described two instances in detail, one for a major sport facility and the other for a domestic scale project. The sport facility project was critically affected by its location over part of a large contaminated landfill site. In spite of some conspicuously unsuccessful attempts to grow trees around the site the client insisted, they wanted trees for their facility. As A40 puts it:

> I kept on saying, "look the trees are going to die". "Oh, but you're a Landscape Architect, you've gotta make…" And I said, "no, they're going to die"… sheer frustration and… I came away from this meeting and I (wondered?)… and it just came to me like that, "if they want trees they can, then they're going to die, I'll give them dead trees to start with, "electricity poles, you know, all the recycled electricity poles. So we made a forest out of electricity poles. And it just, I don't know, it just suddenly came to me and I thought, "YES! That's what we'll do.(laughs) And so we did this, sort of, sculpture of all these electricity poles and gave them trees, but they were dead. A40.

A40 declared that most of her design ideas came to her when she was not working, suggesting this may be forced on her because she has so much to do, but also adding..

> I don't find that by sitting there trying to, sort of, grind it out really works, 'cause I don't think you end up with a good solution that way. A40.

A40 didn't make a direct comparison of the relative insightfulness of cold discoveries and hot discoveries but the general conclusion of statements she made about her way of working and of discovery is that *hot* discoveries are both, less frequent and less insightful than *cold* .

Respondent A05

Female Architect: Commenced practice: Mid 1980s
Current status: Partner with A18 in small near city practice.
Has won a National, Timber Housing Award.

A05 described a project from her student years, where crucial ideas for the design of a scout hall came to her when she was asleep, or almost asleep, in what she described as being like a meditative state.

> I had the project working, but there wasn't that real enrichment of it, and then I just dreamt about forts, because it was a scout hall… forts and then this whole quite interesting journey through buildings… then I remembered in the morning thinking; 'ah that's what can be'. A05.

Reference was also made to a more recent project, houses, currently under construction east of the City, where significant improvements to the design were realised and implemented after development approval (DA) had been obtained. Again A05 had reservations about the design. She referred to an unwillingness to become rigid about a design even when it has been accepted.

> if you're open to it you just keep looking at it ... I mean you can… say; 'well that's it. That's all. I'm not looking at it again, but I think what we do is we're always looking, looking, looking; 'is it right, is it right, is it right?' You know. So I think if you're asking that question, then it's going to come to you. A05.

An incubation-like process was alluded to in A05's description of the suddenness of the revelation.

> Suddenly. It was like, there. Yes. I think they do come suddenly. I mean, I think they're, maybe subconsciously, they're kind of there forming and then, all of a sudden, it comes into the conscious realm. It's like when you are understanding about yourself, you know, you are kind of aware of certain things and all of a sudden it comes into the conscious and [you] think; 'oh, that's it,' or 'oh I see, that's what it is, or that's where it is'. A05.

When I asked if her discoveries were not so much solutions to problems as new understandings, A05 replied:

> I think a lot of the work is that. Like a new understanding, you know. Yeah, it's not like someone says; 'this is the problem and, what's your solution? It's like you have to know what question to ask, you know? No one's asking you the question. You have to know yourself what question to ask. Yeah, that is the difference. And you can not-ask yourself. It's easy not to ask yourself a question… But if you're kind of, you know, tenacious and want to make life difficult for yourself, you can keep asking. A05.

A05 is clearly a strongly motivated and emotionally intense individual who needs to calm herself. She described her cold discoveries as often occurring while she is engaged in activities. This appears to be valuable professionally, emotionally and physically.

> Often it's not when you design, it's when you are in the shower ... actually I do a lot of thinking in the shower... all that running water I find very good... it's the calming... I think it takes the pressure off, because you're not actually sitting at a board designing... you're actually having a shower or having a walk or going to sleep, you know. You're doing things... I am one of those people that has to exercise, so that's an important thing to me ... probably a calming thing for me. A05.

When we discussed how these ideas, at the non-working times, compare with ideas that occur on the job, A05 made the following observations:

> I don't even know if… you really get the strong ideas at the board. I don't think it happens that way… You know you are sitting in an office the phones are ringing. It's just not that kind of a space. I think for me I have to be quite alone, in quite a solitary place… I just say they're more in that realm, almost in an unconscious realm, I suppose that's the pattern… Almost like a meditative… I think too when I go to a client's house for the first time I almost go into a ... not a trance because that sounds bizarre, but it's almost like... you go to a different plane... Its almost like a focus. I mean you say trance, because its a word, but it's not ... you're not really in a trance. A05.

5.3.2 Insight Level 3 - Recognition experiences

Respondent P2

Female Graphic Designer: Commenced practice early 1970s
Current status: Partner in small practice with P1: Teaches graphic design part-time at a Sydney college.

P2 views herself as designer-maker. Her liking for both the Bauhaus and William Morris signifies her interest in both the physical and mental aspects of graphic design and her view that quality of conception and craft are both critical to good design..

> For me design that is well conceived, but badly crafted hasn't made it. It isn't good design and, by the same token, if something's beautifully crafted, but badly conceived, it's not good design. P2.

P2 provided several indications of insightful designing including a classic insight discovery and statements about her work that indicate insightful thinking. For example she stated that she was familiar with ideas coming in *chunks* and of *getting stuck*, by what she referred to as the *brick wall stage*. P2 also expressed a belief in a valuable unconscious incubating process.

INSIGHT EXPERIENCE - HYPOTHESIS 1

P2 recalled her recent struggle to develop a driving idea for her Masters thesis about the end of the Print Era.

> With my thesis, I've been struggling for a long time, trying to decide exactly how I wanted to approach this thing. I think that thesis and research development is very like designing. It's another form of design. I think the processes are similar. P2.

Preparation

P2 spent months resolving the fundamental idea of her study.

Fixation

Earlier in the interview P2 refers to the "brick wall" stage when stuck:

> I call that my brick wall state. That's when I start to really struggle with it. And I start pushing it and, trying it, and trying various solutions to the concept and the brick wall is when I always hit a point where I think it's not going to work. P2.

In the thesis example there was a sticking point.

> … what I was trying to do was come up with an argument about what I was doing. I was trying to say, "Well, I believe this and then I've got to prove it, by knocking out all these arguments against "The End of Print", lets say… What I really wanted to do was not to argue for or against this, but… [show] where this sort of thing had happened before. P2.

A key point P2 makes about the revelation that ended this quandary (see Restructuring below) is that her brick wall state could not have been resolved, in the way it was, by any rational process.

Incubation

Several statements by P2 affirm her incubation experiences.

> For me, the breakthrough is usually through distance, like actually going away. I believe there is an incubating process. I think there is a subconscious process that is very valuable, which is moving away from it, and going and doing something totally different. Walk around the block, wash the clothes, have a coffee with someone, see a movie, whatever. P2.

In this example the incubation may be associated with development of a state of mental preparation and alertness that will induce P2 to respond to otherwise trivial cues, such as a reference by Edward de Bono, to parallel thinking.

Restructuring

The reported discovery, involving analogical transfer, occurred as follows.

> I wanted to get it right down to what it is that I am actually trying to do, and I was looking through (nothing to do with the thesis) but looking through my books, organising my books… into stacks ... I came across another de Bono book called Parallel Thinking... I bought it years ago… And I started reading…something he said about parallel thinking and design… that we tend to argue or look for the truth in things by having adversarial arguments. It's the Socratean type of approach to solving problems.
>
> I ended up deciding that instead of just, sort of, dealing with the end of print, because the computer's come along, you know, "what happens with books?" [I would] look at where this had happened before. And where it had happened before was with illuminated manuscripts... [Once there] was a huge industry, of designing and making these incredible books. And along came the printing press. P2.

"Aha!" Factor

> And there was this wonderful contrast of the two, for me…Now that just came out of stacking some books. I would never have just come to that. How would I have come to that through some sort of logical

> process? I wouldn't have… So I feel that… design involves accidents, serendipity, chance and it requires a state of the mind that will do that. You know, you've… got to be able to risk and trust and be illogical. You've got to be non-logical, non-linear… So I think that the brick wall thing is part of that. I think it's chance. It's accident… For me that's discovery. I came across that. I was not looking for that... You're not saying, "I am going to stack these books because they will give me the answer." It just seems to click. P2.

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2

P2 describes ideas coming at the times she associates with reverie, such as driving, in the shower, watering the garden, times where you have a legitimate space to think and daydream. She says:

> … at school that was the one thing you were always getting told-off about. 'Stop daydreaming!' And yet daydreaming is designing. So's reverie… those periods of time when you get a space, that is legitimate... Watering the garden. You are doing something. 'Can't you see? I am watering the garden.' But you're actually not. Your mind is floating off and you are thinking about designing, or what you are going to do, or whatever the problem is. P2.

Importance

Frequency - In the initial P1 to P5 interviews respondents were not asked how often ideas come to them when they are not working. Frequency assessment therefore is reliant on clues. P2 described her ideas as coming at the times she associates with everyday routine experiences of reverie, such as driving, in the shower, watering the garden. This suggests that these experiences are frequent.

Value - P2 associates breakthroughs with getting away from a job and describes the incubation process as very valuable

> I always find that it happens after you have walked away from a job. I think that for me, the breakthrough will always come. It won't come by working at it… For me, the breakthrough is usually through distance, like actually going away. I believe there is an incubating process. I think there is a subconscious process that is very valuable, which is moving away from it, and going and doing something totally different. P2.

Hotness-Coldness

Proximity to *hot* time - It is not clear how recently P2 had been working on her thesis prior to the discovery, but the breakthrough came when she was doing an unrelated task, which is consistent with her other more general statements.

Nature of *cold* time - In the given example the discovery occurred while P2 was stacking books and not intentionally thinking about her thesis.

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3

P2 expressed a clear and positive view that *cold* discoveries, or ideas that come from out of the blue, tend to be more potent and innovative, while those that come while working are more controlled, connected, practical and predictable.

SUMMARY A21

P2 presents the indications of Insight level 3. Her cold discoveries are, 1) frequent and may be either internally cued, eg. during times of reverie and externally cued, as in the example of the thesis on books and, 2) are regarded as more insightful, in the sense of being more potent and innovative than her hot discoveries.

5.3.3 Insight Level 3 - Idea experiences

Respondent A13

Female Architect: Commenced practice early 1970s
Current status: Leads small near city practice. RAIA Awards: 1970s, 2005

A13 described an idea which transformed the design of a house she is currently working on.

> I don't normally do anything with any curved form... but my client wanted views from every single room and I just suddenly got the idea of having this radii point, radius and centering around it... And it just worked. I mean it was just suddenly... it was there. It had been going that way, but it was determined by other forms… and whatever, and it just would never work. And then suddenly it just seemed so

obvious… it totally fitted in with the landscape… A13.

The genesis of the curved form was not fully described. The discovery may have come while the respondent was designing. However when asked about ideas coming up, when not at her drawing board A13 responded:

I think I do it all the time actually… I can't remember a specific incident but I know I'm always mentally thinking about something, when you're walking, or just sitting… But it's more than when you're just sitting. It's funny, because you're absorbed in something else and somehow that frees... I mentioned walking, I mean, swimming and gardening because you're doing something else, but somehow unexpectedly you think of it and things occur to you. A13.

Respondent A07

Male Architect: Commenced practice: mid 1990s.
Current status: Senior architect in large city practice

An experience when working with the Renzo Piano Building Workshop in Genoa, Italy, a few years prior to the interview, involved a significant discovery for A07. The project was an extension to a major museum in the USA. In this instance the discovery concerned the means of attaching the new work to the existing building, designed by another very prominent architect. A strategy in the form of a metaphorical idea had been proposed by Renzo Piano, but after more than seventy options had been proposed no one had produced an entirely convincing idea. A07 was given an opportunity to try, in direct collaboration with the Master. Later, after making many attempts, A07 was walking among the olive trees in the Design Workshop garden when he thought of a viable concept.

… the solution… came from that process, just sitting down, walking around, thinking about … sort of imagining the 3 dimensionality of the problem. A07.

A07 makes no explicit mention of incubation or subconscious processes in relation to this example, but is clearly accustomed to design ideas coming to him when he is not designing. In addition he made a clear distinction between discoveries that came after preparation (ie. that he had been thinking about before) and those that he had not been thinking about. I asked if he could recall the extent to which unexpected, unplanned ideas that came to him might be the outcome of work done before, or alternately, just ideas out of left field. He replied:

Bits of both, really. I find that things which I've partially resolved, or resolved in other ways before, I find I come to a lot more easily than things I haven't thought about before and it's often things that I haven't thought about before that I actually need to go for the walk. Do the yards. (laughs) A07.

A07 strongly affirmed the frequency of cold discoveries.

They always come to me unexpectedly, when I am not designing. I find that it's when you stop thinking about a problem that you are most likely to come to some understanding of how to resolve it. It comes again with taking yourself out of the familiar. Putting yourself into a place, where you have never been, I think you can be more creative in that place. A07.

Reliance on discovery was clearly articulated by A07, when asked about the extent that he relies upon ideas just coming to him:

Always, even in the most mundane tasks. Always looking for a different way of resolving it, or a better way. Always thinking about, even just simple detailing problems, from first principles. A07.

A07 also described *cold* discoveries as more resolvable

… in the initial sense there's not that much difference, but by the time I get an idea that I've come up with, whilst I've been out walking, or something, down onto a piece of paper, I find that it's a lot more resolved, or a lot more resolvable than the ideas that I've been struggling with at my desk. A07.

Respondent A16

Male Architect: Commenced practice early 1990s
Current status: Partner small near city practice

A16 works closely with his partner A15 and referred to the same discovery that she described as being typical. This was a project for a house, for which a workable set of plans had been developed. The

clients were expected to approve this, as it incorporated ideas that had been discussed with them. However both A15 and A16 were dissatisfied with it. In A16's words:

> … the one that A15 described last week is very typical of the sort of thought processes we go through, where we're just kind of going through it and we're unhappy… we're showing clients designs, but actually we're not particularly content that they're the right way to go with the project. And then suddenly there'll be something which just kind of triggers the ... development of the thing, into something that we're much happier with. A16.

Many attempts were made to resolve the external appearance of the building over a month, or more and then finally on the day of the meeting:

> … we back tracked and said… "We'll just see whether we can pick one of those schemes and work it up and see if anything interesting comes out". A16.

A15 subsequently found the selected solution in the form of an earlier sketch. Both saw it had potential. Then A16 developed a 3D version of it on his PC. A15 made a further critical contribution in turning the modelled item from horizontal to vertical, and this was sufficient to transform the design into something that pleased them both.

This discovery was made during a design session and appears to owe more to A15 than to A16. However, A16's statements show that he experienced cold discoveries often, when short opportunities present themselves, such as when swimming or driving.

> I find the stronger ideas when I'm not trying to come up with something, like driving the car from a site meeting on another job and suddenly an idea was coming out of nowhere, while I'm sitting at the traffic lights at Bondi, or something, for a project that, you know, you've got to be working on in a few days time, or totally unrelated to what you've been doing that day. So it's like "ching!" the light bulb goes on... A16.

The combination of the expression, *stronger ideas*, when not trying to come up with something and A16's use of the light bulb metaphor, together are clear indications that he views cold discoveries as more insightful than discoveries he makes when working.

Respondent A04

Male Architect: Commenced practice mid 1970s
Current status: Leads small practice

A04 referred to a recent project for a rural museum. The project, a winning competition entry, required the building to incorporate, museum standard, environmental controls and display features and also to capture the grandeur and spirit of the great bush buildings of the past. He describes the idea of the design coming quickly.

> … the insight came very quickly. To say "well look, what you really need to do is… just create a big cheap space which is just the shed, which has some soaring vertical qualities which has the qualities of light coming through. Which can in fact become the shelter for the smaller museum part, but in the process gives you a whole bonus space to put the sort of junk which you might normally find littered around a country museum's yard". You know the tractors and… this, that and the other. A04.

One strong feature of this idea, more evident in the building than in the above statements, is that constructing semi self-contained refined building elements, inside a larger, less refined shelter system, gave the designers freedoms they would not have had in a single integrated structure. For example large horizontal and vertical forms could be used to delineate spaces, create a sense of scale and identity, and provide, different forms and levels of shelter, in an abstract way, at low cost, with very much simplified junction and weather proofing requirements.

In saying "the insight came very quickly", A03 is not stating that there was a sudden moment of insight, but rather that the initial idea was arrived at rationally within days, rather than agonising over the problem, or alternative solutions (say) for weeks. A04 says:

> … making the key idea, of the building, this sense of a museum which is really precious and small, versus this dramatic space was really important… understanding that and then seeing how that could drive environmental agendas and stuff and tie everything else together was clearly a breakthrough and that came from just thinking, observing and thinking. A04.

The discovery described by A04 appears not to have been a cold discovery, but statements by A04, through the interview, indicate that he does experience discoveries when not working.

> …you're thinking about it all the time, seven days a week. So often you might be off doing something completely different and something just triggers, something you just see, experience here, just triggers an idea, an association… A04.

A04 was quick to acknowledge the clarity of discoveries perceived in the head, without the detail and complexity of drawings and other externalities.

> You get the sense of bits clicking together in a simpler way, because it's happening in your head. All things are possible and there's a clarity. Sometimes when you try, and when you're drawing, you sometimes just realize the complexities of things. In the head, in those serendipity moments… it becomes effortless, the connection. A04.

Respondent A31

Female Architect: Commenced practice early 1980s
Current status: Partner, large city practice

A31 is a senior partner of a major Australian architectural firm, with offices in several Australian cities and other countries. As a leader of teams of designers she applies her creativity largely by means of the directions she gives other people. The value of her directions, like design decisions generally, is not only whether they fill some immediate gap, or complete some process, but whether they lead (people, actions or events) towards the achievement of their intended outcome.

In the example the project was an office fit out. The development of ideas during the course of the designing had led to situation where the means of connecting the major elements became critical, but an ideal, general hinge solution had not been resolved by the team. A31 under considerable pressure from the client tried to resolve the problem herself, without success. Then, when the client suggested he should get someone else to look at it, A31, recognising there was no solution available contacted a hardware supplier.

> I enlisted the support of one of the suppliers and he kept saying, "Tell me what you want" and I said "No… this is the challenge and you come back." And he came back with a synthesis of 2 different products … in fact I didn't know about either of these… and he put them together and he said, "Well I've got an idea." I said "Can I see it?" And he said "No!... It's confidential." I said, "Look you trust me," you know. And he faxed this thing over and I just said, "That's it mate." And he said he could get a… prototype together in Milan, in the time frame we needed and [it] just happened that… one of the client's henchmen was… on holiday in … Rome…I rang him and he literally got out of the car and left his wife at a roundabout, with the rent-a-car and hailed a taxi to the airport … and we got a prototype… air lifted out to here and the client that had been dangling me over a cliff walked in and said… F'ing fantastic I think it was… It became then a world product… rolled out globally"… A31.

When answering the question, of whether she is always on the case, A31 affirmed:

> … you actually have to go and do other things because… that's how your subconscious works, why you have really good ideas when you're asleep is that your away from it and your brain's kind of rattling it all around and suddenly (doink!) something clicks and an idea comes, and that's the solution to what you've been working on. A31

This statement indicates that cold discoveries are important to A31, because they tend to be solutions to problems that had frustrated earlier attempts at solution. Her statements about value and frequency reinforce this conclusion, in being assertions that the cold discoveries tend to be both, frequent and frequently, the critical design solutions, that are needed to make the big ideas work.

Respondent A33

Female Architect: Commenced practice mid 1990s
Current status: Leads small near city practice

A33 described a recent project, a northern beaches boutique hotel and residence. The design involved extensive excavation and landfill to sit on the site. As designing proceeded it became evident that the building was going to exceed its budget and that the magnitude of the site works may complicate the approval process. Later, after a period of consideration, A33 went to Melbourne to attend a course and, afterwards while still in Melbourne, with no drawings, but stimulated by the weekend's activities, she realised what was needed. The main idea of the simple solution was to rotate the ground floor of the building 90 degrees, while maintaining the same orientation of the upper level.

Cold discoveries are important to A33: 1) because this architect is strongly driven by a set of values and principles to produce design solutions that represent and respond to their surroundings and push boundaries, and 2) because her regular office working time is not as conducive for generating innovative, non-conservative ideas and discoveries as the times she spends in the stimulating company of her peers, or exercising outdoors.

