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**The Role of Images in Support of  
Graphic Design Ideation**

A thesis  
submitted in fulfilment  
of the requirements for the degree  
of  
**Doctor of Philosophy**  
in  
**Computer Science**  
at  
**The University of Waikato**  
by  
**Simon Laing**



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## Abstract

Graphic design is a discipline whose purpose is the creation of visual messages delivered to an audience, typically on behalf of a client. Practitioners of design are encouraged to demonstrate creativity in the execution of their work, and to develop and maintain awareness of visual culture to enable them to create works that are likely to be effective in their intended purpose. As a discipline involving communication between humans, the task is further complicated through the presence of many unknowns, poorly defined or emergent problems and constraints. Within this context, this thesis examines whether it is possible to support graphic designers during ideation through the provision of relevant images, with consideration of the influence on both creative output and process.

In this work, a selection of literature is examined informing a background for understanding graphic design, creativity, visual language and predicted image effects, then further literature regarding identifying image needs is evaluated, together with methods applied by other researchers for evaluating design ideation. In addition, the prior work is identified suggesting theory, methods and results for determination of image needs, as well as the measurement of effects upon process.

Developing from the reviewed literature, the thesis then presents full descriptions of methods applied and results obtained from three studies of design; the first study identifies specific roles that images are determined to play within the practice of professional graphic designers operating within New Zealand; the two following studies then examine the effects of supplying those images upon design output and

process through laboratory experiments involving graphic design students working on typical graphic design tasks.

Finally, the results of all three studies are discussed in relation to the research plan and literature; the thesis conclusion being that based upon the evidence, images representing the aesthetic tastes of the client and market do not consistently influence ideation output, however, they are shown to have a measurable influence upon the ideation process of the designer and that it is, therefore, possible to support design ideation through provision of images.

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## Publications from this thesis

This thesis contains sections from the following published material<sup>1</sup>:

- Laing, S., & Masoodian, M. (2015). A study of the role of visual information in supporting ideation in graphic design. *Journal of the Association for Information Science and Technology*, 66(6), 1199–1211. <http://doi.org/10.1002/asi.23231>
- Laing, S., & Masoodian, M. (2016). A study of the influence of visual imagery on graphic design ideation. *Design Studies*. 45, 187–209. <http://doi.org/10.1016/j.destud.2016.04.002>
- Laing, S., Apperley, M., & Masoodian, M. (2017). Investigating the effects of client imagery on the ideation process of graphic design. *Design Studies*, 53, 78–98. <http://doi.org/10.1016/j.destud.2017.08.001>

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## Chapter 1

### Introduction

Since the advent of the computer and digital technologies, graphic design has steadily changed, adopting digital tools into all aspects of creative work, from initial client contact to finished work. Increases in power and efficiency of contemporary digital tools have allowed fine-grained control over production, while advances in communication technologies have made it possible to access and share vast quantities of content from diverse physical locations throughout the process.

Operating within this space, graphic designers and their clients can exchange information in a variety of ways, and there is potential for such exchanges to improve the efficiency of the process and quality of outcomes for all parties. Designers, clients, and their audience are increasingly able to gather visual imagery through a variety of devices; however, the effect of access to such data is not known: If designers were provided such data while engaged in generating their ideas, would this result in them producing better or more appealing ideas?

While it seems beneficial to develop a system to automatically present images to graphic designers to aid their process, it is prudent to identify the likely influence upon both the design process and output resulting from using such a system. Therefore, this thesis formally identifies potential effects of exposing graphic designers to certain types of image during idea generation and presents findings based upon both established literature and specific experimentation.

## 1.1 Motivation

---

Graphic designers principally work to communicate on behalf of their clients to an audience, which is discussed more fully in Section 2.1. To be effective, they must ensure that they understand the messages from their clients, identify their audience, and then apply their skills and training to produce visual messages within appropriate media for that audience. The process necessarily involves acts of interpretation, message encoding and message delivery to reach the audience, who in turn must decode and interpret the result. In short, graphic design is about communication.

To enable designers to build their understanding of the problem, they are encouraged by design literature to build and maintain familiarity with both their own task domain, as well as others which might provide cross-disciplinary insight. They are encouraged to identify the problem and then articulate this to the stakeholders involved. Ultimately, they must act to create a visual message, bringing the abstract concept into reality, giving form to the message through selection, creation or structuring of symbols. It is this stage of the process that is investigated in this thesis, where the designer, aware of the need for the work and various constraints upon it, is required to act to create candidate solutions: How is such a designer influenced if supplied images, including those potentially gathered during preceding stages of the design process?

Rather than introducing random inspirational images into the process, this thesis identifies the types of visual information presently sought by designers to inspire their ideation, before testing the effects of supplying such visuals as images to designers engaged in ideation. It is argued that without investigation it is unclear whether an effect is detectable in the output of the work, the process, or the perception of these either by the designers themselves, the client, or an external observer.

In the following section, the approach used in this thesis to formally investigate these questions is presented.

## 1.2 Approach

---

The principle question of this thesis is whether graphic design ideation can be supported through the provision of images using digital technology, however, such a question cannot be answered directly without further breaking the problem into smaller questions. Therefore, the problem has been approached by dividing the question into the following related questions:

1. What image types do graphic designers seek while designing?
2. For what roles do designers report using the images?
3. Is there a measurable effect seen in the design ideation output resulting from image use?
4. Do designers experience the ideation process in a measurably different way when exposed to images?

To develop responses to these questions, an examination of the existing literature is carried out in Chapters 2 and 3, which leads to the identification of knowledge gaps, presented in Section 3.4. Following identification of the gaps, an original study is described in Chapter 4 that uses interview data gathered from graphic design professionals to help answer the first two questions: six distinct image roles are identified as being significant to designers, involving many image types; examples of two of the image roles are then used in further investigation.

Questions three and four are answered using data from laboratory experiments conducted under controlled conditions, showing that the images have a measurable effect upon the experience of the process when supplied; the methods and results of these studies are described in full in Chapters 5 and 6 respectively. The results of the individual studies are then examined leading to the overall conclusion presented in Chapter 7, that it is possible to support graphic design ideation through image provision; responses to the individual research questions, along with known limitations, potential future work, and an overall summary of the collective outcome of the thesis are provided.

## 1.3 Contributions

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This thesis makes the following original contributions:

- Identification and review of literature providing evidence that provision of images could influence graphic design ideation and that the influence is likely to be measurable; identification of gaps within the existing literature providing a background for investigation.
- A report of an investigation of image use by graphic design professionals during their design ideation process identifying image types, and six specific image roles in preparation for or during ideation, as well as an analysis of tools available to support that purpose.
- A report of an investigation documenting the influence of aesthetic of the client and aesthetic of the market images upon ideation output and process. Using results obtained from laboratory testing of graphic design students, evidence is presented showing an influence on the ideation process, but little influence on ideation output.
- A report of an investigation into the influence of the aesthetic of the client images upon ideation process and output from controlled testing with graphic design students, providing evidence of influence upon the experience of the process.
- Critical commentary and reasoning linking the gathered evidence in the form of a thesis, asserting that graphic design ideation can be supported through provision of aesthetic of the client and market images as identified in the work, subject to the limitations described.

## 1.4 Thesis Structure

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Following the initial *Introduction* chapter, Chapter 2 of the thesis provides a background from literature identifying and defining relevant topics in separate sections, including *Graphic Design, Creativity*, and the *Expected Influence of Images on Graphic Design*.

The *Related Work* (Chapter 3) critically examines the literature to identify what is claimed to be known and the basis by which such knowledge is claimed. The first section of the chapter therefore presents studies carried out regarding *Discovering Designer Image Needs* (Section 3.1); the next section presents methods that have been employed to analyse design activity, along with relevant criticism regarding their abilities and limitations in *Methods for Analysis of Design Ideation*

(Section 3.2); *Measurement of Image Effect upon Design Ideation* (Section 3.3) then identifies and comments upon studies presenting empirical evidence for the influence of image use within design; finally *Knowledge Gaps* (Section 3.4) summarises aspects of the motivating problem that are not answerable from the existing literature, and consequently sets out the formal research questions to be investigated further.

Chapter 4, *Understanding Image Roles*, presents the method and results from an interview study investigating how graphic design professionals use images in their process, identifying and classifying specific image roles, as well as considering accounts of the image types used within the design process by those professionals. In addition, the study identifies problems experienced by the designers in using existing computer systems to access and manage their image collections.

In Chapter 5, *Image Influence on Ideation Output*, examples of images corresponding with two of the image roles identified in the prior study are used as visual stimuli for evaluating the effect of images upon ideation output. The chapter describes the testing method and results obtained from a study in which graphic design students are exposed to the stimuli while involved in related ideation tasks, which are then assessed by expert judges, clients, and the participants themselves.

The final study reported in this thesis, *Image Influence in Ideation Process* (Chapter 6), again draws upon the image roles and types identified in Chapter 4; however, only the influence of a single image role is tested. The text of the chapter describes the study method and results, which again involve graphic design students involved in ideation while exposed to the stimulus. Unlike the prior experimental method, this experiment derives results from use of a think-aloud protocol during the ideation activity of the student participants, as well as additional measures including expert judge, participant, and client evaluation.

Chapter 7 contextualises the results within the sequence of the individual studies, which are then discussed in relation to the research questions; *Answers to Research Questions* are given in Section 7.1; the known *Limitations* and potential *Future Work* are identified in Sections 7.2 and 7.3 respectively; finally, the overall implications of the work to the field of knowledge appear in the *Summary* (Section 7.4).

Supplemental information including proof of faculty ethical approval is provided in the Appendices.

## Chapter 2

### Background

Following from the introduction of the topic as presented in Chapter 1, this chapter provides more detail regarding key elements of the problem outlined in Section 1.2. Beginning with definitions from literature of both the activity of graphic design and the parties typically involved in it, the chapter then presents models for the design process, providing both a general overview of the process while also demonstrating variations present within the literature. In Section 2.1.4, the chapter introduces measures for determining the “goodness” of graphic design, before moving into literature about idea generation or *Ideation* (Section 2.2), general *Creativity* and *Creativity within design*, including measurement (Section 2.2.1). *Expectations of the influence of images* appear in Section 2.3, while a summary of the chapter is given in Section 2.4.

### 2.1 Graphic Design

---

Graphic design appears to share many similarities with other design fields including architecture, fashion, and industrial design. Indeed, schools of design such as the Bauhaus (c. 1920) taught different design disciplines alongside one another. Despite the apparent commonality between the design fields, Carvalho, Dong, and Maton (2009) state that each value and give emphasis to different aspects of the process. The following section, therefore, defines from literature both what graphic design is and identifies models for such activities.



As an occupation, graphic design has been formally defined within the Australian and New Zealand context, thus:

GRAPHIC AND WEB DESIGNERS, AND ILLUSTRATORS design information for visual and audio communication, publication and display using print, film, electronic, digital and other forms of visual and audio media.

...Most occupations in this unit group have a level of skill commensurate with a bachelor degree or higher qualification. At least five years of relevant experience may substitute for the formal qualification. In some instances, relevant experience and/or on-the-job training may be required in addition to the formal qualification (ANZSCO Skill Level 1). (Pink & Trewin, 2006, p. 213)

A key aspect of the role described by Pink & Trewin is that of communication; however, their definition does not mention a client. An earlier definition from Marcus explicitly acknowledges the role of a client when describing graphic designers as those who “work in small or large offices to give form to the books, magazines, websites, advertisements, and other graphic messages that their clients want to communicate through print and digital media” (Marcus, 2002, p. 17). Similarly, Samara presents a definition of the designer as a giver-of-form, but also implies the quality of the output of such an individual is sensitive to external influence when he states:

A graphic designer is a communicator: someone who takes ideas and gives them visual form so that others can understand them [...] A graphic designer assimilates verbal concepts and gives them form. A designer organizes the resulting form into a tangible, navigable experience. The quality of the experience is dependent on the designer’s skill and sensibility in creating or selecting forms with which to manifest concepts, or messages. (Samara, 2007, pp. 6–7)

To allow for further discussion on the impact of introducing visual images into the design process, the following subsection presents a selection of models from literature that describe the broader structure of the design process, allowing contextualisation of idea generation activity within that process.

## 2.1.1 The Client

As stated in Section 2.1, communication, frequently on behalf of a client, is a key goal of graphic design; it has been suggested in literature that the presence of a client is a potentially distinguishing feature between art and design activities (Dougher, Plazm, & Berger, 2005, p. 36).

Acting on behalf of the client, it is the task of the designer to plan and arrange communication with the intended audience; the client may serve as an intermediary between the designer and the audience during the design process (Cornish, Goodman-Deane, Ruggeri, & Clarkson, 2015, p. 177); however, the literature states that clients should not be confused as being the same as the audience (Leonard & Ambrose, 2012, p. 70).

Working for a client, it is considered necessary to please that client (Leonard & Ambrose, 2012), which can involve taking into account their likes and dislikes (Curtis, 2002, p. 29), though not all designers take steps to consider the character of the client (Lawson, 2006). A stated goal of investigating the client is to discover what makes the client unique, what sets them apart, so that the designer can use that information to differentiate them from their competitors (Curtis, 2002; Leonard & Ambrose, 2012; Visocky O'Grady & Visocky O'Grady, 2006). However, many designers are said not to explicitly include the client in their process due to budget and time constraints (Cornish et al., 2015).

Communication between the client and the designer is considered important (Lawson, 2006); however, this aspect of the design process is said to have had little research (Cornish et al., 2015, p. 178). Industrial design process research has suggested that not all requirements may be able to be articulated by the client initially, and that requirements often change during the early stages of a project (Haug, 2015).

## 2.1.2 The Audience

For graphic design communication to work, it is considered essential to understand the audience for that communication (Hembree, 2006; Herring, Chang, Krantzler, & Bailey, 2009; Leonard & Ambrose, 2012; Visocky O'Grady & Visocky

O’Grady, 2006), though Pruitt & Adlin are attributed as stating “designers are commonly asked to design for ‘everyone’” (Miaskiewicz & Kozar, 2011, p. 428).

Understanding of the target audience is said to be developed through exposure of the designer to visual stimuli associated with the audience (Hembree, 2006), but also “music, media and other things users might have around” (Herring et al., 2009). Leonard & Ambrose suggest that the success of choices made by designers regarding such things as “materials, typefaces and colours” depend upon how “the audience relates to, and understands them” (2012, p. 76). The Design Institute of Australia articulates this idea in their definition of graphic design as “the matching of information styles to audience requirements” (“Design Industry, Graphic Design,” 2013).

### 2.1.3 Models of the Design Process

Graphic design is described in literature as generally following a process, examples of which include Fletcher’s (2001) five-step model, Meggs’s (1992) five-step model, Hembree’s (2006) five-step model, Arntson’s (2007) six-step model, and Curtis’s (2002) seven-step model. Hembree (2006) suggests that it is normal for companies to develop their own models to describe “their own creative procedures” (p.46). Similarly, while Lawson (2006) discusses a variety of design models from across related disciplines with similar stages, he suggests that in architectural practice, having stages within models may be driven more by the need for regular billing of clients rather than representing significant differences in the underlying thought processes involved.

#### Generalised map of the design process

Lawson presents a number of models in his work discussing the basis for design thinking; one of the models he described as common to design literature (2006, p. 38) is a model referred to as the “generalised map of the design process”, featuring the three terms listed below in a mutually interlinked arrangement:

- Analysis,
- Synthesis, and
- Evaluation (or Appraisal).

Similar forms to this model appear in literature (Beatty & Ball, 2010; Gero & Kannengiesser, 2004; Leonard & Ambrose, 2012; Visocky O’Grady & Visocky O’Grady, 2006; Wallschlaeger & Busic-Snyder, 1992). Lawson himself is critical of the model, suggesting that it does not reflect the reality of the design process.

### *Analysis*

Described as “involve[ing] the exploration of relationships, looking for patterns in the information available, and the classification of objectives. Analysis is the ordering and structuring of the problem” (Lawson, 2006, p. 37); Wallschlaeger & Busic-Snyder present a similar definition of analysis, adding that it is a “commonly expressed objective in science, social studies, philosophy, and the arts” (1992, p. xi).

### *Synthesis*

Lawson defines synthesis as “an attempt to move forward and create a response to the problem – the generation of solutions” (2006, p. 37), while Wallschlaeger & Busic-Snyder refer to it as “the process of putting together elements to form an end product” (1992, p. xi).

### *Evaluation*

According to Lawson, evaluation or appraisal involves “the critical evaluation of suggested solutions against the objectives identified in the analysis phase” (2006, p. 37). Wallschlaeger & Busic-Snyder refer to it as “the process of formulating judgments about a particular idea, method, and so on [which] may be qualitative, quantitative, or both [involving] the use of criteria for appraising the accuracy, effectiveness, and satisfaction of the idea, method, end product, etc.” (1992, p. xi).

### **Curtis’s model**

Curtis (2002, p. 20) defined a seven-step process for graphic design, as used in his company:

- “Listen”, gaining information through engaging with the client;
- “Unite”, including and involving all parties within the process;
- “Theme”, having a unified idea for the entire work;
- “Concept”, embodiment of the theme;
- “Eat the audience”, developing an awareness of the audience;
- “Filter”, working with the media and the limits it creates;
- “Justify”, evaluating success against the brief.

The model and its various stages are described as being sometimes mixed, and the distinctions between them can become blurred (Curtis, 2002, p. 20). The practitioner is encouraged through such an approach to develop familiarity with the client and the audience.

#### Arntson’s model

Arntson (2007, pp. 8–13) presents the following overall stages in a graphic design project:

- Research,
- Thumbnails,
- Roughs,
- Comprehensives,
- Presentation,
- Ready for press.

While the different stages are listed in order, Arntson states that the steps may not be strictly sequential, and that steps such as “roughs” may expose a need to return to the earlier “thumbnails” stage to find a more suitable solution. Similarly, during the presentation stage, Arntson notes that further revision should be allowed for through returning to earlier stages of the process and does not place limits on which stage such a revision could return to.

#### Meggs’ model

Meggs (1992, p. 153) describes a five-step model for graphic design, given in the following order:

1. Problem definition.
2. Information gathering.

3. Idea finding.
4. Solution finding.
5. Implementation.

Despite the implied order in the above model, Meggs states that “the steps in the design process are not rigidly sequential” (1992, p. 154) and some steps may not be directly evident in every project; Meggs is, however, insistent that “the first step must always be to define and understand the problem” (1992, p. 153).

### Hembree’s models

According to Hembree (2006, p. 42), the graphic design process is broken down as follows:

1. Discuss the problem.
2. Develop creative brief.
3. Concepts.
4. Refinements, execution.
5. Implementation, print production.

In the visual representation of the above model, the stages are depicted as a form of Venn diagram, in which each step overlaps the preceding and following steps.

## 2.1.4 Good Design

Having discussed what graphic design is and parties involved, it is necessary to consider what “good” design is before investigating how to support phases within it. From the literature, there are several viewpoints about who can evaluate the goodness of a design, and what criteria should be applied. One viewpoint offered is that what good design is cannot be determined by an individual, but must be arrived at through consensus building with a panel of experts (Marks & Porter, 2009). Roberts indicates that good design must be considered in the context in which it was created, including limits imposed on the designer and the needs of the client in the project, as well as effects the resulting work has upon the world (Roberts, 2006).

Some of the determining qualities of design that are explicitly mentioned in literature include function (Beaird, 2007; Marks & Porter, 2009; Roberts, 2006), clarity of message (Marks & Porter, 2009), creation of an emotional experience

(Samara, 2007), aesthetics (Beaird, 2007; Marks & Porter, 2009; Roberts, 2006), and technical quality (Marks & Porter, 2009; Roberts, 2006). Detailed checklists for both good and bad design have also been published, such as those of Samara, and Chase, Hughes, Miriello, & White, which are reproduced below.