> Architecture is an ongoing, never ending thing for me… But the arrival of the thought is usually… when I'm not doing … churning the, you know, the wheels around. A33

A33 also values cold discoveries, because they are more likely to affirm her design aims than the more conservative ideas generated in the more pressured and constrained circumstances of her office working hours.

> … a lot of the greatest ideas, I believe, come over coffee, or with friends… I love talking to people about the ideas and they come then. Then I… have a bit of a conversation, gesture, dialogue and then the dialogue, I just take with me, and come here and then I'll produce the work. So it's totally different… when you're doing labour intensive drawings… you're just, more, doing the cogwheel stuff. A33

5.4 INCREMENTAL DESIGN

The individuals in this category are designers for whom an insightful discovery may be welcome, but is not a common or expected event in their designing. Among this group are individuals whose designing is consciously based on a rational incremental process and some who design collaboratively. Different forms of collaboration are employed including workshopping techniques which spread the creative responsibility and ownership among a group of colleagues. The collaborative respondents may be insightful, but are difficult to categorise in this way because group work literally brings together a lot of unknowns. Establishing whether a person, or a *vibe* in the group, is chiefly responsible for a breakthrough is problematic. Individuals may not remember and some would consider the question unimportant. It is also difficult to assess the extent to which, in being part of a group, a person is either stimulated, or exhausted by the experience and therefore is more, or less, likely to experience *cold* discoveries when away from the group.

Insight Level 0 respondents - 6 total							
		RAIA award winners			Other respondents		
		ID	Rating	Comment	ID	Rating	Comment
	Male=blue	A01	2.0.1	Rational design	A28	0.0.1	Rational design.
					A24	2.0.1	Collaborative Design.
					A18	0.0.0	No recollections.
	Fem.=red	A10	2.2.2	No recollections	A08	0.1.0	No recollections

Figure 5.4-L4 Respondent Discovery experiences by categories - Incremental Designers

A total of six, or about 13% of the respondents, have been categorised as incremental designers. These respondents made statements that could be interpreted as positive for only a small number of the defined indicators associated with insight based discovery. In spite of the small numbers this is an interesting and varied group comprising three distinct types.

- Rational design - These respondents, who are active proponents of rational, methodical processes of designing, are the most recognisably incremental.
- Collaborative design - In some firms, responsibility and credit for design quality and discoveries, is intentionally shared amongst individuals collaborating in group, or workshopping settings. This process can be very productive, depending on the quality of the participants and their group dynamics. However as workshopping involves unknown individuals working together it is inappropriate to consider discoveries from such sessions as the work of the respondent.
- No recollections - Some respondents were unable to recall any discoveries or made very few or no statements about discoveries that were indicative of insightfulness.

A discovery by one respondent (A01) is described in detail. The key experiences of other Level 0 respondents are in summarised form.

5.4.1 Insight Level 0 - Rational design experiences

Respondents in this category used adjectives such as rational, analytical, methodical and deterministic, when describing their process of designing. There were indications among these designers of suspicion and perhaps disdain for design concepts that were the outcome of inspiration or 'eureka!' experiences.

Respondent A01

Male Architect: Commenced practice late 1960s
Current status: Sole practitioner

A01 describes his strengths as being mainly at the conceptual level - processing complexity to create architectural form, in other words, conceptual design. He views architecture primarily as a continuum from the past, grounded in historic process, in precedent, in the environment and the requirements of the brief. Consistent with that view, A01 describes his way of working as initially methodical, analytic and deterministic, adding that this may lead to cognitive breakthroughs.

INSIGHT EXPERIENCE - HYPOTHESIS 1

A01 recalled an instance where his discovery involved recognising a solution in an error.

> I remember actually... struggling with… [an elevation] and having given instructions for perspectives … the guy who was doing it … made a mistake in terms of what I'd intended. But it was a brilliant mistake which solved a whole lot of… formal issues. I can still remember that and I've always been very grateful for his misinterpretation of what was expected. A01.

Preparation

A01 had been unable to resolve an aspect of detail in an elevation and recognised the value of the accidentally improved drawing.

Fixation

Not referred to.

Incubation

There was a delay between instruction and seeing finished work, but no reference has been made to incubation. Conversely, the respondent's advocacy of methodical, deterministic process and externalisation rather than keeping thoughts in the head, suggests that A1's designing is conscious and intentional.

Restructuring

A01 reinterpreted an error as an improvement. The restructuring was literally made by the drafter. But A01's act of recognition appears to have involved a reinterpretation of goals.

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2

There were few indications of cold discoveries being an important or valued component of A01's designing. A01's reply to the question of design ideas at times when not designing clearly associates discovery with externalisation, that is, *hot* discovery:

> … rather than some sort of flash of inspiration, it's usually finding that a deadline has crept up… So you just sit down… and you draw it at the stage that it is... that usually… moves the project onto a new plane, because it suddenly brings out all of those things that have been floating around, but are not yet articulated. A01.

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3

A1's view on cold discoveries was positive but qualified by a degree of scepticism.

> Lots of ideas come floating through, possibilities, but sometimes a chimera. A01.

SUMMARY A01

Three items, 1) the example of the fortunate error, 2) the view of the act of externalisation bringing out the not-yet-articulated and 3) the association of cold discovery with a chimera, together indicate that A01's designing is mostly rational. Other statements in the interview indicate a degree of pragmatism, suggesting that his rational approach at the global level, comes naturally to him and is a strength he is comfortable with. For example he describes himself as, "very much a front end guy". A01 described himself as not great with details or items in isolation and passed on a statement he heard from a project manager, which clearly appealed to him:

> "It's not that he can't do it, it's that he just doesn't want to." It's a question of there's only one person and there's so much to be done… A01.

This workface orientation may also partly account for A01's faint regard for the value cold discoveries, that emerge unexpectedly, when there are particular things to do.

Respondent A28

Male Architect: Commenced practice early 1990s
Current status: Partner, small near city practice

INSIGHT EXPERIENCE - HYPOTHESIS 1 SCORE 0

A28 described a rational process when talking about his work and indicated some skepticism of the place of discovery in architectural work. Referring to the project Information I supplied, he said:

> When I was reading this… I think it was the discovery kind of thing that jarred with me, or concerned me, because I'm not sure how much discovery architects actually do. A28.

Then A28 referred to a house where the conceptual development of the design owed little to discoveries and more to precedent and attention to detail.

Preparation *0*

The design was the outcome of a rational approach based on that practiced by A28's previous employer, Foster's in London.

Fixation and Incubation *0*

Not stated

Restructuring and "Aha!" Factor *0*
Not evident as significant.

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2 SCORE 0

When asked how often he found design ideas came unexpectedly, at times when not designing, A28 replied:

> Quite often, yes, yes. I've never dreamed a solution and if I have they never work. But yes… quite often you'll be doing something and some idea might sort of, spring to mind, and [you] sketch it down… I'm sure every architect does it. A28.

A28 described some cases where seemingly valuable progress was made through making notes of ideas that came to him when not working, but his enthusiasm for them was relatively mild. I asked if he could describe, in general terms, how such unexpected ideas compare with discoveries made while working.

> I probably enjoy the ones more, that I make while I'm working and that maybe comes out of… the methodical problem solving of going through and of being able to, almost like a jigsaw puzzle, assemble all the pieces and put it together… A28.

I asked, if by saying "enjoy them", he meant that he gets greater personal satisfaction from achieving them.

> Yes, because it's been a lucid approach to the problem. And you understand, the steps, that you've achieved what you have by problem solving, by the processes that I've described. You arrive at a point that works and the client knows why it works. And I'm talking about, you know, the building [is] built, and the construction details have followed that process. And the client comes in and knows instantly why it was done. That's satisfying, much more than [ideas arising from inspiration] because I am wary of those things. A28.

This discussion continued, with A28 affirming that the inspiration based ideas had a higher casualty rate than ideas generated through analysis. In general A28's reason for this view is that the inspiration ideas tend to be made in an instant, are superficial or oversimplified and overlook vital aspects of a project.

IMPORTANCE

Apparently, not important to A28

HOTNESS-COLDNESS

Insufficient information is available for comment.

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3 SCORE 1

A28 is skeptical of the value of non incremental discoveries

SUMMARY A28

It is possible that A28 is unaware that models of creative problem solving typically include a preparation stage. This could account for his misconception that cold discoveries are less likely to be the outcome of honest toil and less worthy than discoveries made while designing. The prevalence of this view is not known at present, but it is possible that it may be found among other rational incremental designers. It doesn't appear to be common among insightful designers, as the *pie-in-the-sky* form of unconnected discovery appears to be rare among the present respondents.

5.4.2 Insight Level 0 - Collaborative design experience

Respondent A24

Male Architect: Commenced practice early 1980s
Current status: Partner, with A12 in small near city practice since 2000.

The partnership of A24 and A12 has been operating for about 2½ years at the time of the interview, following around 15 years of working with other architects. Processes within the practice are developing, combining influences from the time both partners spent with the Renzo Piano workshop and their personal innovations.

A24 stated an interest in being an innovative designer, but it was clear this desire did not motivate him to work alone. Perhaps as a result of his experiences in the Renzo Piano workshop he was enthusiastic about working with A12 and implementing the team environment with her.

> … we find a kind of workshop environment is incredibly productive… You can have a few bits and pieces on the table and… you know, in a group of 3 or 4 enthusiastic people like we have here, it will turn into this snowball really quickly and it just grows in front of your eyes and everybody stands up and goes "whoa! That's cool"… within a matter of minutes we can have worked up an incredible set of ideas about a problem… afterwards you're not quite sure where that came from. It's quite amazing and we really enjoy that and that's what we try to foster here. A24.

INSIGHT EXPERIENCE - HYPOTHESIS 1

A24 described three examples of breakthroughs. A significant feature of these is not that he has claimed three discoveries, but that the discoveries have occurred in a team environment, either with his partner A12, or in a larger group. In these settings A24 has been an instigator, if not the proclaimed leader, but he has not necessarily made the discoveries.

1. A productive design session occurred while travelling with A12, through Europe on a train. The two of them had been working on the design of an Australian church, while living in Italy, but on this particular day they were travelling.

> … it was the first time I realized that train travel was quite a good spot for ideas… We were just gazing out the window and started talking about it… we cranked out a whole bunch of sketches, on whatever paper we could find, and kind of came up with something we were very happy with. A24.

As A24 was finding it difficult to recall more details of this (1980s) discovery, he then began to describe the next, much more recent, example.

2. A critical design element of a large apartment project remained unresolved.

> … we were stuck for a matter of weeks and knew we didn't have anything and it came in an over night session after a discussion with one of the guys here… we'd been working on it for weeks… there were bits and pieces lying around, drawings, bits of model… discussions… fragments of ideas... just with a suggestion about one element becoming structural... all of a sudden, things that we had been mucking around with went (click) into an idea… we all went home and he actually turned it into something that worked. He did it overnight… when we were talking about it we realized there was something there, and he just happened to interpret it very well... I still can't remember where the little breakthrough came from… I do remember there was stuff going on for weeks, that none of it was making sense and suddenly it did… the work shop thing… is about a lot of ideas being bounced around and coming together. So I'm

just not exactly sure which combination it was then, and that's the nice thing about it. A24.

3. A structural member on one project was transformed from a timber box beam to a clad truss. A further transformation, to eliminate the truss by utilising the strength of the metal cladding, was the current solution. In this case the idea came from a structural consultant who had recently joined the project team. A24 attributes the discovery to two factors, a 1:1 scale detail drawing of the structural member pinned on the meeting room wall and the collaborative approach adopted by his firm, as illustrated by the following statements.

> … that [the 1:1 detail] is a good example of a tool. You'd never think of that if you were looking at a drawing this big, a little one like that, but when it's up on the wall full scale you think of it in a different way… that's another part of the collaborative approach. It's not just about the people in this office. It's about the others we work with, suppliers, contractors, engineers and all sorts. A24.

Preparation

In all three examples discoveries have been made about items with a history. The church project was not new. The apartment project problem had been frustrating the team for weeks. The third item, the unresolved beam, also had developed over time. According to A24 the drawing caught the consultant's eye and the reaction was spontaneous.

Fixation & Incubation

Not evident from A24's statements

Restructuring

All three instances involve restructuring

"Aha!" Factor

Not evident from A24's statements

COLD DISCOVERY EXPERIENCE - HYPOTHESIS 2

When asked how often design ideas come unexpectedly, when not designing, A24 referred to a dream state sometimes, such as during interstate travels when:

> you're not actually thinking about it, but it just pops into your head, or… seeing an example of something as you [are] moving around the place. A24.

A24 referred to examples of thoughts being prompted by things he had seen. I asked how such ideas compare with discoveries made while working? His characterisation is that:

> … the ones that come to you when you're not seeking for ideas, are not necessarily related to any project. They're just something that cross your mind, as something nice to try, or to investigate, or … building of a bit of a library of things you're interested in I guess. A24.

Importance

The importance of cold discoveries to A24 is unclear. None of the three discovery examples described have necessarily involved cold discovery. While the cold discovery experience appears to be familiar to A24, not enough information is available to establish the extent to which this experience is the outcome of internal mental activity, or cued by things he sees around him while on the move. The value of A24's cold discovery experiences is related to the extent to which the discoveries have contributed to designing, or the resolution of design issues, as opposed to more accidental externally cued thoughts. This is not evident.

Hotness-Coldness

Not assessable - no particular cold discovery recalled

COLD DISCOVERY INSIGHTFULNESS - HYPOTHESIS 3

Not assessable - insufficient basis for comparison

SUMMARY A24

It is evident that A24 is both a gifted designer and leader, who is comfortable giving both resposibility and credit to others, in order to achieve more than he could do alone. It is likely that he is insightful, but the extent of his collaborative activity hides this aspect of his design thinking.

5.4.3 Insight Level 0 - No recollections of discoveries

Respondent A08

Female Architect Commenced practice early 1980s
Current status: Partner small near city practice

While confirming that they happen, A08 found she was unable to recall any discoveries, or breakthroughs when directly asked. This was also true of cold discoveries, although A08 could describe when cold discoveries are likely to come:

> … when you're not actually drawing… like when you're sort of driving or doing something like cooking, you know… actually while you're doing something else, it just sort of comes. Yes quite often. A08.

Respondent A10

Female Architect Commenced practice mid 1980s
Current status: Leads small near city practice

A10 has a strong interest in art and regards herself as an intuitive, rather than a methodical designer. She recalled that discoveries have happened, but described them as having evolved naturally and that they have been little things.

> Sometimes those things have happened but they've just… evolved, sort of, naturally. Not like a big sort of… light bulbs going off, no. A10.

While affirming that design ideas came to her quite when not designing, A10 was unable to recall any.

> Oh quite often… going for a swim or … waking up in the middle of the night, or just driving along in the car. Just times when you've got a bit of quiet time… and the mind's working without you kind of thinking … realizing it. Yeah that happens quite a lot. A10.

The observation that the discoveries are minor suggests that, if A10 was to recall discoveries, she would still fit best in the incremental category.

Respondent A18

Male Architect Commenced practice early 1990s
Current status: Partner with A05 in small near city practice

A18 describes the work of the partnership as very site specific. The aim in each design is to identify a fundamental idea which will drive the project.

> … that idea might be program, or brief related, or site related, or more typically, with us, it's somehow welding the brief and the site together with a clear idea. A18.

He was unable to recall any recent breakthroughs, or discoveries during the conceptual design stage, other than one instance involving a house at Bronte designed a few years earlier. However this discovery was made by his partner A05 and is described in that interview.

A18 concedes that breakthroughs and discoveries are not characteristic of the way he works. He described his design progression as often incremental.

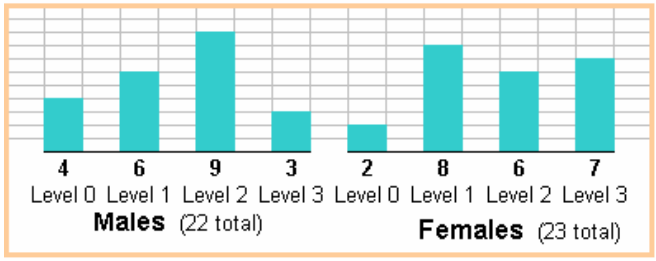
CHAPTER 6

DISCUSSION

6.1 REVIEW OF DISCOVERY FINDINGS

It is noted in Chapter 5 that the three hypotheses, confirmed by the research, represent not merely different insight experiences, but also different levels of insight experience. Respondents have been categorised as Insight Level 0, 1, 2 or 3, based on the hypotheses confirmed by their statements of discovery experiences. Characterisation of the hypothesis findings as levels is confirmed by indications of adaptation, by respondents, to exploit their particular level of insight experience. This is evident in statements in Chapter 4 where respondents describe alternative actions when they get stuck and other regularities, such as taking drawings to their bedrooms at the end of a day's, or night's work, to look at before they go to sleep, or sitting drawings on the passenger seat next to them, before driving to the office.

The distribution of Insight Levels has been related to key respondent attributes including Gender, Year of Commencing Practice (A measure of the extent of professional exoerience, based on the approximate year of commencement) and Award Status (A measure of recognised design skill and accomplishment, based on receipt of an RAIA award). Fig 6.1-LG below, shows Insight levels, with the respondents distributed by Gender. The graph suggests female respondents are more likely to Experience insightful discoveries, than males (21/23 v 18/22). The Level 0 value of 4 at the left of the graph indicates that twice as many males, as females (4:2) are incremental, or Insight Level 0 designers. The Level 3 value of 7 at the right side of the graph indicates that twice as many females, as males (7:3) consider their cold discoveries to be more insightful than their hot discoveries.



6.1-LG Insight Level by Gender

It should be noted that differences between groups of respondents mean relatively little in isolation, as factors in the population, other than the nominal one may be influential. For example Fig 6.1-LY is another view of Insight Levels, showing the respondents distributed by Year of Commencing Practice.

This graph indicates that the proportion of incremental respondents is approximately the same in the Before 1984 group and the Later group. This suggests that the likelihood of designers being insightful or incremental does not markedly vary with age, which may mean that people don't become more or less insightful as they get older.

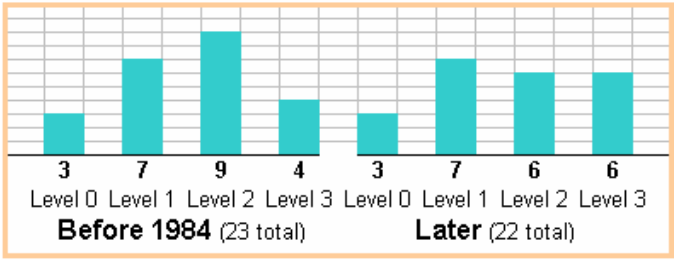


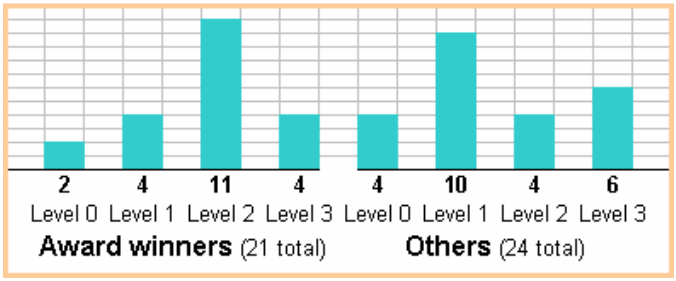
Fig. 6.1-LY Insight Level by Year of Commencing Practice

This graph does show a shift in the balance between Insight Level 2 and 3. Proportionally more of the Before 1984 (older, more experienced) respondents are Insight Level 2. The significance of this, in relation to the first graph (6.1-LG), is that there are proportionally fewer females in the Before 1984 group (9/23) and proportionally more in the Later group (14/22). So it is possible that apparently age related findings are being influenced by gender, or vice versa. The degree to which being young, or being female influences attitudes towards cold discovery has not been explored at this time, but is foreshadowed in 6.3 Future Research.

One question, likely to be of general interest, is whether insightfulness is associated with success or skill as a designer. Among the respondent population are 21 architects who have demonstrated

sufficient skill to be awarded architectural awards by their professional body, the RAIA. This is not the definitive measure of success, or skill, but it is one.