“The Right Design Choices: Twenty Reminders for Working Designers”  
(Samara, 2007, pp. 246–247)

1. Have a concept.
2. Communicate; don't decorate.
3. Speak with one visual voice.
4. Use two typefaces maximum.
5. Show one thing first.
6. Pick colors on purpose.
7. If you can do more with less, do it.
8. Negative space is magical.
9. Treat type as image.
10. Keep type friendly.
11. Be universal; it's not about you.
12. Squish and separate: create rhythms in density and openness.
13. Firecrackers and rising sun: distribute light and dark.
14. Be decisive.
15. Measure with your eyes.
16. Make what you need; don't scavenge.
17. Ignore fashion.
18. Move it! Static equals dull.
19. Look to history, but don't repeat it.
20. Symmetry is the ultimate evil.

It is interesting to note some potentially controversial statements within the checklist of Samara, particularly that the designer should “be universal”, which implies designing for everyone (see Section 2.1.2); while “mak[ing] what you need” appears to conflict with “looking to history”, which in turn conflicts with “ignor[ing] fashion”.

10 Mistakes Designers Make When Creating a Logo, by Alex W. White (Chase, Hughes, Miriello, & White, 2008, p. 21):

1. Not pairing abstraction to the scale of the business.
2. Attending only to figure and not to ground.
3. Designing a logo in a vacuum.
4. Neglecting to blend at least two distinctive ideas together for fresh results.
5. Not matching the logo with the character of the business.
6. Not giving the logo enough distinction from its competitors.
7. Not investing time to understand the clients' unique standing in the business community.
8. Using the same pieces as everyone else.
9. The designer neglects to optimize the logo for colour, gray scale, and line art reproduction.
10. The designer does not prepare scalable artwork that would ensure all type and spacing remain consistently the same.

As with the list from Samara, the mistakes identified in Chase et al., (2008) attest to examining external sources to avoid “designing [...] in a vacuum”, while, possibly contrarily, suggesting that “using the same pieces” be avoided.

## 2.2 Ideation

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Idea generation, or *ideation*, is described as “the process of generating new and sometimes creative ideas” (Kerne et al., 2007, p. 118), and involves a “reflective representational conversation” (Dorta, Pérez, & Lesage, 2008, p. 129); it is of significant importance to design, which “as a whole [...] is a divergent task [...] rarely an optimization procedure leading to one correct answer” (Lawson, 2006, p. 143). In Meggs’ model for graphic design (p.12), he refers to this idea as *idea finding* and *solution finding* phases; idea finding being a search for an idea using a variety of approaches, including *vertical* and *lateral thinking*, *brainstorming*, *incubation*, *notation*, *synthesis* and *ocular reconnaissance*; solution finding being selecting within the options created through possible processes, such as *establishing criteria*, *selection*, and *validation* (1992, p. 159). Though the terms used by Meggs differ, they seem sufficiently aligned to those of Kerne et al., Dorta et al., and Lawson to consider them equivalent.



The act of ideation is considered to involve analysis and synthesis (MacLennan, 1902, p. 79), decision making (Lawson, 2006, p. 133), significant communication between parties (Sharmin & Bailey, 2011), may include elements of chance (Stones & Cassidy, 2010), and is said to require sketching (Appiah & Cronje, 2013). It is noted that problem-framing activities can occur throughout the design process (Cross, 2001, p. 85), thus it is possible that such activities can co-occur or intersect ideation.

It has been noted within literature that computers have not yet proven helpful within ideation, attributed to their emphasis on precision (Dorta et al., 2008). Therefore, Dorta et al., state “ideation often happens near an idled computer by sketching or creating physical models with malleable materials as it has been done since the Renaissance” (2008, p. 122).

### 2.2.1 Creativity

As described in the preceding section, ideation involves the notion of creativity. Hargrove suggests that it is difficult to describe what creativity is and that, further, it is difficult to measure; however, he identifies that it requires associative thinking and involves both divergent and convergent tasks (2013). Other proposals for defining creativity include that ideas generated be applicable, effective, implementable, and novel (Dennis, Minas, & Bhagwatwar, 2013); or simply novel and appropriate (Collado-Ruiz & Ostad-Ahmad-Ghorabi, 2010).

Distinctions of creativity have been proposed, including that there is a difference between “creative” and “merely original” work, and that there are different levels of creativity: “every day, evolutionary, revolutionary” (Shneiderman, 2002, pp. 212–213). Dubberly similarly distinguishes three levels of problem requiring creative solutions: “well-defined, or simple; ill-defined, or complex; wicked-hard, or unsolvable” (1995). Classification of the uniqueness of a creative solution is attributed to Boden as being either *historical (h-creativity)*, “the creativity of generating something unique and relevant for a society”, or *psychological (p-creativity)*, “coming up with a novel and valuable solution for a problem at hand, even if it has been generated somewhere else previously” (Collado-Ruiz & Ostad-Ahmad-Ghorabi, 2010, p. 484).

## Creativity within Design

Design problems as addressed in design schools are described as being from the “well-defined” category, with professionals typically dealing with the “ill-defined” or “wicked-hard” problem types (Dubberly, 1995), while Collado-Ruiz and Ostad-Ahmad-Ghorabi claim design tends toward p-creativity in generating solutions (2010). Work by Heller & Ilić does lend credence to the notion of design being primarily p-creativity, which they suggest is likely not a conscious decision on the part of the graphic designer, when they state “sometimes — actually most times — designers do not know the derivation of their work” (2007).

Literature from various sources suggests that it is possible to measurably influence creativity through provision of stimuli, including images. Ambiguity within visual stimuli is said to be a driver of creative discovery, attributed to Wiseniewski & Gentner (Finke, Ward, & Smith, 1992), while Shneiderman wrote that Leonardo Da Vinci similarly understood the “benefits of random visual imagery as a source of inspiration” who he described as examining various visual phenomena for creative inspiration (2002, p. 209).

## Measuring Creativity

Developing perhaps from the difficulty in defining what creativity is, as mentioned by Hargrove in Section 2.2.1, there are several methods proposed in the literature for assessing how creative the output of a design process is. Most research encountered in the preparation of this thesis measured divergent thought, though one researcher (Kerne et al., 2007) was noted as also measuring convergent thought. Kerne et al., state that unlike task measurement involving Information Retrieval and Human Computer Interaction, “the accuracy of the answer, and the latency, or time to form it” are not appropriate measures, instead “to investigate creative ideation [...] one quests for many possible answers to open-ended questions” (2007, p. 119). They reference metrics from literature in their own studies that they consider to be objective, which are “fluency (i.e., quantity of ideas), flexibility (number of different categories of ideas), originality (i.e., statistical infrequency of an idea), practicality/quality, and emergence”; in addition they used subjective measures “[performed] by participants, their peers, and by experts [rating how] informative, communicative, and expressive” a work is (2007, p. 119).

Other examples of output measurement include quality of work (Casakin & Goldschmidt, 2000); originality, practicality and quality (Goldschmidt & Sever, 2011); originality, appropriateness (feasibility or usefulness), “surprisingness” (sic), specification meeting or requirement fulfilment, and interest (Collado-Ruiz & Ostad-Ahmad-Ghorabi, 2010); Wallach and Kogan’s Similarities Test (fluency, originality), Mednick’s Remote Associates Test (“unusual associations to a given stimulus”, convergent thinking focus) (Hargrove, 2013); and novelty, workability, and relevance (Dennis et al., 2013).

## 2.3 Expected Influence of Images on Ideation

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As has been discussed in preceding sections in this chapter, there is an expectation of designers gathering and reviewing images and other visual samples to inform various aspects of their work, including acting as examples or elements for direct use within their designs (Arntson, 2007; Heller & Ilić, 2007; Samara, 2007). In Meggs’ model of the design process (Section 2.1.3, p. 12), the “idea finding” phase is described as potentially involving ocular reconnaissance, described as:

The visual stimulation of looking, surveying, and inspecting [and] one of the most fertile sources of inspiration for designers. Wandering through an art museum, a hardware store, or the library can reveal forms, colour combinations, and images that enrich the data bank of the brain. (1992, p. 158)

Clearly, Meggs considered that such information obtained would positively influence later thought. Similarly, in the Curtis model of design, the incitement to “[eat] the audience” implies deliberate gathering of information to influence subsequent design activity.

Regarding the client, Tonkinwise draws attention to the contribution of Pierre Bourdieu as having demonstrated that there are “homologies between different fields of taste” for people (2011, p. 536); Tonkinwise states that such knowledge has been applied by film art directors to quickly convey background information about characters to an audience, and may also be of value to a designer:

Glimpsing that poster, those objet d’art, and these kinds of clothes, allows me as a viewer to make quick hypotheses about the person whose room this

is, about their class, their level of education and financial standing, for instance - but also, especially if you are a (interaction oriented) designer, of what they are capable, their facilities with various kinds of activities. (Tonkinwise, 2011, p. 537)

Aside from their potential to provide insight on client and audience, images are also known to have, or at least be associated with, thought and meaning: as Dondis asserted, “there is visual syntax and its dominant characteristic is complexity. The complexity, however, does not defy definition” (1973, p. 12). Similarly, Novitz argued that images are not merely aesthetic, that they have communication abilities as well (1977), even if they are not, as Mitchell is attributed to have said, “fully explicable on the model of textuality” (Rose, 2001, p. 10). As Rose describes it, “knowledges are conveyed through all sorts of different media”, including combinations of media (2001, p. 10); therefore, it seems reasonable that images would convey information of potential benefit to a designer engaged in a design process and may be expected to alter both their output and process.

There are suggestions that the image is indeed influential in enabling communication within the design process between parties, particularly with artefacts such as *mood boards*, “those assemblages of images and, less frequently, objects, which are used to assist analysis, creativity and idea development in design activity” (Garner & McDonagh-Philp, 2001, p. 57), which have been applied in other design fields for such purposes (e.g. product design) (Keller, Paman, & Stappers, 2006).

## 2.4 Summary

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In this chapter, the notion of what a graphic designer is has been discussed (Section 2.1), and the general purpose of graphic design has been laid out: from the literature, it is a discipline concerned with communication on behalf of other parties, and there are suggestions of the need to be aware of external influences.

The client and the audience are obvious potential influences upon a designer that are identified in the literature; however, as discussed in Section 2.1.1, opinion is divided as to what information the client can or should provide, and to what extent a design can or should be adapted to suit them. Conversely, the design audience

(discussed in Section 2.1.2) acting as a possible source of inspiration seems non-contentious; however, it appears that not all designers define the audience fully, or in a way that would allow gathering useful inspiration from them. It also appears unclear from the literature how to make use of inspiration obtained from the audience within the design process itself, other than to simply be exposed to it.

Though the various models of design presented in Section 2.1.3 convey a general sense of forward progress, closer inspection reveals that many of them include cyclic stages, or make fuzzy distinctions between stated phases. Therefore, there is the possibility that new information will be sought and may be injected into the process at various stages, to help drive the process forward.

The section on Good Design (Section 2.1.4) provided some insight into how value might be determined in design output, including consideration of the circumstances in which the work was produced. Checklists from Samara, as well as Chase, Hughes, Miriello, & White, both demonstrated specific questions that may be asked of design output to evaluate the effectiveness of a design; however, they cannot provide guidance in the idea generation process beyond recommending building a visual sensitivity.

The idea of generating concepts was further examined in Section 2.2; ideation was described as approachable using a variety of methods, one of which was identified as ocular reconnaissance (Meggs, 1992), while chance was noted as another factor considered to play a role (Stones & Cassidy, 2010). Levels of creativity were identified and associated with design activity from the literature, including that it is possible to consider work creative that is not necessarily historically unique (p-creativity) (Collado-Ruiz & Ostad-Ahmad-Ghorabi, 2010). In *Measuring Creativity* (p.17), several potential measures for creativity were identified, suggesting the possibility of measuring the phenomena in a meaningful way.

Finally, the potential for influence of graphic design ideation through image provision was discussed in Section 2.3, particularly including the work of Tonkinwise, which linked Bourdieu's idea of character insight with their aesthetic tastes. Further, it was discussed that images can be vehicles for conveying meaning, which in turn may have an influence upon the process as well as the output of design.

The following chapter identifies and examines those studies providing evidence regarding designer image needs during design ideation; methods employed to analyse design processes; studies reporting on the influence of images upon design generally; and finally, identifying areas of knowledge that require further investigation to answer the thesis questions posed in Section 1.2.



## Chapter 3

### Related Work

In the previous chapter, graphic design was described as an activity in which the designer produces visual messages for clients, for transmission to audiences on behalf of the client. Further, it was established that there is an expectation that such actions be creative, though the definitions of creativity presented allow for both historically new content creation, as well as the repurposing or reuse of existing content via p-creativity. In addition, it has been identified that images may have an influence on graphic design ideation, and that it is reasonable to expect that images could influence ideation beyond simply serving as exemplars.

In the following chapter, the thesis presents literature examining the image needs of designers along with efforts to determine the effect of images on the process. The chapter then concludes with a discussion of the knowledge gaps that remain despite investigations reported to date.

#### 3.1 Discovering Designer Image Needs

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This section identifies studies of the need for and type of images required by graphic designers or in related disciplines. In addition, some studies indicate how the images are expected to influence the process when they are provided.

Beginning with graphic design literature, Sharmin & Bailey report on the use of artefacts for communication purposes during ideation, based upon data obtained



using semi-structured interviews with seven graphic designers, four web designers, and four industrial designers. They found that expert designers “request more for client and product related information to learn more about the design space and from the experience of other designers” (2011, p. 193). They suggest improving the design process by “creating a vocabulary for capturing and categorizing different types of communication with related artefacts (e.g., requirement, user preference, design decision, and feedback) [which] would allow effective access and retrieval” (2011, p. 195).

Also addressing graphic design specifically, Leonard & Ambrose provide guidelines for conducting research including images, and suggest ways in which that research may be utilised within the design process (2012). Their work is based upon analysis of literature and retrospective accounts of graphic design from selected designers.

The work of Paton & Dorst (2011) presents evidence based on retrospective interview studies with fifteen visual communication or graphic design practitioners discussing how they frame the design problems, and how this affects subsequent work, including discussion on their use of mood boards to help drive conversation with the client; the work does not examine the role of the images with subsequent concept generation.

Keller, Pasman, & Stappers (2006) studied six industrial design professionals, establishing principles for a computer system to support design, including: active collecting, merging physical and digital collections, promoting serendipity, encouraging visual interaction, breaking rhythms to inspire, and the social value of visual material. Keller, Visser, van der Lugt, & Stappers (2009) evaluated the use of a prototype tool to assist with providing visual inspiration for three designers over a period of four weeks; of the three designers performing the evaluation, one worked in a company that performed graphic design, while the others provided industrial design or similar services. They identified several behaviours that were influenced by the use of their prototype, including encouragement of “Active collecting”, “Merger of physical/digital collections”, “Visual interaction” and storytelling through composition, “Serendipitous encounters” leading to further discoveries, and “Social use” between people during design tasks (2009, p. 75). The authors expressed confidence in the ability of such a tool to positively influence

design practice, based upon their results; however, it is noted that they had a very small sample of responses to base their judgement upon.

Mougenot, Watanabe, Bouchard, and Aoussat (2009) studied four automotive designers to find which images were of interest to them, including how the participants decided what was interesting about the images. Their study identified three levels of abstraction used by the participants in selecting images of interest: “high (atmospheres, sensations)”, “medium (products or sector names)”, and “low (materials, colours, textures)” (2009, p. 4478).

Makri and Warwick (2010) reported on a naturalistic observation of nine postgraduate architecture students as they sought image resources. They observed and documented a range of behaviour, including “finding information”, classified as “accessing, searching, browsing, encountering, surveying, monitoring, exploring, chaining”; “assessing information”, classified as “selecting, distinguishing, extracting”; “interpreting information”, classified as “analysing/synthesizing, visualizing/appropriating”; “using information”, classified as “editing, recording”; and “communicating”, classified as “consulting, sharing/distributing” (2010, p. 1754). The authors reported participants’ information-seeking behaviour, including “looking at material that was not directly related” to the given design task, but that had the potential to inspire the student later; they remarked that participants were not seeking exact results in their searching, instead reporting inspiration as “a driver for and outcome of information seeking and use” (2010, p. 1766).

Haug (2015) reported an interview study involving ten industrial design students, documenting their need for information about a client, the client's preferences and requirements, and how knowledge about the design problem is built as the project progresses rather than being supplied at the outset of a project.

Professional image database usage studies have been performed using log analysis by researchers including Jörgensen and Jörgensen (2005), Westman and Oittinen (2006), and Cunningham, Bainbridge, and Masoodian (2004). These studies have presented evidence of the types of images sought by designers and other image professionals engaged in their design processes; however, the use of log analysis techniques to gather such data can be problematic: for instance, they may reveal

only search strategies employed rather than the terms used (Westman & Oittinen, 2006), and may not be able to distinguish different users within shared environments (Jørgensen & Jørgensen, 2005). Log analyses of online collections may therefore show only information about how individual images are sought, without providing insight into the context in which they are used.

## 3.2 Methods for Analysis of Design Ideation

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Existing knowledge on the design process develops from a variety of methods described in the literature and variously applied in several design and design-related fields, including Architecture, Engineering, Industrial Design, and Graphic Design. In the following section, a summary of these techniques is presented.

### 3.2.1 Thematic Analysis

Although said to be rarely acknowledged, thematic analysis has been described as a widely used form of qualitative analysis, encouraging the researcher to search for themes or patterns, which is considered epistemologically and ontologically flexible (Braun & Clarke, 2006, p. 78). Beatty and Ball (2010) provide an example of the application of this method in an analysis of poetry composition strategies compared to design practice. Braun and Clarke provide detailed instructions on the appropriate way to conduct a thematic analysis in the form of a checklist, which they state as follows:

1. Transcribe data appropriately, check against tapes (regardless of whether you were the transcriber).
2. Give each data item equal attention in the coding.
3. Make sure codes are not generated from “a few vivid examples (an anecdotal approach)”; be thorough, inclusive, comprehensive.
4. Collate extracted themes.
5. Check themes against each other, the original data.
6. Make sure themes are internally coherent, consistent, distinctive analysis.
7. Interpret, analyze data; don’t just paraphrase or describe.
8. Analysis and data should match each other; data should support claims.
9. Check analysis tells a convincing story about the data and topic.
10. Balance analytic narrative with illustrative extracts.

11. Spend enough time on each phase of analysis, don't rush.
12. Be explicit about the approach, the assumptions made.
13. Ensure good fit between described method and reported analysis.
14. "Language and concepts in reporting [should] be consistent with the epistemological position of the analysis."
15. Researcher should be positioned as active in the research; themes don't simply emerge.  
(Braun & Clarke, 2006, p. 96)

### 3.2.2 Ethnomethodology and Conversation Analysis

Luck (2012) describes *Ethnomethodology* and *Conversation Analysis* as useful tools for examining design processes, which are based on the "contemporary or human sciences"; the focus being to capture and document "naturally occurring talk and interaction", which in turn reveals "the methods by which social action is ordered and accomplished" (2012, p. 521). Luck asserts that, through using the technique, it is possible "to recover work practices from the field" (2012, p. 526) and, in combination with expected research developments, "readers will then be able to witness the lived praxeological work of design for themselves, viewing the live data sources that preserve the temporal order of design conduct" (2012, p. 527).

Goodwin & Heritage (1990) describe *Conversation Analysis* as an instrument created to study ordinary conversation, which emerged from the "Cognitive Revolutions" of the sixties. In use, emphasis is placed on "participants' orientation to indigenous social and cultural constructs" through analysis of action, mutual knowledge, and social context (Goodwin & Heritage, 1990).

### 3.2.3 Protocol Studies

Studies of design have utilised protocol studies to examine many aspects of design, including problem formulation, solution generation, and process strategy in the design process in a variety of design-related disciplines (Cross, 2001; Salman, Laing, & Conniff, 2014; Tang, Lee, & Gero, 2011). Within protocol studies, the selection of an appropriate coding scheme and the encoding process itself are described as being of key importance to the successful implementation of such studies (2011); however, Tang et al., assert that while "a large variety of coding

schemes have been employed in protocol studies in design”, they also note that “very few coding schemes have been re-used by researchers other than those who established them” (Tang et al., 2011, p. 3).