Fig 6.1-LA, at right, suggests that Award Winners are more insightful than Others, although the difference is not large. The high and low values for Insight levels 2 and 3 respectively, among the Award Winners group, also suggests that, although cold discoveries are more common among Award Winners, proportionally fewer of the award winners are convinced that their cold discoveries are insightful.



6.1-LA Insight Level by Award Status

Again, the composition of the two groups and the visible peaks and troughs are likely to have been influenced by age and gender. The Award Winners have been in professional practice longer than the Others (Median year of commencement of Award winners is 1980, versus 1985 for Others) and more are male than female (Ratio M:F Award winners = 12:9, Others = 10:14).

The remainder of this sub-chapter summarises findings in relation to each hypothesis. There are four parts, corresponding to the three hypotheses plus a summary of the individuals who have not been categorised as insightful designers. The first part, 6.1.1 Insight Experience - Hypothesis 1, reviews findings of relevance to this hypothesis, in relation to insight components. Insight component are described in detail in Chapter 2 and further discussed in relation to the discoveries of individual respondents in Chapter 5. Part 6.1.1 refers to all 45 respondents, not just the Insight Level 1 group. Parts, 6.1.2 and 6.1.3, which follow, are specific to Hypotheses 2 and 3 and focus on the distinguishing characteristic of the Insight Level 2 and the Insight Level 3 respondents. The fourth part 6.1.4 is a summary of observations about the remaining respondents, categorised as Incremental designers.

6.1.1 Insight Experience - Hypothesis 1

An insightful discovery may be a solution, or it may facilitate the realisation of a solution. The discovery need not resolve the main preoccupation, or the most pressing need, or be what is most wanted at the time of discovery. It need not be the focus of the item a designer is currently working on. Insight experiences can also be, for all one knows, arbitrary in their timing.

There are significant variations, in the associated components of insight and in the qualitative features of the Discovery Experience. A brief analysis of these items and possible associations between them follows. In the analysis the components are considered in relation to objective respondent attributes including Gender, Year of Commencing Practice and Award Status. Qualitative features of the Discovery Experience, including Clarity, Fluency, Recognition and Idea are also discussed under Restructuring.

PREPARATION

In Chapter 2 preparation was described as an indispensable component of the Gestalt view of problem solving as the problem solver needs to engage with the problem, to recognise that it is novel, to appreciate that the situation is problematic and become more likely to recognise or devise approaches that differ from what has previously failed. For the purposes of this study Preparation time is an unspecified combination of working time and elapsed time. At the time of thesis preparation, no systematic measurement of the balance of working time and elapsed time has been attempted. This would be a substantial and difficult undertaking, not warranted unless there was a significant issue at stake. In the mean time it can be inferred, from the context of respondent statements, that a substantial amount of preparation time is elapsed time. Common sense suggests also that the ratio of elapsed time goes up as Preparation time on a task increases. When respondents say they were working on a problem for months, the more likely meaning is that the problem remained unsolved for months, rather than that the respondent was actively engaged in trying to find a solution to that problem, night and day, to the exclusion of everything else, for weeks, months or longer.

During the interviews respondents were asked about breakthroughs and discoveries in their designing. Their comments indicated that, while many are intuitive in their ways of working, and many are insightful, none expected to produce good designs simply by intuition, or a *bolt from the blue*. On the contrary, it is evident that respondents generally are experienced, capable and strongly motivated and that active preparation is close to universal.

See Fig. 6.1-P, at right. Of the 45 respondents, most reported that they had worked on the subject of their discovery for more than one day. Over half said more than one week. One, A30, referred to a breakthrough as the outcome of years of thinking.

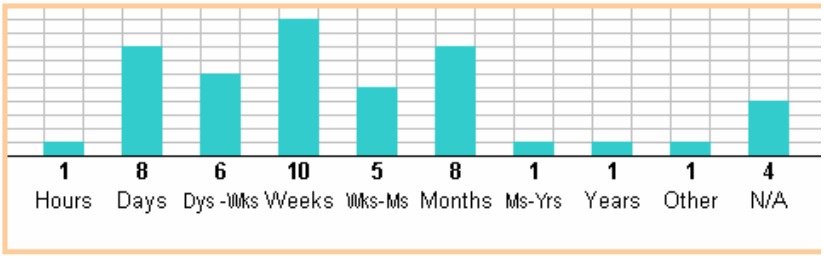


Fig. 6.1-P Preparation time distribution (45 respondents)

The single individual shown in the Hours column, actually P1, is an Insight level 1 graphic designer who is associated with *resumption* discoveries. Many of his jobs are small, some requiring one day or less. Typically he has a number of projects proceeding at any time. If he gets stuck he shifts attention to another. He doesn't waste conscious time on jobs if he gets stuck, because he knows concepts often come to him as soon as he resumes thinking about the job, after a break. The individual in the column described as Other, actually A38, strongly advocates thorough preparation. However the particular discovery he described in his interview came to him very suddenly. The remaining four, shown as N/A are no less enthusiastic about preparation, but their preparation had not been rewarded by insights they could remember, or describe, during their interviews.

It is possible that good outcomes, following extended periods of hard work and frustration, could be more memorable than equally insightful or revelatory initiatives that occurred in a flash, without a lot of work beforehand. Perhaps some individuals are reluctant to give an impression that ideas come easily to them. These possibilities haven't been systematically tested, but there are no obvious signs of this being an issue. Some respondents described cold discoveries, when they were prompted or cued by things they saw or heard, or they thought of good ideas for future reference; *ideas in search of a problem,* you could say. But these typically, were additional to other problem solving discoveries.

Additional graphs have been compiled to relate Preparation time to significant variables. Fig 6.1-PL, below displays reported Preparation Time against Insight Levels 1 to 3. Each column shows the number of respondents in each four broad Preparation Time bands (Days and days to weeks, Weeks and weeks to months, Months and months to years, or Other, if neither of the other three were appropriate) These broad categories have been chosen because statements about times by respondents were relatively vague at times. While the sample is small (39 of 45, due to the absence of the 6 incremental respondents) the trend is large. Ten of a total of 12 Days and Days to Weeks preparation estimates (the shortest preparation category) are in the Level 2 group. This suggests that Insight Level 2 respondents have made their discoveries much earlier than either Insight Level 1 or Level 3 respondents; ie. in days rather than weeks. That is a surprising occurrence and not easy to interpret. The fact of cold discovery suggests that minds are *working overtime* and perhaps the Level 2 respondents feel a greater conceptual urgency, while the Level 3s are more content to let their concepts incubate longer. This may be related to the pressures of practice. For some practitioners, working to deadlines, their cold discoveries may be no more insightful than their hot discoveries, but if they emerge in days instead of weeks that shortcoming may be of no concern.

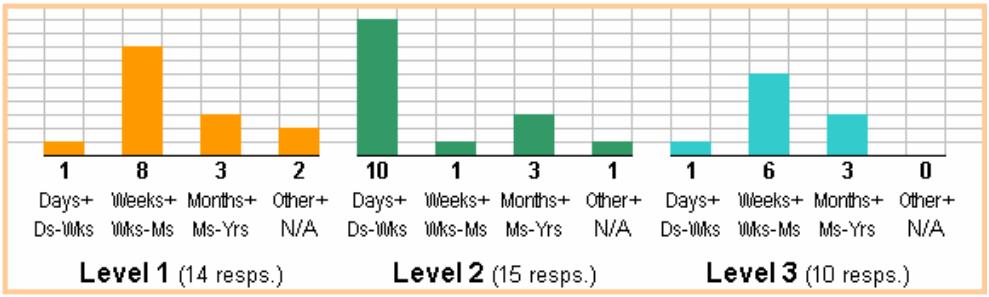


Fig. 6.1-PL Preparation Time by Insight Levels 1 to 3 (39 respondents)

The delayed cold discoveries, of the Level 3 respondents, is also curious. One way to explore this now is to consider the Discovery Experience. Fig. 6.1-PE below, shows that 9 of the 12 respondents reporting the (relatively rapid) Days and Days to Weeks, Preparation times, experienced Idea based discoveries. This suggests that a majority, of the 10 Level 2 discoveries (in Fig 6.1-PL) are also Idea based.

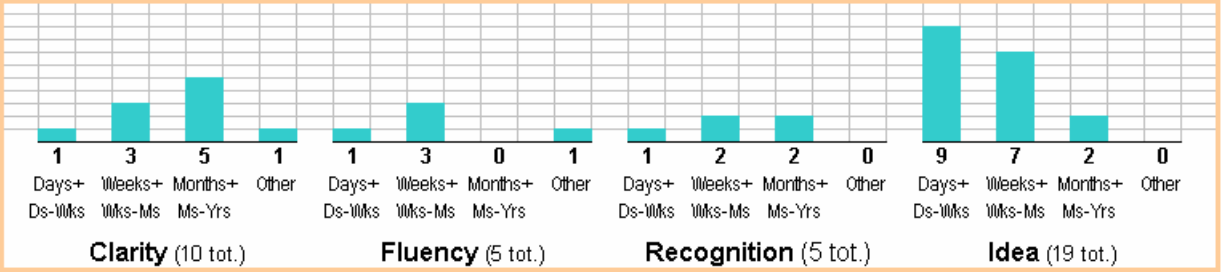
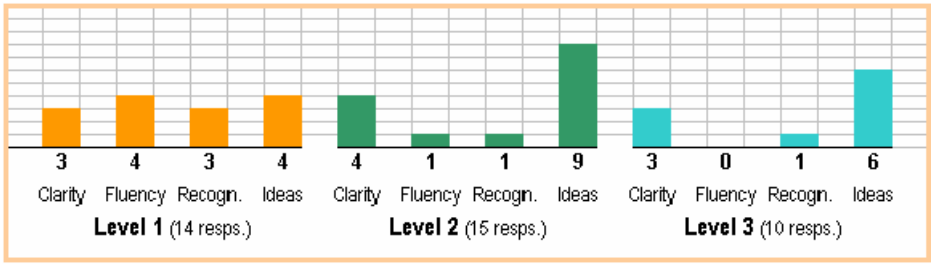


Fig. 6.1-PE Preparation time by Discovery Experience (39 respondents)

This is supported by the fact that 9 of the 16 Insight Level 2 respondents reported Idea based discoveries. See Fig.6.1-EL below. However a similar process of investigation will show that many of the Level 3 Insight respondents also experienced Idea based discoveries. This appears to rule out different Discovery Experiences as a major contributor to the difference. It is possible that the difference is an outcome of more persistent Incubation, that has been rewarded, or multiple cold discoveries. Either of these factors could result in better or more insightful discoveries. This appears to be an interesting finding which warrants further investigation, including closer analysis of individual records, further querying of the respondents and verification by additional respondents.



6.1-EL Discovery Experience by Insight Level

A general observation that can be stated with some confidence now, is that time and place of insights and the subjective nature of insightful discovery have associations with preparation, but the direction of the association is unclear. It is obvious that preparation (what goes in) influences discovery (what comes out). But it is also likely, from respondent statements, that the quality and nature of insight experience also influences preparation. What has been established is that respondents tend to think about what they are doing and carry out work before coming up with their design concepts. This rather obvious finding is made more interesting by the range of preparation times and differentiation that appears to be associated with Insight Levels and Discovery Experiences.

Appendix 1 includes additional graphs, relating Preparation time to RAIA award status, Gender and Years of Practice. See p.7, List of Figures, Figs. 6.1-PA, 6.1-PG, 6.1-PY. These suggest that awardees spend less time on preparation than other respondents, that males spend less time on preparation than females and that older respondents spend less time on preparation than younger. One reason why this could occur is that Preparation time is influenced by knowledge and self confidence. Another is that the respondent variables Award Status, Gender and Years of Practice are interrelated. More Award Winners are males than females (12:9), whereas the reverse is the case with Others. (10:14) Similarly, more older respondents are males than females (14:9), while the reverse is true of the younger respondents (8:14). This suggests that the influence of gender is wider than it first appears.

An impression could be given that female practitioners are more cautious or painstaking in their preparation than men. However it is necessary to remember that Preparation time includes a significant component of elapsed time and that, for women, preparation time may be subject to more

frequent interruptions arising from non-professional activities, such as child minding. Many of the female respondents refer to their families and their children, and it is the younger ones who are the most affected. Women practicing before 1984 are more likely to have grown-up families and now have greater freedom to get on with their designing. This is a fascinating matter, warranting much further study, but too complex to unravel any further in this thesis.

Another important aspect of preparation, requiring attention, is the nature of the preparation. This too is complex, but is important because it is a point of association between preparation and other components of insightful discovery, Fixation, Incubation and Restructuring and perhaps the "Aha!" experience too. Clues to the qualitative nature of preparation are evident in the respondent statements. A variety of formative characteristics and inclinations will not only have influenced their formation as designers, but can be expected to continue to influence their current designing. So too will the components of their design philosophy, their values, aims and goals and emotional factors, such as their personal likes and dislikes. It is unlikely that the high levels of motivation, characterising the respondents, derive from something other than strong individual feelings. In this study major determinants of design direction have been grouped into three components of Design Focusing, Orientation, Scope and Framing. Orientation and Scope are likely to reflect thinking or working styles, whereas Framing is more likely to reflect design values, preferences and feelings. This aspect of study, essentially the driver of designing, will be explored considerably in future research.

FIXATION

Among the respondent statements there are a variety that directly or indirectly relate to Fixation. As shown in Fig. 6.1-F, at right, for about ¾ of the respondents (33:45) the influence of Fixation was evident in the description of a discovery (15:33), or an awareness of Fixation was affirmed (9:33).

Some respondents (9:33) provided combinations of both in statements about discoveries or designing in general. The remainder, shown as Unclear below, includes 5 of the 6 incremental designers and insightful designers who, for different reasons, said little or nothing to indicate Fixation.

An example of an Evident Fixation is an account by A06 of the design of a glass roof over a hallway that was radically reoriented during construction, a year after the original design was drawn. Although the Fixation was not acknowledged, A06 clearly was slow to recognise and respond constructively to a problem of excessive sun penetration, until it became obvious to him during a site inspection, fortunately well before the roof was built.

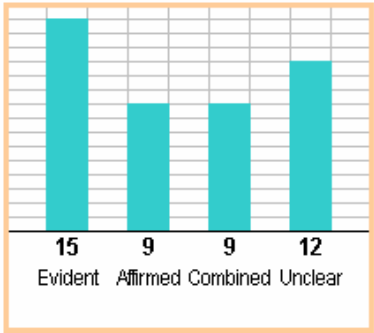


Fig. 6.1-F Fixation distribution (45 respondents)

As with Preparation above, additional graphs have been compiled to relate Fixation to other significant attributes including Insight Level and Discovery Experience. The first graph, Fig. 6.1-FL below, shows variations in statements of relevance to fixation, for different insight levels. This suggests that the presence or absence of Fixation when designing probably does not influence Insight levels. Put another way, it does not appear that experiencing Fixation, when designing, markedly influences whether subsequent insightful design discoveries will be hot or cold. It is possible that different types of fixations may have more pronounced affects, but this has not been investigated. One hint of a trend is that awareness of Fixation appears to increase with Insight Level. Based on the sum of the Affirmed and Combined columns, a higher proportion of the Level 3 respondents have referred to fixation, either as experienced or avoided, than the Level 2 or Level 1 respondents. (L3 = 6/10, L2 = 6/15, L1 = 5/14)

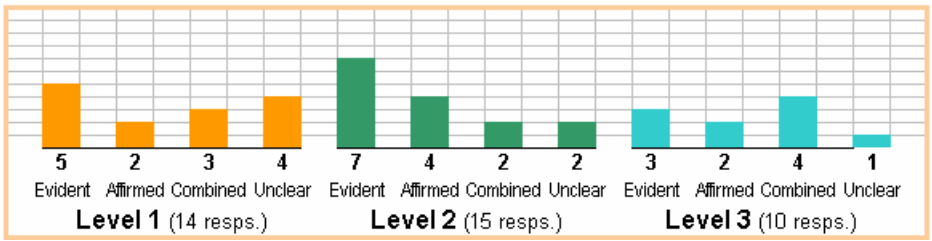


Fig. 6.1-FL Fixation by Insight Levels 1 to 3 (39 respondents)

The second graph, Fig 6.1-FE below, shows minor variations between Discovery Experiences, given that some sub-groups are small. As observed, in relation to Insight Levels above, the presence or absence of Fixation, when designing, probably does not markedly influence whether an eventual Discovery Experience will involve Clarity, Fluency, Recognition or an Idea. However two exceptions are apparent. The first concerns awareness of Fixation which, as noted above, appears to increase with Insight Level. Again, based on the sum of the Affirmed and Combined columns, a high proportion of the respondents reporting Clarity experiences have referred to Fixation, either as experienced or avoided, than all of the others. This may suggest that the Clarity experience itself may be associated with greater recognition of former barriers to understanding.

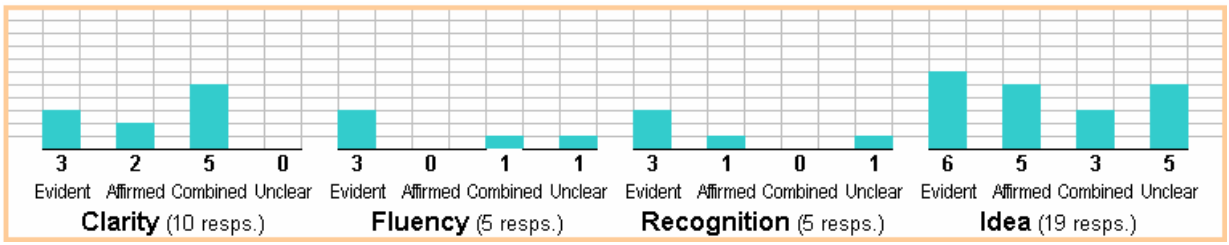


Fig. 6.1-FE Fixation by Discovery Experience (39 respondents)

INCUBATION

The nature of incubation is one of the key issues of insight. As the research in this thesis is essentially exploratory, finding signs of Incubation, rather than unravelling its mysteries, has been the first priority. The pragmatic view of Incubation as, *any interruption of conscious problem solving that later appears to have aided in attaining the solution* proposed by Kaplan & Davidson (1988, p.3) has been sufficient as a working definition. On this basis definite indications of Incubation can be found in the statements of respondents.

Recognition of incubation in designing

The first graph Fig. 6.1-IL below, shows variations in statements of relevance to Incubation, for different Insight Levels. This graph indicates that the experience of Incubation was evident or affirmed by, between 55 to 70% of respondents. The experience of Incubation was least common among the Insight Level 1 designers who tend to experience hot discoveries and appears to be most common (certainly most affirmed) by the Insight Level 2 designers. The first finding is unsurprising. Many discoveries made while consciously designing may well be a direct outcome of intentional cognition that preceded them. Moreover, the notion of Incubation may not come to mind, or seem unnecessary, to designers accustomed to making discoveries in the stimulating environment of a design session. It may be unnecessary to these designers.

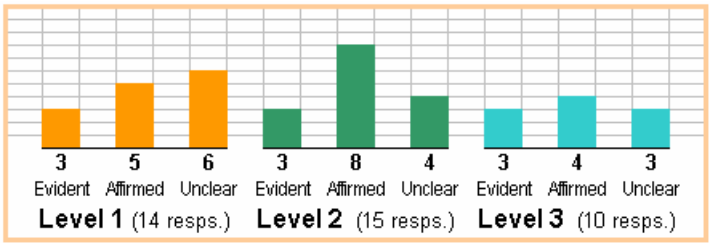


Fig. 6.1-IL Incubation by Insight level (39 respondents)

More curious is the high Affirmed figure for the Level 2 respondents, compared with the Level 3 group. Why respondents, who think their cold discoveries are more insightful than their hot discoveries, are less inclined to acknowledge Incubation is a curious result. However another graph Fig. 6.1-IE suggests that the Discovery Experience of Idea may be the influencing factor. This graph shows that many of the respondents affirming Incubation have reported Idea experiences.

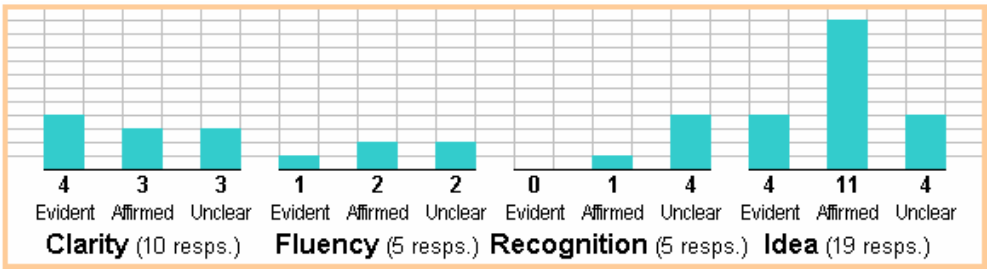


Fig. 6.1-IE Incubation by Discovery experience (39 respondents)

Incubation and latent preparation

There is evidence that a more complex and assertive mental dynamic, than what is commonly understood as Incubation, is an everyday part of the life of many designers. Experiences described by many respondents appear to be incubation-like, but vary from one respondent to another, in when, where and how they occur. The experiences appear to be scattered across a wide range of states, between active conscious designing and unconscious mental activity. The experience varies markedly in the extent to which it appears to be an unplanned, uncontrolled, undirected or unnoticed activity, that may take place at any time, during different states of consciousness and attention. It is clearly not only an unconscious process.

Some respondents recalled events where incubation appears to have occurred in their sleep. A26 described an incident when he went to bed thinking about his project and later awoke with a concept he could apply. P3, A05 and A27 also described experiences of waking from sleep, with a strong sense of knowing, that they had not experienced the night before. A31 offered a more general observation that:

> … often if you just simply go to sleep, you wake up in the middle of the night with the answer, because your brain keeps processing.

Many other respondents made statements descriptive of a process. A09 proposed that when, or while one has a problem, it is retained in the mind, subconsciously. A12 refers to ideas continuing to *tick-over* after leaving work. A17 described a combination of active cognition and a more passive process, in the background of other activities, that could be regarded as a form of incubation. A21 stated that he tries to *forget* about a problem if he gets stuck and then, later, *respond spontaneously* to the problem. He described himself *carrying around* several problems at a time, or having them *percolating away*. A23 described liking to *chew things over* and letting them *float around* for a while before pinning them down. A27 refers to the problem: *going round in your head*. A30 described himself as a great believer in things *ticking over in the mind, on a subconscious level*. A36 referred to *working out a problem without really thinking*. A37 referred to the thoughts as friends, because they are all *chattering away* in her head.

Some respondents described events in general, or an acceptance of latent mental activity going on while they are doing other things. A14 refers to unconscious workings, saying:

> If the problem's unsolved it doesn't disturb me. I do tend to think well, you know, "I'm going to rely on fixing that tomorrow." And often I do, yes. So I guess it's unconsciously working away and… rather than consciously trying to beat it out of you, you know? A14.

A20 also accepts that her way of designing involves unnoticed mental activity going on while she is doing other things and that sometimes, while in the midst of some mundane domestic task:

> ... it strikes you that there's a solution for something and then that just snowballs and pulls everything together, and I find that happens a lot for me. A20.

A13 associates incubation-like experiences with activity, like walking, making an observation that suggests a level of symbiosis between the physical and the mental activity:

> …It's funny, because you're absorbed in something else and somehow that frees... I mentioned walking, I mean, swimming and gardening, because you're doing something else, but somehow unexpectedly you think of it and things occur to you. A13.

The combination of the variety of these experiences and consistencies, from one respondent to another, suggests it is possible that:

- Incubation is only a component of a broader latent mental activity.

- The view of incubation as being an unconscious process does not fully account for the range of insightful experiences of many creative people, such as designers.

It certainly appears that the issue of whether incubation is a conscious, or unconscious, process is not critical to the investigation of insightful discovery. In the context of this study the latent activity may be regarded as latent designing. But in the broader psychological context it appears more appropriate to regard the incubation-like activity as Latent Preparation. The reasons for this are that, like incubation the activity precedes restructuring. It appears to invoke, or prompt restructuring and is terminated by the conscious realisation that is typical of restructuring. However, unlike incubation:

- There is no serious reason to doubt that mental activity takes place, since the respondents are periodically aware of what they are thinking about, or ruminating upon.
- The mental activity fluctuates between normal conscious thought, mental wandering, daydreaming, or a more dream like reverie state, to unnoticed and unconscious processing, including sleeping and dreaming.
- The activity appears to possess continuity from earlier conscious preparation, either sustained, as in a work session, or episodic, as in periods of conscious thoughts when attention is fluctuating.

RESTRUCTURING

The term Restructuring is used to mean acquiring a new understanding of a problem situation, more specifically reformulating, or changing the way a problem is represented. In Chapter 2 alternative conceptions of insightful resolution of problem situations, drawn from the Gestalt tradition by Mayer (1995) were reviewed. It was proposed that it is both convenient and sensible to adopt a broader use of the term Restructuring as a label for the critical event in the process leading to insight, to accommodate insight models from cognitive research that are not necessarily Gestalt based. This is intended to facilitate investigation of the extent to which different sources of insight are alternative forms, or components of Restructuring, or triggers that prompt Restructuring.

Restructuring Concepts

Concepts put forward by Mayer (1995 pp.8-25) included.

- Reformulation, which consists of two alternative modes, *suggestions from above* and *suggestions from below,* attributed by Mayer to Duncker (1945) and treated by Mayer as restructuring archetypes.
- Completing a schema, initiated by *schematic anticipation* of a goal, then filling a gap, may be regarded as both a structuring and a restructuring process akin to conjecture. This concept also overlaps with Sternberg and Davidson's (1982) concept of *selective encoding* and *selective combination,* in that schematic anticipation should be understood as being sufficient for encoding, or recognising both relevant items and a potential for, or a manner of, combination.
- Sudden reorganisation of visual information, when a problem solver literally looks at a problem situation in a new way, may be regarded as a visual restructuring.
- Finding a problem analog, or recognising that a new and old problem share the same underlying structure also overlaps with Sternberg and Davidson's concept of *selective comparison*.

Insight experiences

Respondents were not specifically asked about restructuring. However in the descriptions of discoveries by nearly all respondents some form of restructuring was evident and many described classic restructuring experiences that clearly fit the above categorisations. See Fig. 6.1-RL. Only two respondents described discoveries that appeared unlikely to have involved any restructuring. Respondents experiencing cold discoveries (Insight Levels 2 and 3) experienced proportionally more classic restructurings than respondents experiencing only hot discoveries (Insight Level1).

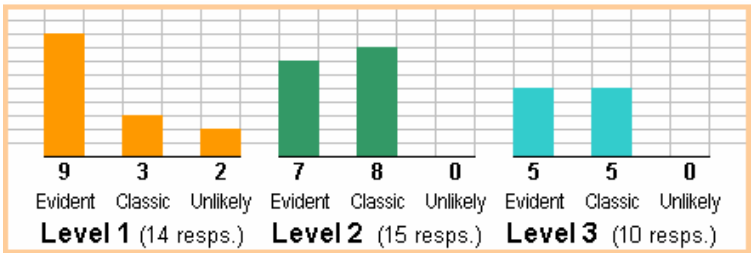


Fig. 6.1-RL Restructuring by Insight Level (39 respondents)

The discovery experiences, Clarity, Fluency, Recognition and Ideas (See Figure 6.1-EL, earlier) are associated with restructuring. The outcome of schematic anticipation may be a sensation of clarity or sudden reorganisation of visual information. Completing a schema may be associated with fluency. Finding a problem analog may be associated with recognition. However the differentiation between experiences is not exclusive. Some insights appear to result from combinations of experiences. Experiences may vary from event to event. There is a lot more to explore in this area. The structure of the summary which follows is based on the four discovery experiences. Descriptions of restructuring modes are included in the descriptions of the examples of respondent discoveries.

CLARITY EXPERIENCE

The Clarity experience, characterised by a distinct sense of realisation, rather than a specific idea, appears to be relatively evenly distributed over the three insight levels. The experience appears to have features in common with classic Gestalt conceptions of insight, such as Wertheimer's notion of *having insight into the problem* or *what* Kohler referred to as, *awareness of new relations among problem components.* Wertheimer (1959) Kohler (1929). The examples chosen below contain the sense of insight into situations and several refer to an awareness of relations.

A23 offered the view that because many of her projects are large they are not resolved by one idea.

> … it's not like a light bulb comes on in your head…. I think a lot of ideas, or clarity of thinking, probably comes when you're not actively trying to make it come. I think it comes when you're kind of relaxed, basically… I think it's more insight, less ideas, more insight. A23.
>
> Based on her recollections of the resolution of a screen design, A23 reinterpreted goals based on an understanding of the client and the possible influence of a previous project.

A21 described successfully coming out of an extended mental block, by deciding to relax and draw up what he had. It is likely that he experienced a restructuring associated with schematic anticipation.

> Even though I was in a very distraught state, I managed to become a little more peaceful, listening to this music and draw. And draw…with a little more care and a little more detachment, right? And I drew it, right? And then I thought, suddenly, "I had broken through", right? And I thought, "Well, I can make this so much better". A21.

A38 also appears to indicate schematic anticipation, when referring to the state of mind, early in the morning, which he described as *reverie*, when the mind is in a *strange state of flux*, when it is easy for your mind to *slip cogs*,

> … when you're thinking or relaxing… really your mind never stops working on things, … I'm working on things all the time, not deliberately, but, you know, you've got things to solve, they're always there… I could probably think about every job I've done at different stages… where you actually, somehow realise that suddenly it's all going to go together… A38.

Schematic anticipation may be the driving factor when, sometimes, clarity is combined with or followed by fluency. A19 describes himself becoming totally fluent with a project, like being fluent in a language, in the sense that all things are understood at once. He indicated that individual "aha!" discoveries are not a significant factor in his designing.

FLUENCY EXPERIENCE

The fluency experience, characterised by a succession of ideas, was most commonly associated with insight level 1 experiences. In one classic instance, described by A30, instead of working towards a design by trial and error, the design was simply transferred from mind to paper, in a relatively continuous manner with few changes or corrections. One might expect this fluency would be preceded by some sense of clarity, but clarity is not always present beforehand. It may emerge as the transfer

proceeds but it may not. A30 found he was unable to draft the design from his sketch. Instead he made a scaled photocopy and traced over it. This suggests that schematic anticipation, if it occurred, was short lived, or that the restructuring may have occurred internally as a sudden reorganisation of visual information.

A29 described the restructuring of an existing design solution, that she realised was unfeasible, as coming suddenly, after a site visit. This description may also reflect the experience of a sudden reorganisation of visual information.

> … I just started drawing it and realised … it was like the whole thing came out of nowhere, not out of nowhere… it just sort of fitted together … and then you spend another month trying to work out how it actually works. But essentially the concept was just … all at once… A29.

RECOGNITION EXPERIENCE

Recognition experiences typically occur when the designer encounters something seen, or thought before and perceives in it, something that was not appreciated before. It appears to be more strongly associated with insight Level 1, see Fig. 6.1-EL, (in 6.1.1 under Preparation). There is variety in recognition, characterised by different degrees of directness and remoteness that may be outcomes of recognition occurring through alternative forms of restructuring, such as schematic anticipation, or finding a problem analog.

A34 recalled an experience when reviewing a number of planning options. After reconsidering different aspects of the project, one formerly undistinguished alternative was suddenly recognised as the best option. For A15 and A16 the object of recognition was a sketch, among over one hundred sketches of many different things, containing a form that the respondents suddenly recognised as an ideal façade treatment concept, when it was rotated through 90 degrees. This appears to have been more of an analogical recognition than A34's.

In a more remote example, of an analogical recognition, P4 recognised that an old and familiar shopping centre, near where he lived, contained a vital ingredient to resolve a planning problem in a new development. Another remote example was provided by P2 whose idea for her Masters thesis emerged after seeing a book by Edward de Bono, called Parallel Thinking. This prompted a series of thoughts leading to the analogy of the end of illuminated manuscripts.

IDEA EXPERIENCE

Idea experiences are typically classic "aha!" events, when the discovery may be a specific solution to a problem or a generator upon which a design can be based. They are a markedly more commonly associated with cold discovery, level 2 and level 3 respondents.

Three insight level 1 designers reported idea experiences, P1, A17 and A27. Graphic designer P1, referred to a resumption discovery for the recent design of a logo. Restructuring was unclear in that case. A17s recollection of discoveries, like P1's, was mostly of incremental steps towards constraint driven resolution of designs on restricted urban sites. However, recalling two exhibition design concepts, he said:

> … when working on exhibition designs sometimes you need ... a big idea and… finding that big idea… is quite good and revealing. A17.

A17 recalled two examples of ideas that involved restructuring by means of analogical transfers, from the ear to music in one case and the use of a spiral as a way of orbiting around and towards a displayed artefact, like the Guggenheim (New York), but inward looking.

A27, is an exception in being classed as an insight Level 1 designer, in spite of recalling two idea experiences that were both cold discoveries. Both were solutions to problems, the first from her student days involved restructuring by means of analogical transfer. The other was more recent but ultimately was not used. The level 1 classification was made as a result of A27's very limited experience of design discovery. She had only recently returned to full time architectural work, following several years raising young children.

Nine insight Level 2 designers and 6 level 3 designers reported a considerable variety of idea experiences. The actual ideas are outlined in Chapter 5 and described more fully in Appendix 2 – Respondents, tables and transcripts. Brief observations and impressions of the ideas that I regard as noteworthy, follow.

The first is that idea experiences, in the form of cold discoveries, are arguably as close as one gets to having "ideas out of the blue" or "flashes of inspiration", referred to skeptically and almost disapprovingly, by some respondents. However the reality of these discoveries offers no support for a dismissive view. Most, if not all of the reported ideas embody solutions to problems that were on the respondents' agendas, and probably their minds, in one way or another.

While painting, and not intentionally designing, A02 recognised he could use the painting to present the design of a house in an attractive rural setting, an apparent restructuring by suggestion from above. While swimming A03 realised a combination of plan and section configurations enabled her to capture the north easterly breezes by means of a curved courtyard, an apparent schematic anticipation. A07 described an idea, while having a walk, which resolved the problem of attaching an extension to a major museum in the USA, by one well known architect, for whom A07 was working as a junior, possibly a visual restructuring. A09 reported two problem solving discoveries, one about spaces, in a current house, an unclear restructuring. The second, about his way of communicating with clients, involved a reinterpretation, which led to different design goals.

A13 described an idea for a radial form which transformed the design of a house she is currently working on, an apparent schematic anticipation, or a sudden reorganisation of visual information. A25 woke at 3am with the idea for a roof and skylight treatment over a two storey space. While looking around the site, A32 recognised a configuration for a townhouse development, fundamentally different to earlier plans, based on the analogy of early 20th century angled and stepped terrace houses in the same street. While stimulated by her participation in a weekend course with other architects, A33 realised she could solve a design problem, by rotating the upper floor of a building through 90 degrees. Two separate restructurings were involved in this event, a reinterpretation of goals and, possibly, a sudden reorganisation of visual information, achieved without drawing. A36 realised that a major project for two adjacent international water sports venues could be much improved by joining them with a large common entry. The restructuring in this instance may be similar to A33's experience

Another feature of many of these ideas is that they were not necessarily retained in their emergent form in the final design. Generally the main idea was retained, but the value of the idea was not just in the idea itself. It was also in the power of an idea to stimulate fresh approaches, in effect to clear out fixations. For example, as A25 remarked about her subsequent design and the discovery:

> … it ended up being quite different, but it started the whole thing going. A25.

The ideas of the insight Level 3 respondents do not appear to be markedly different to those of the Level 2 respondents. In other words their cold discoveries appear to be alike. But the Level 3 respondents (by definition) regard their cold discoveries as more insightful than their hot discoveries. For example: A16 said that he found the stronger ideas, when not trying to come up with something. When driving from job to job an idea could come from no-where. A31 viewed cold discoveries as important because they tend to solve problems that have frustrated earlier attempts at solution. A33 values cold discoveries, because they are more likely to affirm her design aims than the more conservative ideas generated in the more pressured and constrained circumstances of her office working hours.

It appears likely from the views expressed by these respondents that attitudes to cold discovery are individual and factual only in the experience of the recipient. Some respondents, such as A21 are stimulated and thrive while immersed in the office setting, while their *mind and hand are as one*, while others like A38 are neutral, seeing it *all as one. …it's just me still working*. But there are others again, like A16, who feel inhibited by the constraints of the office hours setting, or like A31 who have come to appreciate cold discovery as a way of finding solutions that don't come to them when they are trying to find them.

"AHA!" FACTOR

Approximately half of the respondents described sudden gratifying discoveries, either in terms that can be regarded as evidence of "Aha!" experiences, or discoveries, or they described classic revelations often using terms like "*Aha!"* or "*Eureka!"* to describe their experience. As shown in Fig. 6.1-AL the Insight Level 1 respondents were the most definite about their discoveries. They have the highest rate of "Aha!" discoveries and the highest "No "Aha!" rate. The Insight Level 3 respondents are the least definite with the fewest positives and negatives and the most unclear responses. It is possible that the association of level 1 discoveries with design activity, and perhaps with partners, or other designers,

may render these discoveries as more dramatic and *aha!-like* than ideas that occur while swimming laps or during some other unrelated activity. The Insight Level 2 respondents appear to be in between the Levels 1 and 3, literally and in terms of their "Aha!" experiences.

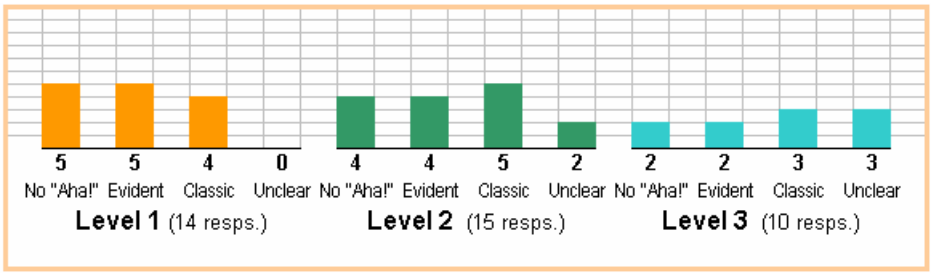


Fig. 6.1-AL "Aha!" factor by Insight level (39 respondents)

Plotting the "Aha!" factor against Discovery Experience suggests that discoveries involving Fluency and Recognition experiences are more likely to be regarded as "Aha!" discoveries than discoveries involving Clarity experiences or ideas. See Fig. 6.1-AE below. Two reasons may be influential here. 1) Fluency and recognition experiences are unusual and perhaps more dramatic and memorable than Clarity experiences and ideas. 2) Clarity experiences and Ideas have scored their high No "Aha!" incidence for a variety of reasons, including not being sudden, (eg. A21) developing through methodical work, (eg. A06, A11) matter-of-fact attitude of designer (eg. A38, A32) and unclear descriptions. (eg. A07, A31, A33).

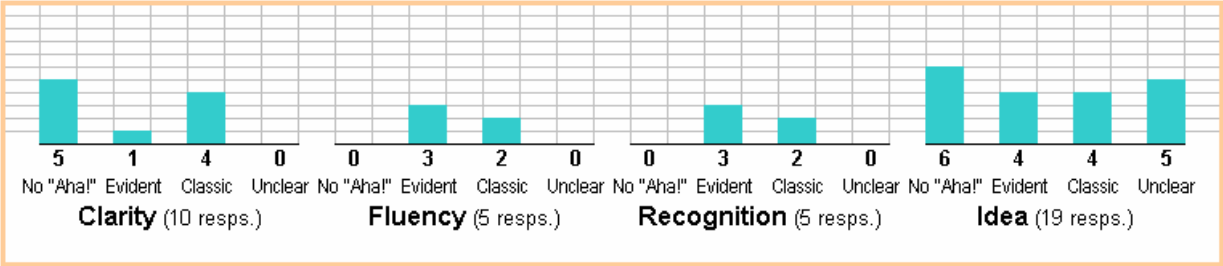


Fig. 6.1-AE "Aha!" factor by Discovery experience (39 respondents)

6.1.2 Cold Discovery Experience - Hypothesis 2

Respondents reporting discovery experiences that support Hypothesis 1 and 2 are categorised as Insight Level 2 designers. The discovery experiences of these respondents are frequent and variable, like those of the Insight Level 1 designers. However, many of the discoveries made by the Insight Level 2 designers are *cold* discoveries, occurring when they are not designing or not intentionally thinking about a particular design. Apart from the timing and context of emergence, the *cold* discoveries experienced by the Level 2 respondents are not very different from their *hot* discoveries. The Level 2 respondents, by definition, do not consider either *hot* or *cold* discovery to be more insightful than the other. Some did not acknowledge, or appeared not to have noticed, any differences between the discoveries at all. Others observed that the hot discoveries are more likely to reflect their current activities and thoughts, but made no distinction in terms of quality or insightfulness.