Limitations of protocol studies have been recorded, including that they are unable to capture “many of the broader realities of design in context” (Cross, 2001). Ericsson & Simon (1985) state that the best results are obtained using the *concurrent* form of probing, since it primarily involves the short term or working memory of the participant; they describe the *retrospective* form of probing as producing a less reliable result due to the reliance on retrieval of information from long term memory by the subject, opening the possibility of introducing errors (Ericsson & Simon, 1985).

Tang et al., identify that both concurrent and retrospective forms of protocol study have been applied in design analysis, with some developments applied to counteract the risks associated with retrospective probes; however, these developments are said to be scattered across the literature (Tang et al., 2011). Explicitly identified developments include the augmentation of retrospective protocols using video-recordings (attributed to Suwa, Purcell & Gero, 1998), *Linkography* (attributed to Goldschmidt, 1994), and measurement-based tools (attributed to Gero & Kan, 2009, Kan & Gero, 2008) (Tang et al., 2011).

Participants using classic think-aloud protocols have been shown empirically to experience “little effect on [their] behaviour and mental workload, except for prolonging tasks” (Hertzum, Hansen, & Andersen, 2009, p. 179); by contrast “relaxed thinking aloud”, where participants are also required to provide explanations and comments about their task reasoning, has been found to negatively influence subject behaviour, and consequently “threatens the validity of the method” (2009, p. 179).

Examples of coding schemes for protocol analysis include the *Function-Behaviour-Structure* (FBS) ontology attributed to Gero, and Gero & Mc Neill (Tang et al., 2011), the *Situated Function-Behaviour-Structure* (Gero & Kannengiesser, 2004), Valkenburg & Dorst’s *Reflection-in-Action* (Tang et al., 2011), and *Linkography* (Tang et al., 2011). The *Function-Behaviour-Structure* ontology derives from the 1992 *Information Processing* design paradigm of H. Simon, while *Reflection-in-*

*Action* is linked to the 1995 *Reflection-in-Action* paradigm of D. Schön (Tang et al., 2011).

### 3.2.4 Design Flow

The *Design Flow* method (Dorta, 2007; Pérez & Dorta, 2011) has been applied to the analysis of design processes in industrial or product design and is based on the original concept of *Flow* (Csikszentmihalyi, 2008; Csikszentmihalyi & Csikszentmihalyi, 1988). The method combines four forms of protocol analysis, each cross-checking each other: think-aloud protocols, in-task reasoning, post-task interviews, and a *Flow Panorama* to capture the participant's state of mind (Dorta et al., 2008). The root concept of a flow state describes an experience in which a person is “completely involved in what [they] are doing—focussed, concentrated; a sense of ecstasy—of being outside everyday reality; [experiencing] great inner clarity—knowing what needs to be done, and how well [they] are doing; knowing that the activity is doable—that [their] skills are adequate to the task; a sense of serenity—no worries about [the self], and a feeling of growing beyond the boundaries of [their] ego; timelessness—[being] thoroughly focussed on the present, hours seem to pass by in minutes; intrinsic motivation—whatever produces flow becomes its own reward” (Csikszentmihalyi, 2008).

### 3.2.5 NASA Task Load Index

The NASA Task Load Index (TLX) scheme has been used as a component in protocol studies for assessment of design activities (Dorta, 2007; Dorta et al., 2008; Pérez & Dorta, 2011). Originally developed to provide subjective measures of overall task performance in the aerospace industry, it has subsequently been applied across diverse fields and in various modified forms (Hart, 2006). Dorta used the scheme to evaluate the “cognitive aspects” of a product design task by providing an “overall workload score based on a weighted average of ratings on six subscales: three dimensions [related] to the demands imposed on the subject (mental, temporal, and physical demands) and three [dimensions] to the interactions of the subject with the task (performance, effort and frustration)” (Dorta, 2007, p. 128).

### 3.2.6 Activity Theory

Activity Theory “facilitates the consideration of interaction in social contexts which is a good starting point for studying contextually embedded practice” (Appiah & Cronje, 2013, p. 16). Engestrom is attributed with defining Activity Theory as “based on object-related activity versus goal-directed action; it deals with objects versus a psychic process; it is concerned with the history of the activity versus the relativism of the present alone; it deals with creation and externalization of new tools versus the internal process only” (Bennett, 2006, p. 75). A more succinct definition states that “simply put, activity theory focuses on subjects using tools to achieve objects” (Tan & Melles, 2010, p. 463).

A summarisation of the theory attributed to Leont’ev is as follows: “activity can be viewed at different levels” from high level “activity addresses a need” to individual “operations”; “actions are specifically goal oriented”, since “goals provide the motive for action”; “activity is mediated” by “tools and sign systems [...] in mental activity as well as in physical activity”; it should be studied “with a developmental approach”, since as things change, societies and their tools change too; activities exist within a social context, and it is not possible to separate “activities, motives, and tools [from] society and culture”; “external activity is responsible for the development of internal mental activity” (Gall & Alabdullaziz, 2015).

In contrast to protocol studies, Activity Theory has been used in relatively large-scale studies. For instance, Appiah & Cronje (2013) used the method in a study with 127 participants where they considered the influence of ICT technology on graphic design pedagogy. Activity Theory has also been used in combination with other techniques, for example in the development of Design Flow (see 3.2.4).

## 3.3 Measurement of Image Effect upon Design Ideation

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Following on from reasoning put forward within Section 2.3 and earlier within this chapter (Section 3.1), images are expected to play a role in influencing graphic design ideation; however, evidence for effects have not yet been presented. In the following section, therefore, this thesis identifies specific research efforts to examine image influence upon ideation for graphic design or related fields, their key findings, and methods for establishing their evidential claims.

In an investigation involving several design fields including graphic design, Jonson (2005) examined the role of sketching within ideation using a self-report diary and semi-structured interviews with five student and five professional designers; Jonson found that sketches were not the primary conceptual tool for any of the participants, and that words were considered more important for conveying meaning.

Herring, Chang, Krantzler, and Bailey (2009) conducted semi-structured interviews in the workplace of eleven professional designers, of whom four were graphic designers. Their study identified positive benefits associated with the use of examples in several design activities, including the ideation phase of design, and provided evidence that such examples may help facilitate client–designer communication. During the “preparation phase” of their process, designers reported viewing relevant information “in order to develop an understanding of what is required and to provide a basis for generating valid solutions”; relevant examples were encountered by the designers through both “active” and “passive” search mechanisms “when the designer is looking for inspiration” (2009, p. 89). The authors suggest designers search for and browse material to see what exists; although they found that examples from the same domain were considered “most useful”, other examples from outside the domain were also used to determine current fashion and style trends (2009, p. 90).

Two studies by Stones & Cassidy (2007, 2010) considered different forms of visual representation and their effects upon the creative output of participants. In the first study, they examined outputs generated during two fifteen-minute design sessions, with results from 96 undergraduate multimedia student participants. The task in their first study required participants to combine two typographic characters, while obeying stated rules, using either a computer system or pencil and paper. Results were based upon the number of outputs generated by each participant and the diversity of the solutions they created; they found that the paper-based sketching method induced more diversity in the participant output. The second study of Stones & Cassidy investigated whether participants saw new shapes in marks that they had made during two twenty-five-minute ideation sessions, comparing results for two logo design ideation tasks produced by 10 student participants. Using retrospective interviews augmented by video recordings, the researchers observed that the participants saw new shapes within the digital images they created, but did



not produce new solutions from them; instead, they were concerned with how closely their output matched their intended depiction. Ultimately, the authors concluded that reinterpretation is more likely induced when using paper-based processes (2010, pp. 455–457).

Skolos & Wedell (2012) present 20 case studies themed around different phases or aspects of graphic design process from a selection of named designers. In one of the case studies, noted graphic designer Michael Beirut provided a retrospective account of his experience producing an identity mark for the New World Symphony, describing his difficulties in generating appropriate ideas, and the inspiration he obtained from receiving sketches from the project client, as well as from the architecture associated with the project (2012, p. 126). Other case studies within the work describe inspiration taking a variety of forms.

Herring, Poon, Balasi, & Bailey (2011) conducted a preliminary study of a prototype design tool called *Tweetspiration*, with eight participants of unspecified training. Their tool was intended to inspire new idea searches upon the Web through visualisation of current discussion in Twitter on the topic, while their study examined how they felt about use of the tool using semi-structured interviews and survey questions; they found that their tool did indeed inspire new search directions (2011, p. 2315).

Casakin & Goldschmidt (2000) tested the results of reasoning by visual analogy upon 17 professional and 22 student architects, finding that participants produced better quality work when instructed to use the analogies; analogies provided included both within and between domain material. Assessment of the output was carried out by three professionals, naïve of the phenomena being investigated, while think-aloud protocols and video recordings were used to capture participant behaviour.

In a similar study, Goldschmidt & Smolkov (2006) examined the influence of diverse forms of visual stimuli from a range of fields, including product design, art, morphology, nature and models of architecture, using undergraduate architecture students as participants. With a panel of three graduate students as judges, they evaluated the creativity of the design output of the participants, seeking evidence of changes in originality, practicality and quality of those outputs. Their results

indicated that “the presence of visual stimuli is positively correlated with the emergence of creativity” (2006, p. 563).

Though not image related, Goldschmidt & Sever (2011) studied the effect of texts as stimuli for industrial design students, finding that their participants produced output that was higher-rated for originality when exposed to the stimuli.

Cross (2001) reviewed studies of design activity conducted using a variety of methods and addressing many aspects of design process: the work considered most relevant to this chapter concerns problem framing activities and the effects of certain types of stimuli upon fixation. Cross identified studies of mechanical engineers and industrial designers attributed to Jansson and Smith, Purcell and Gero, that provide evidence of fixation resulting from exposure to examples in image form, noting that “some designers may be too ready to re-use features of known existing designs”; however, he also observes that fixation should not necessarily be considered a negative outcome (2001, p. 86).

Stappers & Sanders (2004) examined the participatory design perspective within the “design development process”, considering the effect of collage making by non-collage makers. In their experiments, participants used either symbols and words on paper, images and words on paper, mind maps on computer, or images and words on computer to express their “home experience: past, present, and ideal”; assessments of the outputs as well as the participants’ presentations were used to determine that none of the modes were significantly different, and that all were capable of eliciting useful information.