COLD DISCOVERIES

It was evident, from remarks during the interviews, that many respondents are not self conscious about their designing. This may influence some observations. Level 2 respondents, in particular, refer to hot and cold discoveries as being similar, or the same, but some indicated that they had rarely thought about matters at the heart of this study, prior to their interview. Perhaps with more thought some distinctions might emerge. It is also possible that both the hot and cold discovery experiences of the Insight Level 2 designers are different from those of the Level 1 designers. This possibility has not been deeply explored, but comparisons of the Components of insight against Insight Levels 1 to 3, in the previous section (6.1.1 on Hypothesis 1) indicate some differences.

Based on their interview statements, the Insight Level 2 designers:

- Spend, or apparently need to spend, less time on preparation, than Insight L1 or L3 respondents. See Fig. 6.1-PL
- Have a similar distribution of Fixation experiences as other respondents. See Fig. 6.1-FL
- Are more affirmative of Incubation, than Insight L1 or L3 respondents. See Fig. 6.1-IL
- Report proportionally more *classic* restructuring experiences than Insight L1 respondents. See Fig. 6.1-RL
- Have similar distribution of "Aha!" experiences to other respondents. See Fig. 6.1-AL

The cold discovery *range* is likely to be wider than that of hot discoveries: 1) because potential cold discovery time is likely to be more extensive and diverse in character than designing time, and 2) because there is potentially greater diversity in the way cold discoveries may be cued, both internally and externally. Cold discovery time is greater in its extent than hot discovery time, even for a designer who works very long hours, because the amount of time a designer spends on one particular matter is normally small, in comparison with all of the matters they may be considering. There are indications that, incubation-like, latent preparation doesn't only occur when a designer is not designing, but can also occur when a designer is thinking about, or designing something else, either another design, or another aspect of the same design.

Hot discoveries are more likely, than cold discoveries, to be associated with, or cued, regulated, or constrained by, a designer's intentional actions and thoughts. Some Level 3 respondents have distinguished hot discoveries as being more likely to be associated with a current point of focus and perhaps more grounded than cold discoveries. It wouldn't be sensible for designers to sit at their desks working and concentrating their attention if this was not the case. Designing is a serious business and most respondents are clearly serious about their work.

The origins of a cold discovery, while not random, may be any event or sensation perceived by a designer. Cold discoveries can take place over a wide range of conscious states, which broadly speaking are of two types. The first, or rising state, includes discoveries that emerge, from the moment an individual wakens from sleep, when previously not conscious at all, to the intentional commencement of designing. The second, or setting state, starts from the corresponding back end of designing, and progresses down to a resting state. There can be partial rising and setting states during the course of a day, with multiple design sessions, or a long session occupying more than one day. But, all other things being equal, this great variation in waking states can reasonably be expected to provide a greater diversity of internal circumstances from which discoveries may emerge, than the context of being at a work location, designing.

Cold discoveries are likely to be less influenced by the immediate preoccupations that characterise a designer's mind at work. It is likely that for some respondents, internally cued *cold* discoveries can occur at any waking time regardless, of the outward actions of the individual. Internally cued *cold* discoveries can be expected to reflect impressions that have left a mark in the designer's mind, perhaps more influenced by recency in the setting state and perhaps more broadly based in the rising state. Externally cued *cold* discoveries are typically associated with things the respondent saw or heard and then associated with a design. The fact of association also influences the content of externally cued discoveries. Externally cued *cold* discoveries are likely to be far more diverse than internally cued *cold* discoveries and *hot* discoveries, because the number of potential external cues is so great. Something on TV, or read in the paper, glimpses of things seen between home and work. Any of an infinite variety of stimuli, beyond the containment of memory or the work place, may prompt discovery in a receptive mind.

Some respondents are wary of cold discoveries because, in their experience, the ideas sometimes reveal inadequacies when subjected to the rigors of a scaled drawing. Cold discoveries are typically made when external representations of a design, or its context, are not present. The absence of detail is possibly both a shortcoming and an enabling factor. Accurate media may inhibit thought, or cause fixations. Whether these factors lead to more cold discoveries that are useful, or many more that are useless appears to be an individual factor.

It has not been possible within the time constraints of this study to explore attitudes to cold discovery further or more deeply. A number of questions of extent appear to be worth further investigation, including: 1) How much does the quality and frequency of cold discovery improve, with practice and success. 2) How much does the experience of defective cold discoveries inhibit further cold discovery, and 3) How consistent is the genesis of cold discovery for particular individuals. Many respondents associate discoveries with particular places and times, but do they also have similar types of discoveries, or variations on a few discoveries. Do they have many small ones or a few big ones?

It is possible the contexts may be described in terms of different degrees of *hotness*, different qualitative aspects of *hotness* or by reference to other factors. Items of relevance to context are reported in the respondent descriptions below. While this aspect of discovery is confined to observations in the current study, it will be investigated more actively in future studies.

OTHER ISSUES OF COLD DISCOVERY

The terminology of hot and cold discoveries is metaphoric, simple and convenient, but is not informative of process. However, statements by many respondents contained indications of process, that could lead to additional findings. Two types of respondent who stood out as different in this context are those with well developed visualisation abilities and those who made discoveries in the *border zones* between active designing and not designing.

Several respondents possessed unusual visualisation capabilities that enabled them to design at any time. P3 described a combination of visualisation and an *all-hours* action style. A32 also described an ability to visualise space well, without seeing it in drawn, or real, form and the *all-hours* action style referred to by P3. These are briefly described below.

Visualisation and action styles

For some respondents there is uncertainty whether discoveries they make, outside normal working times, or places, are actually cold discoveries. Foremost among these respondents are *visualisers,* or respondents with varying combinations of developed three dimensional visualisation skills and retentive visual memories. Several such respondents possessed unusual visualisation capabilities that enabled them to design at any time, which they did.

P3 was the first to describe a combination of visualisation and an *all-hours* action style, as in the following statements

visualisation

> I can actually design a whole space in my mind, and I get frustrated that somebody hasn't kept up with me... I can jump very quickly mentally… P4 (husband and fellow architect) has to actually externalise… he cannot visualise it in his mind.

action style

> I will constantly think about my work, whether I am in bed or not. So during the day... if I am not distracted, my mind will be virtually doing checklists of outstanding work, or unresolved things...my 'bus' just does not stop. I thrive on… coming up with solutions...

A32 also described an ability to visualise space well, without seeing it in drawn, or real, form and the *all-hours* action style referred to by P3:

visualisation

> I seem to be very good at visualizing things in my head, without needing to put them on paper and I can actually work through a number of different options and have gone through and worked out which ones worked, which ones have flaws, before I commit to paper.

action style

> I lie awake at night… I'll be sitting driving my car, I'll be doing, whatever and it's all going through my head, but I don't have to wake up in the middle of the night and grab a sketch book, you know, I seem to be able to hold it there.

A34 stated that she possessed a strong visual memory for small projects:

visualisation

> I can actually think about how a space will look in my head and I think that is a strength that I have got… but it's probably more for small projects… I can actually visualise how something might look and try to work out a solution and … a lot of it is sorted in my head, before I actually draw something.

I asked A34 if she is constantly thinking and received a response that matches P3 and A32.

action style

> I'm constantly thinking, all the time, I go to bed at night and I think about work and I dream about work, I

dream about meetings, I dream about presenting. I'm on the go all the time. My mind is constantly going.

A36, while not claiming to be a constant designer, also described a pattern of thinking about designs when not at work and the ability to visualise without a drawing, as this next statement makes clear.

action style and visualisation

... I think often… when I'm asleep, you know, or relaxing, when I'm not actually thinking too hard and, I find sometimes quite surprising, how I can actually, just in my head, work a problem without… the paper in front of me. I can actually move things around in space, as if I'm working on a drawing and then just come back and draw it later.

A10 described herself as someone with a good visual memory. She made no reference to the use of visualisation skills in designing, but instead designs by sketching. In terms of visualisation she said:

visualisation

I think I've got quite a good visual memory. Almost like a photographic memory in some ways… I sort of remember things to great, sort of, detail … especially spatially, I think I've got a very good spatial memory. Which serves as… a little encyclopaedia of spaces to refer to.

action style:

I probably do it through processes of sketches, you know, sketches and site inspections of ideas.

A12: described visualisation skills that assisted her designing. However her action style has been constrained, if not cramped, by recent motherhood:

visualisation:

I suppose I've always had an ability… to understand how things go together and … even by eye, what looks to be the right… sized member to go into a particular place … and thinking in 3D too, I've never had any trouble imagining things as they will be when they're finished, or from a drawing, or whatever.

action style:

… when I'm at home I don't think about the office at all. Not because I don't want to, but I've trained myself not to… before having children, I used to think about projects all the time and dream about them … conceptualize things in dreams and I suppose I do that a bit still. But, since having children, I have decided, and being married to my partner, who I work with here… [at home] we basically don't talk about work at all.

BORDER ZONE DISCOVERIES

A second group of respondents, quite unlike the first, but sharing the hotness-coldness issue are individuals who are rarely, or never interrupted by cold discoveries, during any of the non-work activities that have been described. They may experience as many discoveries as anyone and their discoveries may be as good, but they come at particular times or places, associated with designing.

Resumption discovery

P1, was asked whether design ideas unexpectedly ever come at times when he is not designing, he replied that he doesn't think about design at such times. When he gets stuck, P1 consistently redirects his attention from the stuck project to another of, commonly, half a dozen other jobs he may be handling at any time. When asked if breakthroughs for one job "A", came while he was working on another "B", he said that never happens, the breakthroughs only come after returning to the first job..

I always concentrate on job B. I would be working on job B. I wouldn't even think about job A… When I'm on the second one, all my concentration is on the second one. It's when I finish the second one, when I come back to it (job A) … thinking back now, that's like having a coffee break, except my coffee break isn't a coffee. My coffee break's another job.

A19 stated that leaving a problem for a while has led to many discoveries, but not necessarily cold discoveries. I asked specifically about times of realisation and he replied as follows:

It actually has happened driving, in the shower, or other places, but not generally. It's generally when you've gone back into it and have absorbed it... all the problems are in there, somehow, in your brain and … for that moment you sort of feel… whilst there's a sense of frustration, there's a sense of power because you've actually got all the pieces there.

This answer suggests that *resumption* or *warming* discoveries tend to emerge not long after resuming design activity, while the sensation of holding all the pieces is strong.

Immersion discovery

P4 stated that he completely relies on ideas just coming to him, but this tends to occur in the work setting although not necessarily when he is working. He described a conceptualisation method of approaching problems indirectly, by playing around with the components. In that playing a pattern may be seen or breakthroughs occurred, after 'stepping back and abstracting, but rarely, if ever, when P4 is completely removed from a project. They occur when the ingredients are "in play", or when "the material is there". P4 appears to need the stimulus, or reassuring familiarity of seeing his sketches or notes, or being at one of his regular places of work, or having his sketchbook and pen.

6.1.3 Cold Discovery Insightfulness - Hypothesis 3

Respondents reporting discovery experiences that support Hypothesis 1, 2 and 3 are categorised as Insight Level 3 designers. The discovery experiences of these respondents are also frequent and variable, like those of the Insight Level 1 and 2 designers and many of the discoveries are *cold* discoveries. However, these respondents regard their *cold* discoveries as more insightful than the discoveries experienced while designing.

AFFIRMATIONS OF COLD DISCOVERIES

Respondents were not asked directly whether they thought cold discoveries were insightful, nor were they prompted in that direction. Terms such as *insight* and other Gestalt concepts relating to insight are not mentioned during the interview, unless the respondent raises them. Respondents were simply asked how their *cold* discoveries compared with discoveries made while working. While not necessarily thinking of insight related features many respondents distinguished cold discoveries, clearly and positively.

More insightful

Some respondents observed that their cold discoveries were simpler or clearer than earlier thoughts while working, or affirmed that an incubation-like period, preceding the discovery, enabled clarification to occur. These include:

A04

> I think the associations. You get the sense of bits clicking together in a simpler way, in a simpler way because it's happening in your head. All things are possible and there's a clarity that sometimes … when you're drawing you sometimes just realize the complexities of things… in the head, in those serendipity moments. It just is … it becomes effortless, the connection... … I think you build a project in your head in some ways and… whether you're drawing it, or making models of it, or working on the computer. And somehow the construct is really developing in your head as well, so that you can… get really strong design connections working within your head, which are sometimes very hard to explain.… I mean you don't have a bloody model of it in your head, but you've got an understanding of the idea. A04.

The source of the greater resolvability referred to in the next observation was not specifically described. Resolvability may be an outcome of greater clarity, of the idea being more essential, or unencumbered by details A07 would be holding in mind, at his desk.

> … in the initial sense there's not that much difference, but by the time I get an idea that I've come up with whilst I've been out walking or something, down onto a piece of paper, I find that it's a lot more resolved or a lot more resolvable than the ideas that I've been struggling with at my desk. A07.

A13's observations have points in common with A07, the *gist*, or the *guts* may be regarded as meaning the essence. The realisation need not always be something new. A good idea may already be in the design, but sometimes the designer may be slow to appreciate that it is *the* important idea.

> Sometimes they don't translate in detail, but the gist will work. The guts will be there, because you're not constrained by scale. Maybe [you are] thinking of the visual, thinking of the essence a bit more. A13.

A05 affirmed this general view, qualifying it with the observation that the novel or less familiar cold discoveries are more likely to require testing.

> Stronger, better, but need testing... I don't know if I really get the strong ideas at the board. I don't think it

happens that way. A05.

Valuable aspects of a design

Some designers differentiated their cold discovery types by reference to different, but valued aspects of their designing, or of a design.

KEY ELEMENTS

A31: observed that the designer sets out with a conscious agenda of big strategies, but then encounters certain key things which may be problematic.

> When you are working you are attacking the big strategies which require certain key things in order to work. It is the key things that you mull over, that make it different, that need to be solved. They are the things that make this thing different ... maybe a junction. Often it is the practical things that make the design work. A31.

I asked A07 if he could recall the extent to which discoveries might be the outcome of work done before hand, or just ideas out of left field. He replied:

> Bits of both, really. I find that things which I've partially resolved, or resolved in other ways before, I find I come to a lot more easily than things I haven't thought about before and it's often things that I haven't thought about before that I actually need to go for the walk. Do the yards. A07.

EXPLANATIONS OF LEVEL 3 INSIGHTFULNESS

The reasons for perceiving cold discoveries as more insightful than hot discoveries are both, quantitative and qualitative, partly situational and possibly associated with habit as well.

Three clearly different types of perceptions are evident in respondent statements

- Negative factors associated with work situations
- Positive factors associated with non-work situations
- An incubation-like, latent preparation process

These three perceptions are describe and illustrated with respondent statements, below.

Work situations

Some respondents tend not to make discoveries in the work setting, or in the intentional acts of working, or they consider discoveries unlikely at those times.

WORK CONTEXT

Negative remarks by respondents about the work context refer to distractions such as noise, interruptions and office responsibilities. These items, individually or in combination, were thought to render the office unsuitable as a setting for discovery.

A05 described the negatives of the office situation and the positive importance of calming activities, like being in the shower, or walking, doing things other than being at a board designing.

> You know, you are sitting in an office, the phones are ringing. It's just not that kind of a space. I think for me. I have to be quite alone, in quite a solitary place… I do a lot of thinking in the shower... all that running water, I find very good... it's the calming... I think it takes the pressure off, because you're not actually sitting at a board designing... You're doing things... I am one of those people that has to exercise, so that's an important thing to me... probably a calming thing for me. A05.

A15 didn't like to spend office time conceptualising.

> I feel guilty sitting at my desk designing. I feel I am time-wasting, paying for child care for two children. A15.

DESIGNING

Some respondents expressed the view that the actions of work, or actively trying to design, tend to inhibit, or are not conducive to discovery and achievement of the best ideas.

A40 acknowledged both, the inhibitory impact of interruptions in the busy office situation, and also added reservations about the solutions ground out through the actions of working.

> I don't find that by sitting there trying to, sort of, grind it out really works, because I don't think you end up with a good solution that way... A40.

Non-work situations

Non-work situations have been associated with recovery from fatigue. Kaplan, Kaplan & Ryan (1998, pp. 17-22) have described effects of being inundated with information and the toll paid in attention and effort, leading to *mental fatigue*. They propose that, as the tiredness of mental fatigue is related to the need to focus attention, it does not preclude doing something physically demanding and they describe certain enjoyable activities and restorative settings that facilitate recovery from mental fatigue.

Some respondents make discoveries at work and non-work settings, but regard the non-work settings and activities other than designing as better in ways that suggest greater insightfulness - see A05 cited above. Other respondents referred to actions which reduce pressure, calm or relax them, or create a better state of mind.

A23 contrasted the actions of working and not working

> I think a lot of ideas, or clarity of thinking, probably comes when you're not actively trying to make it come. I think it comes when you're kind of relaxed, basically. A23.

A16 also described the non -designing ideas as;

> Stronger, when not trying to come up with something. A16.

A07 affirmed both the frequency and greater resolvability of cold discoveries.

> They always come to me unexpectedly, when I am not designing. I find that it's when you stop thinking about a problem that you are most likely to come to some understanding of how to resolve it. It comes again with taking yourself out of the familiar… in the initial sense there's not that much difference, but by the time I get an idea that I've come up with, whilst I've been out walking, or something, down onto a piece of paper, I find that it's a lot more resolved, or a lot more resolvable than the ideas that I've been struggling with at my desk. A07.

Latent preparation process

Statements indicative of an incubation-like process referred to the following distinct attributes of latent preparation.

- Ideas forming without apparent conscious effort
- Emergence of complete, formed ideas that would be unlikely to arise incrementally

A05 described the subconscious formation of ideas as an outcome of constant looking at the work and asking questions.

> I think what we do is, we're always looking, looking, looking. "Is it right, is it right, is it right?' you know? So, I think, if you're asking that question, then it's going to come to you… I think they do come suddenly… I think they're, maybe subconsciously, they're kind of there forming and then, all of a sudden, it comes into the conscious realm. A05.

P2 described the discovery of a concept for her Masters thesis about the impact of computers on print media such as books, while she was organising her book collection into stacks. She started to look at Edward de Bono's Parallel Thinking and was reading about the dialectic approach, when her own thoughts took over.

> I ended up deciding that instead of just, sort of, dealing with the end of print, because the computer's come along, you know, "what happens with books?" [but rather] to look at where this had happened before. And where it had happened before was with illuminated manuscripts... [Once there] was a huge industry, of designing and making these incredible books. And along came the printing press… there was this wonderful contrast of the two, for me… Now that just came out of stacking some books. I would never have just come to that. How would I have come to that through some sort of logical process? I wouldn't have.

NOT AFFIRMATIVE

A variety of less than affirmative comments were made about cold discoveries. No respondents described *cold* discoveries as less insightful than *hot* discoveries. However, it is possible that non-

insightful cold discoveries might not be perceived as discoveries at all and may be soon forgotten. Forgetting has been a noticeable factor in this study, as many respondents, after saying they experience cold discoveries *all the time,* or *very often*, have been embarrassed at being unable to recall any.

Statements by respondents, who can recollect cold discoveries, but do not view them as more insightful than hot discoveries, can be categorised as follows.

- Slightly positive, minor, unimportant or peripheral - A11, A25
- Neutral - A03, A20, A21, A29, A32 and A39 described cold discoveries as alike, undistinguished, or interchangeable with hot discoveries.
- Unclear, unsure - A30, A34, A35
- Slightly negative - A01, A26 and A28 expressed reservations about the substance, robustness and reliability of cold discoveries, or referred to deficiencies, once cold discoveries are subjected to the rigors of a scaled drawing.
- Can't recall or nothing to describe - A08 and A18

6.1.4 Summary of Incremental designers

Not a lot is said, in this study, about the small group of respondents categorised as incremental designers. This is partly because they are so few and also because this study is about the many who are insightful. Six of 45 respondents are classed as Insight Level 0 and four of the six simply could neither recall nor describe any discoveries they had made. These four may not be entirely incremental in their designing, although their statements indicate that their success as designers owes little to insights. The other two, of the six, described their designing using explicit terms that are readily associated with incremental, rational design.

It is not clear from this study that being insightful, in one way or another is advantageous or conversely, that not being insightful is disadvantageous. Insightfulness may be a characteristic of particular minds, one of many that are not user serviceable. As already stated, this is a big issue for later research.

The present study focuses on exploration of the many, who have shown signs of insightfulness. However the thoughts of the few who are incremental, or who appear to be, are also informative. In the context of this study they are possible pointers to further research in several directions. Two such pointers are attitudes towards insightful discovery and attitudes towards collaborative design. A third factor, failure to recall discoveries, could also be of interest in future research, but this has not been examined in depth at this time.

SKEPTICAL VIEWS OF INSIGHTFUL DISCOVERY

The two respondents most associated with incremental design made statements that indicate a degree skepticism of the value of insightful discovery.

A28 expressed misgivings about the notion of discovery almost before the interview began, after reading information I provided about the study.

> When I was reading this… I think it was the discovery kind of thing that jarred with me, or concerned me, because I'm not sure how much discovery architects actually do. A28.

A28 referred to one of his houses where, he affirmed, the conceptual development of the design owed little to discoveries and more to precedent. He appeared to possess a view that inspirational ideas tend to be made in an instant, are superficial, or oversimplified and overlook vital aspects of a project.

> I've never dreamed a solution and if I have they never work. But yes… quite often you'll be doing something and some idea might sort of spring to mind, and [you] sketch it down… I'm sure every architect does it… I probably enjoy the ones more, that I make while I'm working and that maybe comes out of… the methodical problem solving of going through and of being able to, almost like a jigsaw puzzle, assemble all the pieces and put it together… A28.

The last statement leaves no room for doubt that A28 is an incremental designer and happy about that. However A28's statements give an impression that he associates insight with ideas coming to mind before engaging with the work rather than after. This is clearly at odds with the experiences reported by the insightful respondents and Gestalt insight theory, and suggests the possibility that A28 may be fixated on a non factual view that could inhibit his designing.

A01 also referred to his work as methodical. He described his approach as deterministic and expressed a view of insight as a chimera, which, to me, suggests ideas that are wild, fanciful and perhaps superficial or illusory; certainly not deterministic.

> For me the process... rather than some sort of flash of inspiration, it's usually finding that a deadline has crept up and then suddenly you have to have something for the next day, or for that afternoon. So you just sit down and you just start drawing and you draw it at the stage that it is… And that usually, in a sense, moves the project onto a new plane, because it suddenly brings out all of those things that have been floating around, but are not yet articulated. A01.

What A01 is proposing, in my view is a likely experience for every designer, inspired or otherwise, when a deadline is looming uncomfortably close. A01's statement could be interpreted as skepticism of cold discovery, rather than insight.

Statements by another respondent, A21, an insight level 1 designer described in Chapter 5, are not dissimilar to those of A01, but affirm the experience of insight. He described how a variety of experiences might trigger insights, but also describes a particular transformative view of insightful restructuring, which he associates with working.

> … things happen as one explores and starts sketching… Things rarely happen out of the blue... nothing exists in the void is my feeling… It's more stimulated by something, or it's a general disposition my mind might be in... it's consistent with this idea that thing's transform, they don't just appear... the closest I experience to that is in the immediacy of actually working… when my mind and hand are, kind of, one. A21.

I would propose that the views expressed by A01 could be based on misconceptions about insightful thinking. Insights may be unexpected in their timing and their content, but these characteristics need not affect the basis of an insight. It appears much more likely to me that the rationality, or irrationality of an insight, is very likely to be a function of the individual receiver. It is possible, also, that A01 may sometimes be insightful, when he is articulating (as he put it) *those things that have been floating around,* in a rational way. He may be like A21. A21's experience supports Wertheimer's interpretation that, while insights may be sudden, they represent new understandings, rather than something out of the blue. Wertheimer (1959, pp.210-212) There is no compelling reason to consider insightful discovery must be wild or fanciful. Very often, like the answers to insight puzzles, insightful ideas can seem to be quite mundane, once they are known.

COLLABORATIVE DESIGN

Among some of the respondents who provided the fewest indications of insightfulness there are consistencies that could warrant further study. Three individuals in particular (A18, A28 and A24) are husbands of partners with higher insightfulness scores (A05, A27 and A12). For these individuals an absence of insight indicators may be associated with one or more of the following.

COMPLEMENTARY FACTORS

A trend evident in this study is that partners rarely have similar strengths and weaknesses. These differences could be associated with inherent differences in discovery processes. It is also possible that respondents may knowingly accept particular roles in their practice, which complement the activities of partners and which increase or reduce the likelihood of insightful discovery experiences.

ATTITUDES ASSOCIATED WITH COLLABORATIVE PRACTICE

Other collaboration factors are also in play. Both A24 and A28, with their partners, are directors of practices having at least six full time staff. Both strongly advocate collaborative practice and downplay notions of individual ownership of ideas. Some other respondents who lead practices also work with teams or committees that include clients and other stakeholders. A logical outcome of group-friendly attitudes like these and the reality of collaborative, working configurations, is that discoveries recalled by some respondents are acknowledged as the result of group discussions or workshopping. Therefore, while it may be insightful for an employer to involve, manage and draw out the creative best

from a group of workshopping staff, on a daily basis, this individual will show fewer indications of insightful designing, by not claiming discoveries that are the outcome of a process that he or she, effectively owns.

EFFECTS OF RESPONSIBILITY SHARING

It is also likely, when projects are the work of a team, a respondent, whether a leader or simply an active participant may be less preoccupied with a project than when individually responsible for it.

6.2 THE RESPONDENTS

Most of the respondents of this study have four points in common, 1) They are experienced and accomplished professional practitioners, 2) They are highly motivated in the performance of their professional skill, 3) They perform their conceptual work insightfully, and 4) Most have developed methods of dealing with unsolved and temporarily intractable problems by adopting behaviours that, at least, appear to be a practical acknowledgement of the reality of insightful thinking. Nearly all appear to have evolved different methods of discontinuing active designing, when they get stuck. Common sense suggests that the last mentioned behaviour is associated with self-confidence, that at crucial times, when the respondents need, and are trying to think of an idea, that the *back-off* approach is as likely, and perhaps more likely, to result in useful design outcomes, than persisting. Some respondents do persist, but the evidence of far more respondent's statements implies a confidence that discontinuing work will result in discoveries. But there is a fifth common feature, which is that the respondents are otherwise very different, in a great variety of ways. There are so many differences that following description focuses on one aspect, what they do. What they are and how they got to be that way will be treated in another study. Two aspects of behaviour are described, Ways of Designing and Action Styles.

6.2.1 Ways of designing

Respondent statements described in Chapter 4 revealed an unexpectedly wide range of beliefs and priorities indicating that, from the outset of conceptual design, the respondents attempt to do different things, proceed in different directions, adopt different strategies and use different methods of handling the *stuff* of the design. They experience different ways and means of progressing and of making discoveries, all of which extend the limits of their understanding differently. The general impression, evident from the early part of the interviews is that the way people design is influenced by numerous development experiences, influential people and their own thoughts and actions. These appear to influence the formation and development of design values, aims and goals and a design philosophy. These factors probably contribute to the development of focusing strategies, design processes and action styles, in combination with the individual attributes of each respondent.

Many of numerous variables that can be extracted from the interview data may, in some way, be important in relation to discovery. Searching for influential variables has not been a part of the thesis stage of the research, although it has been possible to carry out preliminary investigations by sorting different combinations of variables in the Excel Worksheet 4 - Response Analysis, described in Chapter 3. The study has been limited so far, for several reasons. First, many of the influences respondents cite as important are circumstantial, or situational, rather than systematic. The respondents appear to have been most strongly influenced in their development by unique combinations of small numbers of different factors, including contributions from family members, teachers, designers, particular events as well as their own talents and interests. While they may be few, the acquisitions from respected mentors, in the form of principles, or rules, may be as durable as a physical or mental skill. Many of these varying influences appear to have interacted throughout their lives. This has made the respondents into the talented unique individuals they are, but in a sense they are now like mixed paint, somewhat opaque and difficult to un-mix.

So far the majority of Excel sorts of different combinations have not yielded surprises. There are not many signs of relationships between formative variables, the variables that describe a respondents design intentions and process and insightful discovery. This is not a declaration that nothing will be found, as progress in this study has often been made unexpectedly. Sometimes reinterpreting categories, or identifying new ones, that are more accurate has led to new understandings. One aspect of designing that has emerged as a class of behaviours having associations with insightfulness

is referred to as Action Style, see 4.3 Design Action Style. Relationships between Action Style variables and insightfulness are referred to in the next section.

DESIGN FOCUSING

Sub-chapter 4.2 describes variations in the way respondents regard their projects, identifying three focusing approaches, *Orientation*, *Scoping* and *Framing*. Each of the approaches can be viewed as a group of strategies to reduce the complexity of a design problem by directing concentration towards an interpretation of a project, which progressively becomes more familiar, and away from many possible less familiar others.

- Orientation is identifiable in three types of statement by respondents in this study. 1) Process oriented statements emphasise designing as the outcome of a process generally, or a particular form of process, such as a rational process, or a collaborative process. 2) Solution oriented statements focus on design generating aspects of project, brief, site and other matters, and 3) Statements of a wholistic orientation encompass the totality of design and context, viewing it not so much as a problem, but rather as the source of an understanding, that leads to solution.
- Scoping is characterised by statements about designing that are: 1) *generic* and generalise about projects as a whole, or as classes of project, or imply that a project is part of a continuum of design activities, or a body of work, and 2) *specific*, suggesting that each project is unique. Generic scoping reduces the complexity of a problem by categorising items into recognisable classes or parameters, while Specific scoping typically involves an *audition*-like process, to identify potential design *ideas* or generators, and this also leads to variety reduction.
- Framing is associated with aspects of design, or designing, that individuals interpret as being of high priority, or interest and which structure, shape and characterise their designs. Among most respondents framing involves an interpretation of modernism. Modernism is a broad base upon which designers can construct their own virtual mesh of conceptual *frames* which represent ethical, technical or artistic beliefs, values or priorities and which serve as primary or lesser design *generators* and *shapers*.

There are possible inter-dependencies between the three groups. For example a *wholistic* orientation appears to be strongly associated with *specific* scoping, while a *process* orientation appears to be associated with *generic* scoping, but not 100%. The *solution* orientation appears to be more flexible, so that considering all options, an indeterminate range of combinations is possible. In order to gain an impression of how Design Focusing may be related to insightfulness I have considered Orientation and Scoping together. At this time no attempt has been made to analyse Framing. This is partly because: 1) There are many framing options relative to the numbers of respondents and 2) Framing was identified later and has been less thoroughly considered at this time.

In Fig. 6.2-dfL, below, Design Focusing (Orientation and Scoping) are plotted against Insight level, for all 45 respondents. Each column shows the numbers of respondents for each Insight Level who indicated a *process*, *solution* or *wholistic* orientation. The columns also differentiate the respondents whose Scoping is *generic* or *specific*, as shown in the legend in the bottom left corner. The graph indicates that there may be relationships between Design Focusing and Insightfulness. There is a clustering of process oriented respondents towards Insight level 0 and 1, and solution oriented respondents towards Insight level 2 (cold discovery). Respondents with a wholistic orientation are relatively evenly distributed, with a slight concentration in the insight level 3 column. The balance of generic to specific scoping varies a little across the four Insight levels, but not enough to be definite and not as much as the variation between Orientations, already referred to.

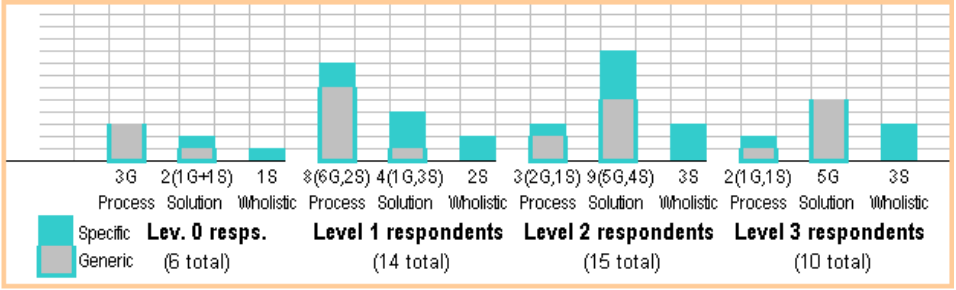


Fig. 6.2-dfL Design Focusing (Orientation and Scoping) - by Insight Level

In Fig. 6.2-dfE, below, Design Focusing (Orientation and Scoping) are plotted by Discovery Experience, for all respondents. The graphic convention is the same as described for the graph above. This graph also indicates that Design Focusing and Discovery Experiences may be related. The link between process orientation and incremental experiences is understandable as several incremental designers are associated with rational or collaborative processes of designing, sometimes with both. The big trend is the strong association between solution orientation and idea experiences, evident also in fluency. This reflects a commonly stated view that architecture is about ideas. In contrast clarity experiences appear to be more strongly associated with process and wholistic orientations.

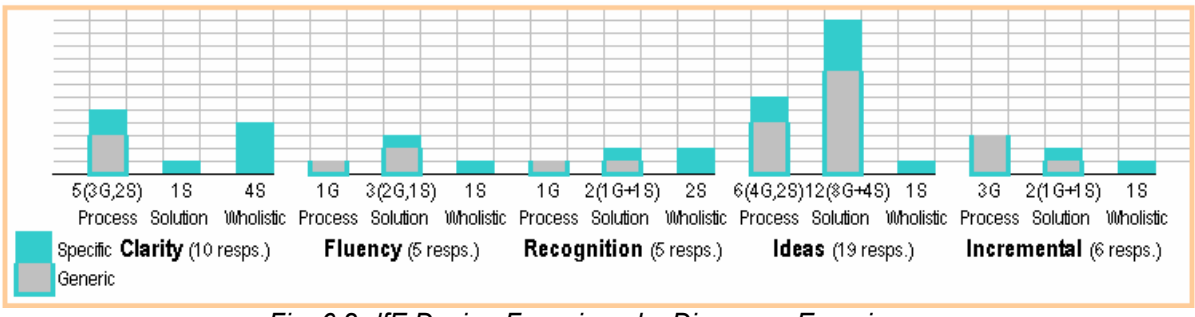
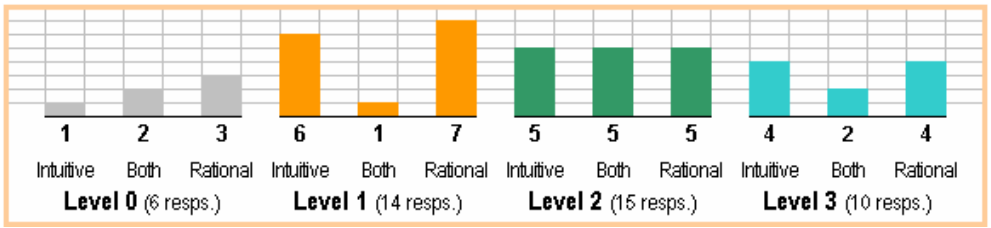


Fig. 6.2-dfE Design Focusing - by Discovery Experience

For another perspective on this information, see also the inverse versions of the above graphs in the Appendix. See p.7, List of Figures, Fig. 6.2-Ldf Insight Level by Design Focusing and Fig. 6.2-Edf Discovery Experiences by Design Focusing.

INTUITIVE VERSUS RATIONAL DESIGN

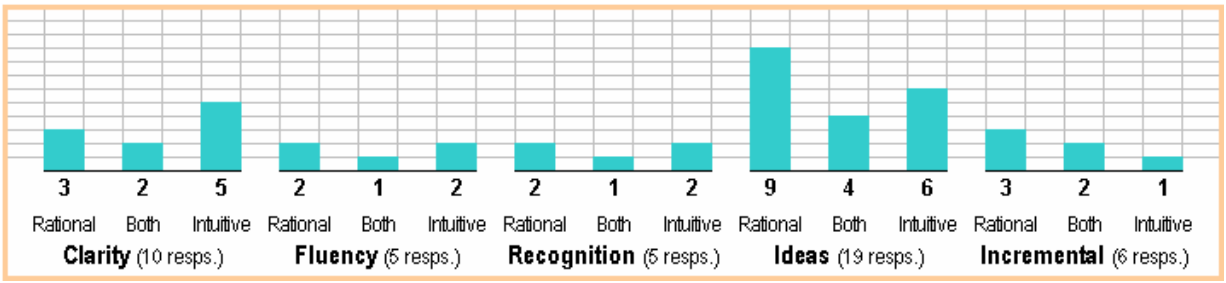
The study has not included specific interview questions or tests to establish whether respondents are rational or intuitive in their designing. However, respondents indicated in many of their statements that their views and approaches to designing lean more strongly towards one, or the other, or are a mixture of both. While this measure is crude, it was expected that designers expressing more intuitive views would be more likely to be insightful, than those expressing more rational views. Fig 6.2-irL which plots Intuitive - Rational design indicators against Insight Levels provides support for this proposition. Only one of six Level 0 respondents (A10) is an intuitive designer. However as there are so few Level 0 respondents, the low representation could easily be coincidental. The shift in the rational-intuitive balance across Levels 1 to 3 is also not great enough to require comment. What is evident is that Level 1 respondents appear to be more emphatically intuitive or rational, while nearly one third of the other respondents indicated a mixture of both.



6.2-irL Intuitive - Rational by Insight Level

In Fig. 6.2-irL, below, Intuitive - Rational design indicators are plotted against Discovery Experience. This graph adds little to what is evident from the graph above, again showing relatively constant Rational-Intuitive balance, but with more Intuitive designers reporting Clarity experiences and more Rational designers reporting Idea experiences. Note that the Incremental respondents (on the right side of the graph) are the same Level 0 respondents, on the left side of the graph above, Fig. 6.2-irL.

Inverse versions of graphs, giving a different perspective, are available in the Appendix. See p.7, List of Figures, Figs. 6.2-Lir Insight Level by Intuitive – Rational, and 6.2-Eri Discovery Experience by Rational – Intuitive.



6.2-irE Intuitive - Rational by Discovery Experience

6.2.2 Design Action Styles

Design Action Styles, described in Chapter 4, are consistencies, in the way individuals design, that have developed and stabilised over time. While there were few signs of associations between design Action Style variables and insight levels 1 to 3, distinctions between insightful and incremental respondents were more apparent. Three Action styles closely associated with designing, Progression, Incessancy and Reactivation are described below.

Progression refers to whether an individual's progress during conceptual design is more often steady and incremental or fluctuates, either not progressing or suddenly progressing at different times. The distribution of respondents, in relation to Progression, described in 4.3.1 Progression modes, suggests that *males* and *RAIA award winners* are slightly more likely to be *steady* whereas *fluctuating* progress and to a lesser extent *both* (steady and fluctuating) is predominant among *females* and *others*. When Years of Practice is considered a great deal of variance is evident in the *both* (steady and fluctuating) column. Few respondents Practicing before 1984 (6/23) describe their Progression as *both* (steady and fluctuating) compared with nearly half of the Later group (10/22). Although there is a gender imbalance in the Before and Later groups it appears that, over time, practitioners become more definite in their Progression.

When Progression is considered in relation to insight levels and experiences there are some surprises. Considering Insight Level, as in Fig. 6.2-pnL, below, the differences between the Level 0 (Incremental) and the Insightful (Levels 1 and 3) are very clear. As one might expect, the Level 0 (incremental) respondents are mostly *steady* (5/6), while more of the Insightful respondents describe their Progression as *fluctuating* (16/39) than either *both* (11/39) or *steady* (12/39). Among the three insight levels there are conspicuous differences, with Level 2 going against the trend, having fewer *fluctuating* (4/15) and more *steady* (6/15) respondents. It is possible that Level 2 respondents, who have a mix of apparently equivalent hot and cold discoveries, are more likely to view their Progression as *steady* or *both* (steady and fluctuating), if their discoveries are frequent. In other words, their discoveries may seem more like incremental discoveries, because they happen a lot.