Examining whether denying sketching had a result on ideation, Bilda, Gero, & Purcell (2006) found that there was not a significant difference in the output of three architects when they were blindfolded during the conceptual phase of their work, compared with when they were allowed to both see and sketch ideas. Their study considered the output using a double-blind panel, composed of three expert judges, using criteria to assess on a scale of one to ten how creative the resulting design was: the criteria used were: “how innovative”, “how creative the sketched design is”, “how well the sketched design satisfies the design brief”, “practicality” and “flexibility”. In addition to the output review, protocol analysis was used to compare paired sessions.

Menezes & Lawson (2006) examined how perception of sketches from within and external to the subject domain varied between different levels of trainee architect, seeking insight on whether certain groups are better able to use sketches during ideation. In their study, they compared a total of 60 novice and skilled architecture student participants using several tests, capturing data using several methods, including a protocol analysis of think-aloud data captured during the tests. They noted that there was a great variety of responses within the group, despite using only two sketches as the stimuli for the experiment (2006, p. 578). Overall, their results were presented as evidence that a number of differences exist in the ways that the two groups view and describe such sketches, including that the higher level students engaged more “verbal cognitive actions per minute”, which they further interpreted as being linked with more active thinking and potentially improved conceptual work (2006, p. 583).

The influence of externalised representations of design concepts upon design process and output has been examined in the context of industrial design, using Design Flow and NASA TLX measures (see Sections 3.2.4 and 3.2.5) to capture the responses of twenty students working within a proposed “Hybrid Information Space (HIS)” (Dorta, 2007). That research found evidence that student participants were able to “ideate more easily, based on factors such as time spent, concept produced and success rate” using the system, while intrinsic motivation was also observed to be a factor in performance (2007, p. 130). Further research involving the HIS considered its impact upon the design process of four professional industrial and interior designers, finding that the tool positively supported three of the participants in their process (Dorta et al., 2008). More recent work by Pérez and Dorta has discussed the findings of these works in relation to the wider challenge of supporting design ideation within the industrial and interior design context (Pérez & Dorta, 2011).

Bonnardel & Zenasni (2010) reported three studies of design support systems, one of which specifically addressed image influence upon design ideation; that study involved working with 48 student designers in their first or final year of study in an unspecified field to carry out their study. Their participants were instructed to produce car designs for a specified client, either supplied no images, or given one of three different types of images; *intra-domain* images “related directly to the

object [being] designed”; *near inter-domain* images shared “functionalit[y] with the object [being] designed”; and *remote inter-domain* images, considered unrelated to the design object (2010, pp. 183–184). The output of the participants was assessed for usefulness and originality by an unspecified panel of judges; video recordings of the participants captured think-aloud data for protocol analysis, used to identify “elements they evoked and verbalized” (p. 184). Results of the study found near inter-domain images enhanced the creativity of the final year participants, while by contrast, remote inter-domain images were found to be the only image type that did not diminish the output creativity of the first year participants (2010, p. 185).

Image exposure upon engineering design teams has been investigated by López-Mesa, Mulet, Vidal, & Thompson (2011); they examined the effects upon both the participant output and process resulting from showing images obtained via search from the Internet; images were selected for characteristics of the shape or the intended usage of the object to be designed. Twelve participants were chosen from a pool of 17 Engineering PhD students and doctors with experience in designing, with selection based on results of a *Kirton Adaption–Innovation* (KAI) test which identified “the problem solving style of each potential participant” (2011, p. 78). Participants were gathered into teams of four, based upon their results, then each team was exposed to either images or text-based questions as stimuli, during design sessions lasting forty minutes. The design task was for each team to create proposals for a map tube case. Results of the study showed that:

[...] teams inspired by images were [...] in a continuous flux of solution alternatives generation; us[ing] the images to produce subsequent ideas that consider other ways to obtain a similar action function as with a suggested solution, leading to numerous solution alternatives at the conceptual structure level; [they did] not engage in detail aspects of solutions; ignore[d] uncertain design situations half of the times.

(2011, p. 52)

The authors also identified team goals which might be positively influenced by images, including “when quantity of solutions is sought”, and when “variety and non-obviousness [of solutions] is sought at the conceptual structure level” (López-Mesa et al., 2011, p. 52).

Miaskiewicz & Kozar (2011) examined the potential benefits to product design processes of providing persona information to designers, including both names and pictures. The authors applied the *Delphi* method, which seeks to build consensus among groups, to gather data from a panel of 19 experts, chosen from an initial pool of 38; selection of the experts used a procedure involving a tool identified as a *Knowledge Resource Nomination Worksheet (KRNW)*. The resulting panel carried out three phases of data formation and analysis, resulting in a ranked list of identified and defined benefits of persona use, which, in order from highest to lowest are:

Audience focus, Product requirements prioritization, Audience prioritization, Challenge assumptions, Prevention of self-referential design, Decision guide, Agreement catalyst, Engagement and unification, Empathy creation, Innovative thinking, Team collaboration, Communication aid, Problem scope definition, Evaluation guide, Organization of research data, Articulate stakeholders' vision, Improved usability, Product offerings, Product evaluation, Intuitiveness, Product marketing, Reuse of research data

(Miaskiewicz & Kozar, 2011, p. 425).

Based upon the list results, the authors stated that the “audience prioritization and product requirements prioritization [benefits], point to the personas' ability to limit the design choices available to designers and to allow for calculated design decisions. By limiting for whom the product is designed for and what features are vital, personas limit the design alternatives that are available to the designers” (2011, p. 428). The authors specifically mention that the use of personas has the potential to encourage better knowledge of the end-user within user-centred design (p.429).

Chandrasekera, Vo, & D'Souza (2013) conducted a pilot study that examined whether subliminal suggestions influenced Sudden Moments of Inspiration (SMI) in architecture; their subliminal suggestions taking the form of visual stimulus demonstrating a possible solution, presented in a controlled manner during the initial task briefing. Their results suggested that there was an effect upon the output and the process of the work; however, as only two participants were involved in their study, the results cannot be assumed to be widely applicable.

## 3.4 Knowledge Gaps

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As mentioned in Section 2.1, different design domains are said to value different knowledge (Carvalho et al., 2009); if true, it cannot, therefore, be assumed that the experimental results obtained from other design fields necessarily apply to graphic design.

Literature for graphic design and related fields suggests that the client, audience, and competitors all represent potentially significant sources of information and, further, that such information might take the form of images. Problematically, however, there are few studies that provide evidence of the actual image needs of graphic designers and how those images appear to be used in their ideation process; studies reported in the preceding chapter and sections tend to involve few participants, or participants from mixed design fields.

For example, while the work of Cross (2001) considered image effects at various stages from a variety of fields, none of them necessarily apply to graphic design; Keller et al., (2009) provide potential insight on image use within graphic design, however, only one of their study participants was related to the graphic design field; results from Sharmin & Bailey (2011) are based on 15 designers, of which 11 participants are graphic designers; Paton & Dorst (2011) do provide evidence of image use in problem framing, based on retrospective accounts by 15 graphic designers, however, the role of the images in subsequent ideation activity is not investigated.

The literature has suggested a variety of methods for analysing design (Section 3.2) that, in combination with knowledge of design creativity (p.17), seems likely to yield useful data allowing investigation of effects in graphic design ideation, as well as the output from that process. Therefore, to gather the necessary data, the following specific questions are asked in this thesis:

1. What image types do graphic designers seek while designing?
2. For what roles do graphic designers report using the images?
3. Is there a measurable effect seen in the graphic design ideation output resulting from image use?

4. Do designers experience the ideation process in a measurably different way when exposed to images?

To prepare to answer these questions, a sequence of studies were designed and carried out, the methods and results of which are presented in the following chapters (4–6). The individual studies apply a variety of methods and approaches derived from the literature to investigate the stated questions.

The first study, presented in Chapter 4, addresses the first two questions. A flexible inquiry method was used to capture information from professional graphic designers regarding their processes and what they used to inspire them. The results of that study identify and, in some cases, confirm specific roles that images play and types of image used in ideation, and provide insight as to what effects they may have within the process of professional practitioners.

In the second study, reported in Chapter 5, controlled testing of sets of images corresponding with two of the image roles identified in the first study is performed, specifically to measure effects on the creativity of the work produced in the design process. The study asked the following questions:

1. Does exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation have an influence on the graphic design process?
2. Does exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation have an influence on the creativity of the graphic design outputs?

Finally, developing on the results of the first two studies, Chapter 6 presents the methods used and results obtained, evaluating the effect of certain images upon the process and output of the design participants. Specifically, the third study asks:

1. How does the provision of AC images during design ideation influence the process of graphic design ideation?
2. Are there measurable effects on the creativity of the design ideation outputs produced in the presence or absence of AC images?

The findings of the thesis thus develop from the findings of these three studies, in combination with the critical reading of the literature from this chapter, and are presented in Chapter 7 of this thesis.





## Chapter 4

### Understanding Image Roles

The previous chapters have referenced literature suggesting that designers should take inspiration from various sources during their design process; however, it was argued that the actual behaviours of graphic designers are little understood; thus, there is a need for seeking evidence of professional designer activity, including identifying what role, if any, images play within their process. To gather necessary evidence, the study presented in this chapter was planned and conducted, involving fifteen design professionals from various parts of New Zealand, with interviews conducted in their workplaces. Full details of the methods employed and the results obtained are presented below<sup>2</sup>.

#### 4.1 Study Methods

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Due to a lack of empirical studies of professional graphic designers focussing on the ideation phase of the design process, a study was conducted to understand better the role of visual imagery in the ideation phase of graphic design. The method and findings of the study are discussed in the following sections; ethical approval to conduct the study was granted by the Faculty of Computing and Mathematical Sciences Ethics Committee (see Appendix A).

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<sup>2</sup> This chapter contains portions of an article already published (Laing & Masoodian, 2015).

The study carried out is a qualitative inquiry based on semi-structured interviews with professional graphic designers in their working environment. The interviews involved visiting the working environments and reviewing samples and artefacts used during the design process by the participants. Some artefacts, photographs, and sketches of the environment were collected for further analysis when permitted by the participants.

The study looks at the practices of designers operating in New Zealand, using companies identified from publicly listed sources such as phone books and websites. Companies were selected based on the professional services they advertised, with emphasis given to graphic design services. Requests for interviews were made with staff directly responsible for providing graphic design services, rather than management or support personnel.

*Table 1 Study participant details*

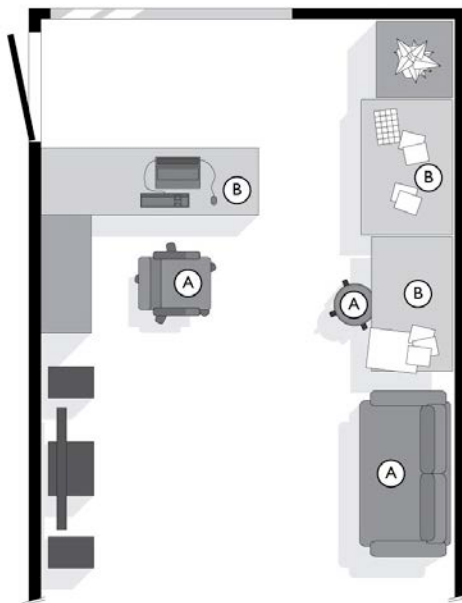
Participant	Company	Work type	Role	Gender	Years of experience
1	A	Advertising, web, print	Senior designer	F	8
2	A	Advertising, web, print	Senior web developer	M	15
3	B	marketing, print	Marketing director	M	8
4	C	Advertising, web, print	Creative, designer	F	3
5	D	3D, compositing, print	Senior designer, creative director	M	11
6	D	2D motion graphics, print	Senior designer, creative director	F	13
7	E	Print design	Senior graphic designer	F	8
8	E	Print, web layout	Graphic designer	M	12
9	F	Web, print design	Senior designer	M	25
10	G	Advertising, web, print	Art director	M	14
11	H	Corporate graphics	Creative director	M	22
12	H	Corporate graphics	Designer	F	4
13	I	Graphic design, print	Director, graphic designer	F	20
14	I	Graphic design, print	Graphic designer, senior	M	6
15	J	Graphic design, print, web, video	Senior designer	F	12

Fourteen interviews were conducted, involving 15 professionals from 10 different companies, all located in the North Island of New Zealand. Table 1 provides a summary of the companies and participants involved in this study. The participants included eight males and seven females, whose work experience ranged from three to 25 years. The median for experience was 12 years. The companies ranged in size from sole owner–operators to businesses with teams of five or more designers and other staff. The two sole operators interviewed had both experienced working in larger companies previously. Participants described their own roles within their

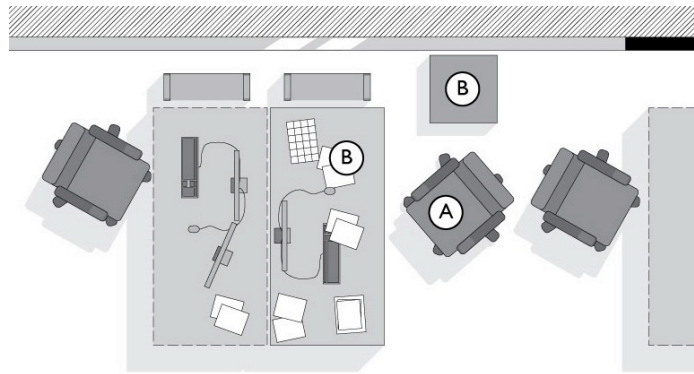
companies as: graphic designers (three), senior designers (eight), senior web developer (one), marketing director (one), creative director (one), and art director (one). Table 1 also provides a summary of the demographics of the study participants. In subsequent discussion, the study participants are referred to using the codes 1 to 15.

#### 4.1.1 Data Collection

The interviews typically lasted between 15 and 45 minutes, although some continued longer. Each interview was conducted in or near to the workspace of the participant, as permitted by them and their managers. Raw data were captured by using digital voice recordings supplemented with written notes and other physical materials from the participants. Some of the participants agreed to having their work area photographed for analysis, but most did not permit photographs, citing confidentiality and other concerns.



*Figure 1 A floor plan drawing of the workspace of participant 3; the designer has seating at positions marked A and working surfaces in positions marked B.*



*Figure 2 A floor plan drawing of the workspace of participant 4. The designer has seating at the position marked A and working surfaces in positions marked B.*

Figure 1 and Figure 2 provide schematic diagrams of two work environments, for participants 3 and 4, respectively. These two work spaces were typical of those used by other study participants and generally consisted of various seating arrangements to meet with clients or work and working surfaces that may or may not include a computer system.

Open-ended questions were used to guide the semi-structured interview process. The questions were divided into four sets. The initial set of questions asked for demographic and general information from the participants, including their age group, nationality, formal title, commercial graphic design work experience, and the kind of work they performed regularly. The second set of questions sought information about the design processes employed by the participants and asked them to discuss these with reference to recent examples when possible. This set included questions such as: “How would you describe your design process?” and “Do you work within defined stages in your process?”

The third set of questions identified sources of inspiration utilised by the study participants, including questions such as: “What do you use to inspire you?”, “Do you have a collection of imagery or objects for inspiring the development of ideas?”, “When looking for inspiration, what criteria do you look for?”, and “What are the common problems that confront you when coming up with new ideas?” A fourth set of supplementary questions was used when time permitted. Questions asked as part of this set included: “How do you evaluate the success of a design concept?”, “Are there features of the space that are intended to optimise the generation of new ideas and concepts?” and “How do you decide that something is

inspirational?” Additional questions and discussion developed during the interviews and were included in the analysis.

## 4.1.2 Data Analysis

The interviews resulted in a collection of data in the form of audio recordings, written notes, some photographs, and artefacts provided by the participants. Audio data were transcribed with some summarisation to account for nonverbal communication and to remove off-topic or sensitive discussions that took place. The collected data were subjected to a thematic analysis (see Section 3.2.1), focussed on identifying how the participants sought inspiration during their projects but also open to the broader context of the whole process. As the information was only coded by a single coder, inter-coder reliability was not calculated. Consistent with a thematic analysis approach, the coding was created and subjected to testing against the data to ensure that it accurately related to it.

## 4.2 Results

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The findings of the study have been divided into three sections: Section 4.2.1 describes the general design processes used by the participants; Section 4.2.2 presents the sources of inspiration utilised for ideation; Section 4.2.3 focusses on the observed role of visual imagery in graphic design ideation.

### 4.2.1 Design Processes Employed

Several descriptions and models of the design process were given by the participants. The descriptions varied in levels of formality and detail; some participants follow defined and explicit models of a process, whereas others rely on an internalised model that they could articulate during the interviews. One of the models that was described progressed through the following stages: client briefing, research, conceptualisation, mock-ups, sign-off, and production. Other models were discussed that had been formalised in diagram form. In some cases, models of the process were shown to, or discussed with, the clients to help guide their expectations of the process and encourage their participation in it.

Not all the participants were involved in all stages of the design process. Larger companies seemed to establish protocols as to whom the client speaks to initially to

convey their needs, often introducing intermediaries such as account managers as the point of contact for the client. In smaller companies, designers tend to have more direct contact with clients and are necessarily involved in a wider range of steps in the process. What is common, however, is that there is an ideation stage in the design process, during which the designers are expected to generate appropriate solutions to the problems with which they are presented. Variations in the ideation mechanisms tend to focus on the level of abstraction with which the individual works. Senior designers and creative directors typically consider a broader philosophical approach, whereas lower-level designers often address more direct concerns. Overall, the design processes discussed by the study participants were judged to be consistent with the models referred to earlier in the literature review (see Section 2.1.3).

## 4.2.2 Sources of Design Inspiration

The types of material collected as part the participants' regular working practices were discussed during the interviews. Collected material took the form of electronic photographs, illustrations, computer screen shots, fonts, website links; printed material such as books, magazines, photographs; and other physical material such as packaging, toys, paper samples, hand drawings, and sketches. The variation in different material collected by study participants is consistent with the graphic design practice described in literature (Arntson, 2007; Meggs, 1992). In addition to collecting material, some participants described going to places such as bookshops or locations directly related to their clients' business, consistent with Meggs's (1992) description of ocular reconnaissance.

## 4.2.3 Role of Visual Information in Ideation

One of the main aims of this study was to identify the nature and purpose of visual information sought by graphic designers and to understand how this contributes to the ideation phase of the design process. It is proposed that there are distinct information-seeking behaviours that take place at different stages in the ideation phase, each of which has a bearing on the formation of new ideas. These activities have been classified into a set of themes: *personal development*, *cognitive aid*, *communication of an idea*, *aesthetic of the client*, *aesthetic of the audience*, and

*aesthetic of the market*. Table 2 provides a summary of these categories, which are referred to in the following sections.

*Table 2 Themes identified in visual information-seeking activities*

<b>Code</b>	<b>Theme</b>	<b>Description</b>
PD	Personal Development	An Image or artefact sought, viewed, or gathered for personal development rather than a specific task
CA	Cognitive Aid	Image or artefact created or used to give expression to an idea specific to the current design problem
CI	Communication of an idea	Image or artefact used to support communication between parties during ideation
AC	Aesthetic of the client	Images or artefacts used to discover or define the aesthetic tastes of the client
AA	Aesthetic of the audience	Images or artefacts used to discover or define the aesthetic tastes of the end user
AM	Aesthetic of the market	Images or artefacts used to discover or define the aesthetic and visual language used by competitors

## Personal Development

Designers in the study reported gathering visual material to inform their professional practice in general. Material collected as part of this type of activity is defined here as personal development (PD). A designer engaged in such an activity is not identified as having a particular design task in mind when they engage with different forms of visual media; instead, designers seek material that is either personally interesting or that might inform some future design task. Such behaviour is consistent with advice given in design textbooks such as that of Arntson (2007). Many different forms of media are accessed in this type of activity, including both physical and digital media, moving and still imagery, and interactive and passive media. Participants also mention engaging in ocular reconnaissance. Information retained or recorded in PD activities forms collections, either private or shared with colleagues. Collection-forming habits sometimes manifest in multiple collections being formed, reflecting different interests and levels of access. Information from PD collections sometimes plays a role in influencing the design thinking for later projects. Time frames between collection and later use could be separated temporally on a scale of days to years. The act of collecting visual material is a long-term activity, ongoing throughout the career of the designer.