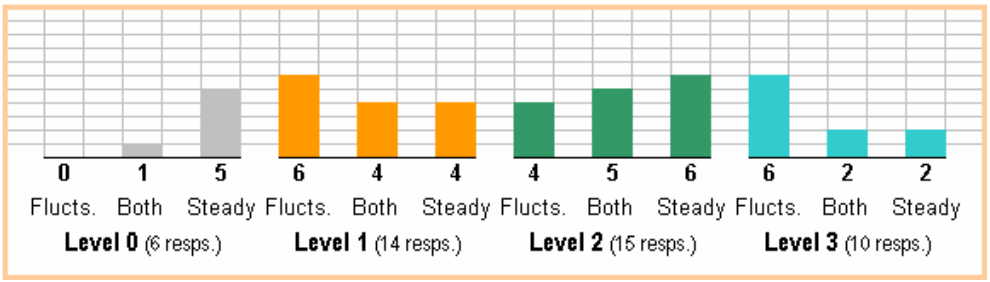


Fig. 6.2-pnL Progression by Insight Level

The Discovery Experience outcome, see Fig. 6.2-pnE below, also helps to explain the high *both* value among the Level 2. The most common Discovery Experience (in the graph above) is *ideas* and many of the respondents who described ideas experiences (in the graph below) reported *both* (steady and fluctuating) Progression.

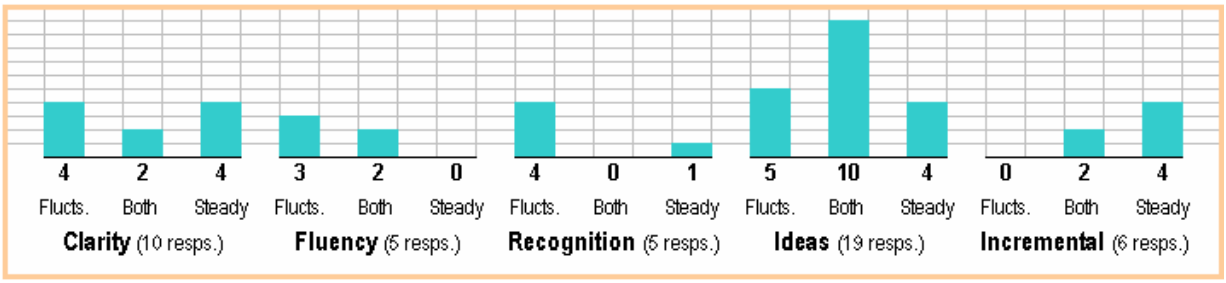


Fig. 6.2-pnE Progression by Discovery Experience

However Fig. 6.1-EL showing Discovery Experience by Insight Level, included earlier in this Chapter in 6.1 Restructuring doesn't support this interpretation. That graph shows the Discovery Experiences of Level 2 and Level 3 respondents to be reasonably similar. That appears to add support to the earlier expressed view that Level 2 respondents report a more *steady* Progression because their discoveries are frequent. The apparent inconsistencies suggest that further more detailed study of existing data and perhaps a larger population will be required make more sense of these interrelationships.

INCESSANCY

Most respondents (35/45) affirmed that they are incessant practitioners in one form or another by always thinking, conceptualising, processing, enquiring, exploring, investigating, or seeking. Most responded to the first of two aspects of incessancy, namely *being the perpetual practitioner*, confirming that being a practitioner is a vocation, involving dedication, rather than simply a job. Many responded positively to the second aspect of *always being on-the-case*, or being constantly pre-occupied with active projects, including some who nominated both. Among the alternatives were respondents who were incessant sometimes (6/45), depending on projects or other situations and others who stated they were not incessant. (4/45).

When Incessancy is considered in relation to outcomes there is little to note, primarily because so many respondents describe themselves as *always incessant*. With regard to Insight levels, see Fig. 6.2-iyL, Incessancy is most dominant with Insight Level 2 (13/15) and least with Insight Level 0 (4:6), but the *no* (non-incessant) levels are so small, one extra or fewer respondent can make a noticeable difference. Similar comments apply to Incessancy in relation to Discovery Experience, see Fig. 6.2-iyE, further below.

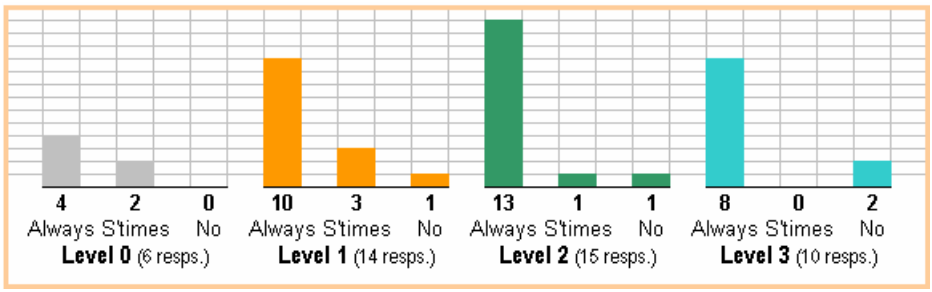


Fig. 6.2-iyL Incessancy by Insight Level

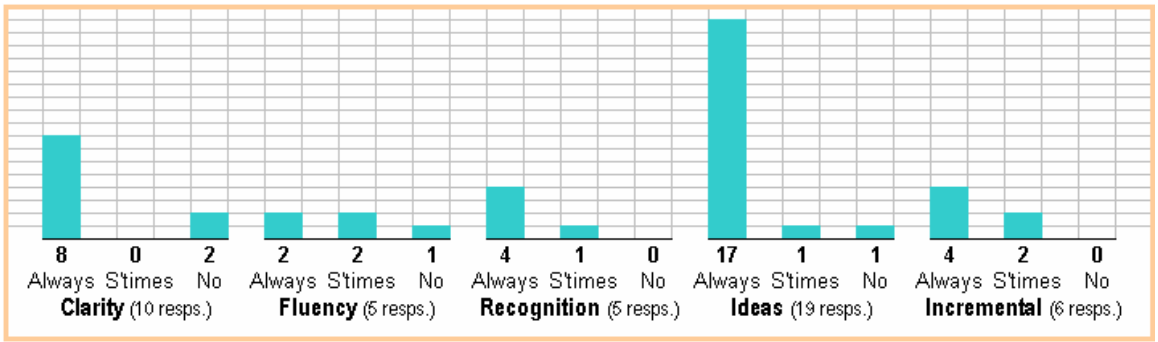


Fig. 6.2-iyE Incessancy by Discovery Experience

REACTIVATION

The respondents nominated one of two fundamentally different options when they get stuck, during conceptual designing. A few will *persist* in designing (4/45) but most (40/45) will stop and either *disengage* and adopt an alternative activity, unrelated to this session of designing, or they will *re-engage* with the same design, by means of different approach, or method. Some will regularly do one or another, while others will alternate between options.

Some variations were evident when respondents were analysed by key attributes. Male and female respondents were found to be relatively similar with regard to *disengaging* and *re-engaging* (See Fig.4.4-reG) but most of the respondents who prefer to *persist* are males, and most of the respondents who nominated the flexible option, *either disengage or re-engage,* are females. When RAIA Award winners are compared with Others (See Fig.4.4-reA) it is apparent that Award winners prefer to *disengage* or keep an option to *reengage*, when they get stuck, rather than *persist* or *re-engage*, which suggests that the Award winners are more confident in their ability to come up with a solution, after a break. This pattern was also evident in the more experienced, Before 1984 respondents. (See Fig.4.4-reY).

When the respondents are analysed by Insight Level, see 6.2-reL below, the option to *disengage* is, I think surprisingly, most popular amongst the Insight Level 0, incremental designers. Of the 5 Level 0 respondents, who opt to *disengage*, 3 indicated *disengage-passive* and 2 preferred *disengage-get away*. In other words they stop thinking about the task for a while. Equally interesting, to me at least, is that the Level 3 respondents are almost the opposite to the other groups. Only two of the Insight Level 3 respondents have nominated *disengaging*. Most of the Level 3 respondents *re-engage* or, by nominating *either*, keep their options open. This provides an indication of why their cold discoveries are insightful. The preference to re-engage in a different way, or to not dismiss that option, is a sign of an abiding interest in maintaining mental contact with the task. This may simply reflect strong motivation, but it also hints that these respondents know they are likely to experience latent preparation which will reward them with insightful cold discoveries. This is a matter to investigate further.

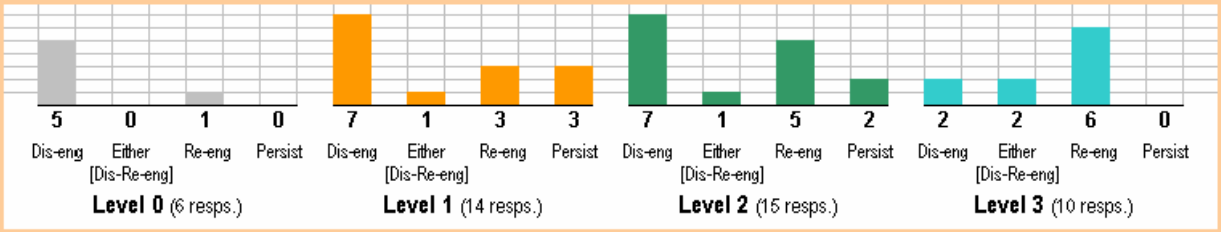


Fig. 6.2-reL Reactivation by Insight Level

The dominant feature of the plot of Reactivation by Discovery Experience, see 6.2-reL below, is a very strong association between Re-engagement and Ideas. This is relevant to the above observation about the level 3 respondents, as 5 of the 6 Insight Level 3 respondents who choose to Re-engage reported Idea experiences. (They are: A04, A07, A16, A31 and A33).

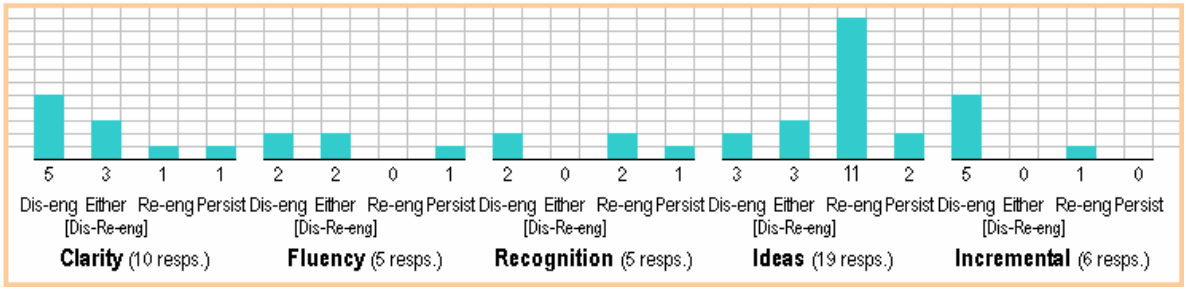


Fig. 6.2-reE Reactivation by Discovery Experience

This section can be summed up with two main points. The first is that a rich network of relationships appears to link individual respondent attributes, how these individuals design, levels of insightfulness and discovery experiences. The second is that, while individual points of association can be readily identified, drawing sensible meanings from these that can be usefully applied will require a level of investigation that will not be fully warranted until the indications of insightfulness presented in this study are supported by a more extensive body of evidence.

6.3 FUTURE RESEARCH

The unexpectedly strong findings from the 45 respondents suggest that future research should embody greater breadth and depth. This study so far has focused on behaviour and experiences. It is evident that the behaviour of each respondent has developed over time and is an outcome of many experiences. Under other circumstances it may have developed differently and it may develop further, in different ways. Each respondent has always been, and still is, a work in progress. There are indications from analysing respondent statements that the way individuals design and manage difficulties, such as getting stuck, influences insight levels and discovery experiences. But currently very little firm knowledge has been collected and organised to form theory.

The findings, so far, need to be replicated by more individuals and extended, to establish a more diverse population of respondents and to better establish the reliability and generality of current findings. The extent to which similar results are likely to be found among other designers and other highly motivated professional practitioners is a matter of interest. At the same time it is possible to explore the data that has already been collected in greater depth and detail, augmented, if necessary by additional information from the current respondents. Current findings can be more thoroughly evaluated both to more firmly establish their authority and to enrich and provide additional levels of detail. A number of items of interest have emerged in the course of the research. These have been noted but have received almost no dedicated attention at this stage. A third possible line of investigation comprises relevant questions that have emerged in the course of the study, that are either tangential to the current enquiry, or associated with cognitive research undertaken by others. More detailed thoughts, on these matters, follows.

6.3.1 Replication and extension studies

It is probable that aspects of the behaviour of respondents in this research are representative of the populations from which they have been drawn, ie. Men and women, talented people, designers, architects, Sydney dwellers and so on. While the individuals in the present study are reasonably diverse they have been selected in a particular way and, therefore, they represent a small proportion of the total population for whom this research may be relevant. Consequently it is not feasible to hypothesise, or test, propositions, about the extent to which insightful behaviour is representative of a broader population, or associated with cultural, personal and other situational factors. Investigations of causation would also be premature until a larger and more diverse population of respondents has been interviewed and analysed.

My future intentions are to replicate and extend the study by interviewing several small groups of respondents, of a range of distinct types.

ADDITIONAL INTERVIEWS WITH ARCHITECTS

It is proposed that the respondent population will be augmented by interviewing additional architects who are systematically different. A selection of approximately 6-8 individuals, in different categories, such as the following, will approximately double the current population and increase its diversity.

ADDITIONAL SYDNEY ARCHITECTS

Additional interviews will be undertaken, with Sydney architects. Respondents with particular professional attributes, including "average" architects, or highly accomplished specialist architects, such as specification writers, documentation, contract, or site specialists will be selected. The aim of this investigation will be to study the extent to which the current respondents, who are strong designers, differ from other architects, in the same population, who are systematically different in other

ways. Examples include architects who may be as highly skilled, but have different strengths. It is also proposed to interview a range of less highly, accomplished and motivated practitioners in order to develop a more diverse sample for statistical analysis.

ARCHITECTS WITH PARTICULAR VISUAL TRAITS

Visual skills are of particular interest, because: 1) designing tends to have a significant visual component, 2) there is a growing body of research, focusing on aspects of visualisation, and 3) respondents in this study, referred to as *visualisers* gave indications of being different from other respondents and from each other, in the way they designed and made discoveries. The aim of this investigation will be to augment the numbers and diversity of *visualisers* already investigated so that a fuller understanding can be gained of the diversity of visualisation traits and their association with design conceptualisation and insightful discovery.

ARCHITECTS FROM OTHER PLACES OR CULTURES

The current respondent population includes individuals from different backgrounds, but there are too few of any particular type to support a useful study of relationships between culture, design and experiences of insightful discovery. Respondents from elsewhere in Australia, other English speaking locations and practitioners from non-Anglo and non-text-based cultures such as Asia are under consideration.

MENTORS NOMINATED BY THE RESPONDENTS

The current respondent population includes RAIA award winners and other, mostly less well known and often younger architects nominated by respondents, all from one city, is a group with many interconnections. Investigating architects from other places and cultures, referred to above, signifies a valuable departure from this pattern. But professional *kinship* between designers is a significant object of study, in its own right, that can be extended upwards as well as downwards. Of particular interest to me, referred to in 4.1 General Attributes - Development history and formative characteristics, is that nearly all practitioners, when asked about the practitioners they most admired, or were most influenced by, referred to one or more of the recognised greats, but also nominated a less well known practitioner, typically from another country. Interviewing these practitioners may help achieve an already mentioned aim, of studying architects from another culture, and also provide insights about the nominating respondent.

INTERVIEWS WITH OTHER PRACTITIONERS

It is also proposed that the respondent population be extended, by interviewing accomplished practitioners from other professions having the common requirement of strategic thinking to manage novel situations. The interview methodology would be similar to the architect study, with minor changes to reflect the professions of the respondents. Examples of that are under consideration include:

OTHER DESIGN PROFESSIONS

As the respondents have made clear in this study, architecture is a design profession with a very wide range of values, orientations and ways of designing, which can be expected to influence the way practitioners think about their work and how they make discoveries. The aim of this study will be to investigate the extent that the practice of different design disciplines is associated with different levels and patterns of insightfulness and discovery experiences. Design fields under consideration include, urban planning, industrial design, graphic design, video game design, fashion design, music composition.

NON-DESIGN PROFESSIONS

This study will have similar aims to the design professions study, however the inclusion of highly accomplished practitioners from professions far removed from design, will allow more systematic investigation of the extent to which insight experiences are influenced by cognitive, motivational, or professional differences. Preferred occupations include those with a significant strategic, cognitive, or creative component. Eg. project management, computing, legal practice, politics, journalism, creative writing and the arts.

6.3.2 Deeper explorations of interview data

It is possible to enrich the current qualitative analysis, by more thorough coding and to further develop the basic existing quantitative study, represented in the simple bar graphs, by applying more advanced statistical methods.

Some particular research questions that are little more than hinted at in the current study include.

DISCOVERY HOTNESS AND COLDNESS.

The notion of hot and cold discoveries is a construct that currently has no particular status or functional basis. There are several key issues relating to differences between hot discoveries and cold discoveries, that can be further resolved. The two types of discoveries differ in their timing and association with active designing. It is likely that hot discoveries are more closely associated with intentional acts in process at the time of the discovery, whereas cold discoveries may spring to mind during unrelated events.

Key research questions include:
- What are the cold discoveries associated with?
- If hot discoveries are associated with working memory are cold discoveries associated with long term memory?
- Would it be more sensible to characterise the discoveries in terms of memory, or some other phenomenon rather than proximity to the heat of activity?
- How should discoveries that are not clearly hot or cold be understood? Included in this question are resumption discoveries, immersion discoveries and design discoveries that emerge while some other design activity is taking place.

ISSUES OF COLD DISCOVERY.

While the notion of cold discovery is not informative of process, statements by many respondents contained clues that may lead to additional findings and a more systematic understanding of the dynamics of cold discovery.

One issue concerns visualisation and action styles. Visual skills may be highly developed, in different ways and influence how and when a practitioner designs. Some respondents claimed to be able to design in detail without drawing. Others referred to a retentive and detailed visual memory, enabling recollection of buildings, or of design decisions made when not working.

PROBLEM SOLVING AND CREATIVITY.

The terms *creativity* and *problem solving* are frequently used in ways that suggest they are interchangeable. Theoretical concepts, such as productive thinking, a component of Gestalt theory, have been associated with both problem solving, and creativity. 1) What do the two labels, problem solving and creativity actually represent? 2) What do they have in common? and 3) what distinguishes them?

PERCEPTIONS OF DISCOVERY AND INTUITIVE DESIGNING.

Rational views. Both incremental respondents, who viewed their way of designing as rational, indicated a belief that unexpected design discoveries emerged without forethought, which made them dismissive of them. However it is clear from the statements of the insightful designers that unexpected discoveries typically, are related to earlier preparation and thinking. The individuals expressing this view may (or may not) be wrong, but they have articulated a point of view that goes to heart of the issue of the nature of insight and value of Gestalt theory. Key questions are: 1) How common is this view? 2) Is it associated with rational-incremental individuals? 3) Do people hold this view because their unexpected discoveries are unrelated to their designing, or 4) Is this a misconceived view and a fixation which prevents some individuals from achieving insightful discoveries? Findings from such a study could have a significant impact on education, at undergraduate, graduate and continuing education levels.

Intuitive views. One respondent, A21, made several references to the value of following one's intuition in the sense of regarding the project as having a life of its own, and in viewing designing as an explorative process.

> I think you've got to follow your intuition. You've got to pull your intellect out of it a little bit, not see it

> as a problem and just let it have it's own life, you know… what's actually important is to launch it and follow it… if you're more prepared to follow it's path, trust your intuition, and see it as an explorative process then I think it [frustration and stumbling] is less likely to happen. A21.

Intuition does not, of-itself, connote incubation, but these statements, suggests an attitude or state of mind that may be conducive to the *percolation* process, of latent preparation. Closer examination of other respondents may be warranted, to determine whether this is simply a personal trait or an approach to designing that may be useful to others.

INDIVIDUAL DIFFERENCES AND INSIGHTFULNESS.

A number of variations in levels of insightfulness and discovery experiences appear to be associated with individual differences. These include:

- Attributes, such as gender, years of professional practice, award status, as shown in 6.1.
- Formative experiences. Many respondents refer to the influences of one or two people at specific times in their lives as being vital. For example, a large proportion of the respondents have referred to parents and relatives who were makers.
- Gestalt insight Components, Levels of insightfulness and Discovery Experiences. There are strong associations between some Components and some Levels. Eg. Short Preparation times and Insight level 2. This association appears to be influenced by a high incidence of Idea experiences. There may be many such interdependencies that can be made explicit by closer analysis.

Current investigations of interrelationships are limited to bar graphs but more systematic studies involving statistical analysis, use of some standard psychological measures and closer study of respondent statements can be undertaken in the future, particularly when additional and more diverse respondents have been interviewed. The current modest sample size inhibits further subdivisions, to consider interactions, as it only takes one or two individuals to change a trend in a small group.

COLLABORATIVE PARTNERSHIP.

Nearly half (22/45) of the respondents are partners in practices (most with other respondents). In the course of interviewing I became interested in the cognitive dynamics of partnerships. Interactions between partners, appears likely to be a fruitful area of further research, combining issues of collaboration and insightful designing. How different are design collaborations between married and unconnected partners? Can partner collaborations inform irregular and first time collaborations?

6.3.3 Further cognitive studies

It may also be possible to use the data collected for the study, so far, as a resource to explore further into the cognitive research area. The following topics appear likely to reward further investigation

ISSUES PERTAINING TO THE GENERAL VALIDITY AND VALUE OF THE GESTALT MODEL.

While many researchers cite Gestalt concepts many are critical of the theory and it is not widely recognised as a potentially useful model of design cognition, see 2.2.1 Criticisms of Gestalt theory. However some concepts that are associated with recent research into design thinking are not unlike differently named Gestalt concepts. For example the notion of *situatedness*, or *becoming situated*, resembles the Gestalt notion of *restructuring.* It is proposed that further mapping of alternative models in conjunction with further development of a theory of *latent-preparation* could lead to a deeper recognition of the value of Gestalt theory and suggest new directions for further theoretical development.

CREATIVE COGNITION AND DESIGN THINKING.

In 2.1.3 Cognitive Research, reference is made to the Creative Cognition theory of Finke, Ward, & Smith (1992) and a resemblance between their Geneplore model (*generate-explore*) and Jane Darke's *generator-conjecture-analysis* view, referred to earlier, under Interview Studies. Darke (1979). The second and third stages of Darke's model (conjecture and analysis) are arguably not unlike the second stage of the Geneplore model (exploring). Darke has proposed that designers use *primary generators* in conceptual design. She describes these mental constructs as components of the designer's cognitive structures. They may be value judgements or ideas that generate conjectures. By this characterisation primary generators may be analogous to Finke, Ward, & Smith's *pre-inventive forms*.

Identification of these analogies raises interesting research questions. It appears that pre-inventive forms are a theoretical construct, whereas primary generators are more practice based, perhaps remote, but testable in a real life setting. On that basis, evidence of the use of primary generators by the respondents in this study may add useful knowledge to the Geneplore model and play a part in its validation. That being the case, creative cognition theory, which has not been elaborated upon in this thesis, may become highly relevant in the study of design thinking.

DISTINGUISHING HOT DISCOVERIES AND COLD DISCOVERIES.

While some designers make no distinction between their hot discoveries and their cold discoveries, one possible distinction is that hot discoveries may be more strongly associated with working memory, than cold discoveries, as the contents of working memory are more likely to relevant when they are designing than when they are doing something else. It is also possible that the way individuals mentally search, or explore, are different in working and not-working circumstances. Simon's search model is based on the familiar metaphor of a seeker looking everywhere for the answer, a *push* type of search. In contrast, a number of respondents gave the impression that by not thinking about the project, when they were stuck, they had stopped searching and were waiting for the solution to come to them. A possibly vital feature of the *latent* model is that it is more like a *pull* search. Parallel push (data driven) and pull (expectation driven) processes have been identified by Gero and Kannengiesser (2003) as a way of representing the interaction of an agent with both its external environment (by interpretation) and its internal environment (by means of constructive memory).

OTHER DESIGN STUDIES.

It is possible that the extensive data collected for the current study, consisting of more than 1000 pages of interview transcript, may be a fertile source of information that can be analysed in different ways to answer questions of relevance to other avenues of research.

CHAPTER 7

STUDY CONCLUSIONS

MAIN FINDINGS

Explorations and scientific investigations tend to begin with the familiar and then proceed into the unfamiliar. Likewise, in this exploratory study, the hypotheses, the findings and now, the conclusions proceed from more familiar and less surprising, to less familiar and perhaps, more surprising.

Among the accomplished architects and designers of the respondent population, the first finding is that conceptual designing involves insightful activity. Statements by 39 (about 86%) of the 45 respondents leave little room for doubt that insights contribute to their conceptualisations. There is also strong evidence that cold discoveries, when respondents are not actively designing, are more important than is currently recognized.

Most respondents (about 55%) confirmed the second research hypothesis, by reporting experiences of cold discoveries, while doing a variety of things other than designing, including resting, performing a physical activity, or doing other work. sometimes the discoveries followed a related design session, where the respondent may have been stuck, but insights could follow a productive design session, as well as an unproductive one.

Many respondents (about 13%) described positive attributes of cold discoveries and used terms such as *stronger*, more *potent*, or *pushes boundaries*, suggesting their cold discoveries are more insightful than their *hot* discoveries and thereby confirming the third research hypothesis. The positive descriptions suggest that respondent confidence in disengaging from active designing, when persisting has not achieved a good outcome, is well founded.

INSIGHTFULNESS

Confirmation of the study hypotheses also encouraged progression of the enquiry beyond plain questions of "do they, or don't they?" towards deeper considerations of manner and method. Respondent experiences, when analysed by means of the components commonly associated with the Gestalt theory of problem solving, broadly match behaviours proposed by that theory, subject to variations in detail. Among respondents active preparation is close to universal. The majority of respondents reported that they had worked on the subject of their discoveries for more than one day, many for much longer. For about 3/4 of the respondents the influence of fixation was evident, either in descriptions of a discovery, or when an awareness of fixation was affirmed. For nearly 2/3 of the respondents there were affirmations that an incubation-like process influenced their discoveries. Respondents either referred to incubation by name, or used a variety of terms that suggested incubation, or other forms of latent preparation, contribute to their conceptual designing.

Other statements by the respondents suggest that they consistently experience different types of insights, or that their insightfulness is more likely to occur in some ways than others. Although respondents were not specifically asked about restructuring, some form of restructuring was evident in descriptions of discoveries by nearly all respondents. These included many classic restructuring experiences that clearly fit Gestalt categorisations. Finally, about half of the respondents described sudden gratifying discoveries, indicative of "Aha!" experiences.

These findings contain theoretical implications and, I would argue, they help to explain why, in spite of shortcomings, and plenty of time, no theoretical alternative to Gestalt theory has taken its place. Given the scope of the current study, this issue must wait, for there is more to describe about the current findings, which may contribute to future theoretical developments.

LEVELS OF INSIGHTFULNESS

There are indications that insights are associated with different classes, or levels, of experience. Four broadly identifiable levels of insightfulness, related to the research hypotheses, have been identified. The respondents whose discovery experiences tend to be rational and incremental are described as

Insightful Level 0. Respondents who confirmed the first research Hypothesis only, described as Insightful Level 1, experience mostly narrowly situated insights, or hot discoveries, within the times, places and intentional activities of designing. Other respondents, who confirmed Hypothesis 1 and 2, described as Insightful Level 2, achieve their insights in more varied situations, including many cold discoveries realised outside of the normal times, places and activities of designing. Finally, respondents who confirmed all 3 Hypotheses, described as Insightful Level 3, are distinctive in affirming that their cold discoveries are more insightful than their hot discoveries.

Characterisation of the hypothesis findings as levels is not lightly made. An order exists, in these levels, since individuals must be insightful at a lower level before they can be insightful at the next higher. That the levels correspond to real experience is confirmed by indications of adaptation by respondents, to exploit their particular level of insight experience. However, the reasons for the different behaviours are not known. As all of the respondents in this study are skilled, accomplished and creative, there are no grounds to suggest that respondents of a higher insight level are more skilled, or more creative, than respondents of a lower level, particularly those whose discoveries are mostly incremental. Insightful individuals may simply be slower at recognition, but more persistent until a realisation is achieved. Certainly being insightful is appreciated by those who are, but whether individuals can become more insightful, or will become more creative, or productive, if they became more insightful is an issue of great interest for future study, rather than for now.

DISCOVERY EXPERIENCES

Statements by the respondents also suggest that they consistently experience different types of insights, or that their insightfulness is more likely to occur in some ways than others. The differentiation is not precise and experiences vary, but four broad categories of discovery experience are identifiable, clarity, fluency, recognition and ideas.

Clarity experiences typically involving a realisation, or achieving an understanding of a design situation, or vital aspect were relatively evenly distributed amongst insight levels 1 to 3 respondents. Fluency experiences, or a flowing of ideas could follow, or be combined with, clarity experiences, or schematic anticipation, but also occurred without revelation or clarity. Among the respondents fluency experiences were most strongly associated with insight level 1, or hot discovery. Recognition experiences, involving perception, or appreciation of something new in something previously seen or thought, appear, like fluency, to be more strongly associated with insight level 1, or hot discovery. The directness and remoteness of recognitions varied, suggesting that they might be associated with alternative forms of restructuring, such as schematic anticipation, or finding a problem analog. Idea experiences, or particular discoveries, appear to be more strongly associated with cold discovery. They were nominated by about 2/3 of insight level 2 and level 3 respondents, compared with 1/3 of the insight level 1 respondents.

DESIGNING

The respondents have developed a wide range of different ways of going about their designing, influenced by development experiences, people and their own thoughts and actions. These appear to influence design values, aims and goals and contribute to the development of focusing strategies, design processes and action styles.

WAYS OF DESIGNING (see also 6.2.1)

Three design focusing approaches, or interpretive strategies that reduce the complexity of a design problem, were identified, namely Orientation, Scoping and Framing. Three types of respondent Orientation, towards parts, or the whole of projects, were identified, Process, Solution and Wholistic. Two types of Scoping, or views of the particularity of projects, were identified, Generic and Specific. A third approach, Framing, associated with prioritisation of competing aspects of projects, as primary or lesser design generators and shapers, was also identified. Among the respondents, framing could be viewed as an individual interpretation of architectural modernism, or the respondents personal *take* on design, that develops over time.

To gain an impression of how design focusing may be related to insightfulness, focus orientation and scoping were plotted against Insight Level. This revealed a clustering of process oriented respondents towards Insight level 1 (hot discovery) and solution oriented respondents towards Insight level 2 (cold discovery). Plotting focus orientation and scoping against Discovery experience revealed an expected relationship between process orientation and incremental experiences, understandable as some incremental designers are associated with rational or collaborative processes of designing. A bigger trend is a strong association between solution orientation and idea experiences and possibly fluency. This reflects a commonly stated view that architecture is about ideas. In contrast clarity experiences appear to be more strongly associated with process and wholistic orientations.

Respondents were also grouped into rational, intuitive, or mixture of both ways of designing, based on self descriptions, and this grouping was also plotted against Insight level and Discovery experiences. The findings in relation to Insight levels were relatively unsurprising. The Discovery experience graph indicated that Clarity experiences are most commonly associated with the Intuitive designers, while Idea experiences are more commonly associated with the Rational designers.

ACTION STYLES (see also 6.2.2)

Three action styles, or consistencies in the way individuals design, Progression, Incessancy and Reactivation were examined in relation to insight levels and experience. The general observation that can be made of this aspect of the study is that there are consistencies between insightfulness and the way respondents describe their work. This is a modest finding although, like the Ways of Designing observations, just summarised, it provides another level of confirmation of insightfulness that is worthy of consideration and future enquiry.

Progression refers to whether individual progress during conceptual design is more often steady, or fluctuating, between no progress and sudden rapid progression. As might be expected the incremental designers tended to progress steadily, while the insightful were more likely to fluctuate, or experience both forms of progression. Some interactions were observed between insight levels and discovery experiences

Most respondents indicated they were incessant designers in being *the perpetual practitioner*, or that being a practitioner is a vocation, not simply a job. Many affirmed the view of *always being on-the-case*, or being constantly pre-occupied with their projects, and some affirmed both. Because the incessancy trend is very strong relationships between incessancy and both, insightfulness and discovery experiences are somewhat unclear. But as a matter of fact, incessancy is most strongly associated with insight level 2 and idea experiences.

Over 80% of respondents employ a variety of methods of Reactivation, or disengaging, changing their mode of engagement, or persisting, if they get stuck. This aspect of designerly behaviour was compared with many other variables. It was observed that males were more likely to persist while females were more flexible in choosing between disengaging, or re-engaging. RAIA award winners appear to more likely than other respondents to disengage, as were more experienced practitioners, which could suggest confidence in their capacity for latent preparation, or alternatively, awareness that they function better after a break. Both alternatives are offered because the plot, of Reactivation against Insight level, (6.2-reL) shows all but one of the incremental, insight level 0, designers opting to disengage. Of equal interest in this graph is a relationship between re-engaging and insight level. Most of the Level 3 respondents *re-engage*. This preference indicates an interest in maintaining mental contact with the task. This may simply reflect strong motivation, but could also be associated with a disposition towards latent preparation, that has rewarded them with insightful cold discoveries in the past. This appears to be supported by the plot of Reactivation against Discovery Experience, (6.2-reE) which shows a strong association between Re-engagement and Ideas.

LATENT PREPARATION

Statements by many respondents indicate that latent preparation is widespread, has different forms and results in different outcomes. A21 referred to ideas he was *carrying around*, which were *percolating away*, A30 to things that *tick over in your mind*. A04 referred to bits *clicking together* and *effortless connection*. A23 referred to *clarity of thinking*, *when not actively trying* to make it come.

Latent preparation can resemble what is commonly called incubation, but varies from one respondent to another in when, where and how it occurs. It appears to be scattered across a wide range of mental states, between active conscious designing and passive apparent unconsciousness and it may take place at any time. It is clearly not only an unconscious process. Contrary to suggestions of inspirations from *out-of-the-blue,* insightful designers often appeared to be rational, methodical and mentally engaged in their work, in many different ways. There are few signs in the interviews that insightful hot, or cold discoveries are necessarily less attributable to cognition than are incrementally derived concepts.

These considerations suggest one or more things; 1) that incubation is only a component of latent preparation, 2) that the view of incubation as an unconscious process does not fully account for the range of insightful experiences of designers, or other individuals who work with their minds, or 3) that the issue of whether incubation is a conscious or unconscious process is not critical to the investigation of insightful discovery.

EDUCATIONAL IMPLICATIONS

Current early findings leave little room for doubting the reality of insightful discovery and its significance to design practitioners who are strongly motivated to produce works of high quality. It is proposed that outcomes of this research, as it progresses, may influence education in indirect ways. There is no reason currently to conclude that students should all be taught, or should try to learn, to be insightful. It appears more likely that becoming insightful is an outcome, of individual styles of focusing, designing and learning, driven by high motivation and reinforced by persistence. More research is needed to better understand all such elements work together.

The findings of insightfulness were based on findings in relation to insight components, particularly preparation, fixation, incubation or latent preparation, and restructuring. All of these look to be significant, both individually and together. At this time it appears that a fruitful approach to research, and future teaching, will involve development of greater understanding of each of these components and how they interact to form a system of gestalt cognition, within the context of designing. Given the diversity of the 45 respondents in this study, it also appears likely that the study of gestalt cognition will embody, 1) recognition of individual modes of learning, 2) further shifting of the focus of learning from fact acquisition to deeper learning and understanding, and 3) emphasis on not only the subjects of learning, but also of learning itself.

This knowledge will then be applicable in educating designers to become more aware of their personal ways of designing, within a fuller and more clearly articulated context.

BROADER CONTEXT OF THE RESEARCH

I will close with some observations on the broader context of this research. Progress in the understanding of cognition has been regrettably and unnecessarily delayed. For much of the twentieth century the dominance of the behaviourist paradigm actively inhibited the study of cognition. The history of events and its many ironies has all the ingredients of a great story, albeit for some other time and place. As mass fixations go, this is certainly not the worst that humanity has experienced in the past hundred years. There has been intense competition for this record, from many other 'isms. But it is regrettable. Knowledge that may enrich human intelligence, by facilitating unaided, individual recognitions that extend beyond surface features, must surely be very precious.

Much is owed to researchers like Herbert Simon, who recognised sense in the concepts and methodologies of European psychologists of the early twentieth century and applied them in his research. In a reflective paper, Karl Duncker and Cognitive Science, Simon (1999) freely acknowledges the early twentieth century German theorists, including Duncker, Adriaan De Groot and Otto Selz. Simon describes how, in the 1950s, when developing his first psychological papers with colleagues Newell and Shaw, he encountered resistance to the merging of Associationist and Gestalt

theories, from both Associationists and Gestaltists. Looking back, he describes how the Gestalt theories appeared foggy and undefined requiring him and his colleagues to fill in the missing pieces before undertaking their computer simulations.

Simon describes one piece, selective (heuristic) search as being at the core of all problem solving. This is a critical division between Simon (and his colleagues) and the Gestalt productive thinking, insight view. Selective search means memory based, reproductive thinking. Simon refers to an interpretation of Duncker's view of insight, by his colleague Allen Newell who, he said, concluded that:

> [it] was for [Duncker] a special computational device where, having encoded the knowledge, the computation could be made by recognition

Simon describes this view as sounding entirely modern. But, while at first sight, use of the term *recognition* might suggest reproductive thought, these are Newell's words, not Duncker's. What Duncker meant by *encoded the knowledge* is not addressed. Another Gestalt pioneer, Wertheimer, also associated *insight* with recognition, but it is recognition of a particular kind. He discusses many examples and strongly emphasises the importance of realisation of inter-relatedness, or how parts fit together. Wertheimer (1959, p.41) Thus solving a novel or non-routine problem, meant recognising something new in the unfamiliar, not like recognising your mother. Respondent A39 made a neat and resonant point about recognition.

> … you don't know when these things are going to come to you, but what's really important is to identify when they're there. A39.

The volume and richness of recognisable signs of insightfulness recounted in this thesis will confirm what some readers already regard as a familiar experience. But while insightfulness may be familiar to some and suspected of others, how sensibly can it be said to be known, without the evidence of systematic enquiry? If designing was known to be insightful this would be widely reflected in teaching and research, but it is not. Nearly a century after Gestalt researchers proposed a theoretical basis for it, insight is not an accepted fact; and while insight remains the stuff of anecdote, folk lore and jokes about light bulbs, the implications of human insightfulness remain unappreciated, in the background of cognitive theories. Insight needs to be demonstrated and represented by coherent and rigorous theory.

To progress in this matter it is important to recognise the distinction between gestalt concepts and Gestalt theory; the parts and the whole. Somewhat paradoxically, whether the formal theory is good, bad, or incomplete has no bearing on the validity of particular concepts, or phenomena, observed by the Gestaltists and on which the theory is based. The theory is an interpretation, but the phenomena are real and can be observed and measured. The task then, as in any domain of science, is to continue the theoretical development process with appropriate respect for the knowledge of the past and a fresh eye, a bit like designing.

Herbert Simon shows his character as a skeptic, in the best sense of the word (of doubting but leaving the door slightly ajar) in the concluding statements of his paper. Simon (1999). He refers to the pioneer Gestaltist Karl Duncker standing on shoulders and others standing on his, as understanding becomes richer. He concludes:

> Nor is there just a single pyramid, but rather many parallel paths, and a considerable redundancy of rediscovery and reinvention. It would be a pity if it were otherwise, if everything were neatness and efficiency. For then far fewer of us would have the opportunity to enjoy the adventure of lives in science, the opportunity to contribute to the building of its fantastic structure.

My intention, long before finding Simon's paper, published in the year I began this study, was to conduct research in that spirit. I hope this is recognisable to the reader.

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