Examples of PD activities by the participants included visiting specialist book retailers to browse their collections of new books without necessarily purchasing (participant 7), copying digital images from online resources (participants 2, 8, 10), maintaining physical collections of photographs (participant 11), and maintaining collections of visual materials (almost all participants).

### Cognitive Aids

Participants seek visual resources intended to express an idea, concept or attribute though such imagery is not necessarily intended for use in the final design output. These types of materials are referred to as being cognitive aids (CA) in the design process. What distinguishes CA from PD are that for CA the visual is sought specifically for a certain job, whereas PD material are not job specific. CA resources are typically viewed by the designer in the context of a particular job, often within the immediate workspace. Imagery used tends to relate to the communication objectives and visual language of a particular project. This imagery does not necessarily belong to a particular target group, competitor, audience, or client; instead, it serves as an aid in expressing, understanding, or recording a particular visual quality that the designer determines to be significant to the project. Imagery sought can be inter- or intra-domain (see p.34) and may be sourced from materials collected as part of earlier PD actions.

Examples of CA material used by participants included artefacts such as photographs, colour samples, websites, material samples, their own previous works, previous works by colleagues, mood boards, sketchbooks or drawings, and notes. Participant 15 described working with samples inside functional documents alongside where the ideas are being created. This participant also remarked that colleagues operated in a similar mode. The subject depicted or represented in CA materials was described as very difficult to predict (participant 15), in that it expressed an idea that the designer wished to convey in the work through some property of the sample image that may be significant only to the participant.

### Communication of an Idea

Visual materials play a role in communication with colleagues, any subcontractors, and clients during the design process. This type of material is referred to here as communication of an idea (CI). Note that the use of CI is distinct from

communicating with the target audience via the final design output. Example CI material identified in the study included visual imagery used by designers to communicate with photographers, particularly where an effect is sought for the design, without the imagery necessarily being the final output (participants 10, 11, 13). In these cases, the imagery was used to articulate the visual outcomes in a way that words alone could not express.

### Aesthetic of the Client

Importance is placed on the aesthetic tastes of the client, and this often plays a role in influencing the thinking of the designer in creating ideas for that client. The participants look for clues about the tastes of their clients to consider solutions appropriate to those tastes. Visual materials used to represent those tastes are referred to here as the aesthetic of the client (AC). AC materials include referencing the clients' appearance or the appearance of artefacts, people, places, or objects to which the client is understood to respond well. The designer uses the information to try and define some of the potential parameters or bounds for acceptable solutions; participant 10 described seeking "a feel for the client" to inform the design.

Participants used several different approaches, varying from active and overt to subtle and passive. Subtle approaches in which the designer had access to the client included simply making note of the visual appearance of the client and any artefacts that they had with them (participants 8, 10, 13). In active approaches, participants asked clients to provide material examples of things that they found interesting or inspiring (participants 3, 13, 15). Other approaches included showing or describing samples to clients to gauge their reaction (participants 9, 15) and asking clients to choose images from a given resource (participants 3, 7). Participant 7 mentioned that interaction with the client can trigger memories of previously encountered designs that may provide a basis for developing solutions to the design task.

### Aesthetic of the Audience

An important aspect of the task of the designer is to communicate to an audience and, as part of this, designers often explicitly consider the visual sensitivity of the target audience. The material used in this type of activity is defined here as the aesthetic of the audience (AA). Participants engaged in these types of activities to

find the appropriate visual language for a specific target audience. Some of the designers try to understand styles or visual language likely to be effective with the target audience through personal critique of existing design work aimed at the same subject area or market. Some of the participants deliberately collect visual AA resources specifically to inform their knowledge of an audience: “If the target audience is 60+ in a retirement home, what are the graphic elements that are going to appeal to them?” (participant 1). Participant 8 spoke of the need to observe the end user engaging with the product or service first hand to “... see people ... how they move ... how they react ... would want to see what emotions you convey, and how people react to [you]. Concepts would then come from that.”

### **Aesthetic of the Market**

Designers seek out design work in use by the competitors of the client, as identified by the client, the designer, or someone else involved in the design process such as an account manager or colleague. Visual material related to information about the aesthetics of the competitors of the client are defined here as the aesthetic of the market (AM). The information gained from AM material informs an understanding of the visual styles and language that the competitors employ when engaging with their target audience. Discovery of the visual AM material associated with competitors is considered important in helping define parameters of acceptable design solutions.

Approaches to gathering this kind of information vary. Participant 3 asked the client to identify the competition, whereas other participants sought the information indirectly from other sources. In all cases, the result leads to retrieval and review of visual AM material relating to the competitors in the market, dictated by the available media such as printed matter, web pages, and physical products. Some designers described accessing collections that they had formed as part of their PD, retrieving from their PD collections images or samples that were perceived to relate to the market for which they were to design.

It was not universally accepted by the designers interviewed that explicitly looking at the competition was an appropriate activity during the development of ideas. Some of those interviewed felt that knowing the aesthetic of the competitors in the market helped provide what participant 3 described as the “look and feel”; others

were wary of being drawn to imitate existing work. It did appear to be common to evaluate proposed solutions in the context of existing works.

## 4.3 Issues Related to the Use of Visual Material

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The interview participants discussed a range of issues related to the use of visual material during the ideation phase of the design process. They identified problems relating to collecting material, costs and time associated with gathering these visual resources, ageing of resources, diversity of media and devices that are used in the design environment, fixation on existing works during the design process, and knowing from where resources came. These themes are discussed in more detail in the following sections.

### 4.3.1 Collection Problems

One of the identified problems in interacting with visual material for inspiration is the lack of an appropriate overview for a given collection. Participants developed strategies to cope with the lack of an overview: Participant 15 described frequently checking shared collections to maintain awareness of what they contained. The strategy exemplified by this participant is not without risk, however; the participant described a chance of becoming lost in the exploration process and devoting too much time to it.

For digital image collections, there is a significant reliance on key word searching, coupled with browsing as the means of retrieving the information required. The preference for browsing is motivated in part by a lack of alternative methods. For example, participant 1 described often seeking images with a “feel”, but there is no mechanism that allows for describing and searching for that “feel” directly. The participant used text-based queries followed by long browsing sessions as a solution to the problem, effectively trying to identify the qualities desired in images through manual inspection of their content.

Participant 13 described retrieval of previous design works created within the same company as being prohibitively difficult and often avoided, despite a recognised value in accessing such content. In discussion with this participant, past works were mentioned as containing information that might be considered relevant to current projects, particularly solutions that had been proposed but not used. However, the

systems in place for discovering and accessing that information relied on word of mouth and the memory of other co-workers. Past work also existed in a variety of media forms and on different storage media, further complicating any retrieval efforts.

During the interviews with participants 5 and 6, there was a clear demonstration that digital filing systems afforded by current computer platforms such as Windows or Mac OS do not support the specific usage needs of designers. When asked about a collection of electronic resources that were kept on a computer, participant 6 was observed to struggle with a fairly free-form and flat hierarchy of folders containing files identified by default names. Participant 6 explained that content such as images saved from the web were usually kept with their default names, and no renaming strategy was used. The resulting collection was therefore not searchable using text-based methods, as it lacked relevant meaning or metadata, forcing reliance on direct browsing of the content. Discussion with various interview participants also revealed issues relating to the collection of physical artefacts, in terms of both storage and retrieval. Some of the collections of physical material cause problems, because the ongoing collection habit causes them to expand within a typically constrained space. For example, participant 15 described a situation in which designers within the same work space each developed collections of inspirational objects, causing storage-space issues. Management of the company, therefore, had to limit the amount of collected material that each designer could store on the premises to control the problem. Other interview participants described their collections as spreading throughout their professional and personal environments. These distributed and expanding collections also lead to access problems, especially when the designer works in different locations. In these cases, the collections are not always available to be accessed, limiting their usefulness. This specific problem was mentioned in the interviews with participants 5 and 6, who were working between regular premises and a temporary office space, so not all their regular reference and inspirational material was available or accessible under such circumstances.

### 4.3.2 Time and Cost

The study participants worked on a variety of different sized projects, varying in length from a few hours to several weeks: consequently, the amount of time

available for ideation also varied. Many of the designers expressed a desire for more time to explore design problems during ideation, but commercial realities such as time, budgets, and clients were factors limiting the amount of exploration that was possible. Participant 15 described this desire for exploration thus: “A creative will always have another idea the next day in the shower, they are always going to have something else that they think of afterwards that is perfect, or they are not easily satisfied generally in what they do; they will always think there is room for improvement.”

Participants also expressed a preference for first-hand experience of environments, contexts, products, or services to inform their ideation process for a given project, which is consistent with the design literature. Unfortunately, first-hand experience is not always possible, particularly when the designer is working remotely relative to the market.

### 4.3.3 Outdated Resources

Books and other printed materials are held in high regard; however, they are also quickly outdated and superseded by new material. During the interviews, life spans for books were identified as being perhaps six months. As an example, participant 7 made up for this by browsing bookstores, avoiding purchase because of pricing and limited useful life span. Others, such as participant 9, deliberately sought older material through online stores as a source of inspiration.

### 4.3.4 Fixation, Confusion, and Noise

Sometimes the designers are concerned about exposure to work that is not their own while they are involved in ideation for a project. Some of the study participants prefer other works or inspiration sources to be kept well away from their working space. Some designers described how, at times, a feeling of clutter impinged on their ability to reason through design problems, leading to seeking neutral spaces in which to work. It was noted in visits to the various studios that designers frequently worked in different locations or spaces within the environment, often leaving what would be recognised as a regular workstation to work on projects. Some of those interviewed described extending the work space to include their home, often to seek quiet spaces free from distractions from the problem at hand.

### 4.3.5 Provenance

Knowing where an inspirational image or artefact is from is an important part of determining the value of such an artefact. Participants expressed an interest in where information is coming from, with obvious preferences emerging among the designers for different resources. When asked about the possibility of a computer system aiding in the discovery of inspirational work, participant 11 responded that “to be most useful it would have to validate itself by showing and reflecting upon what has gone before in a similar vein. What a similar vein is, that is the rub, because what is similar for somebody is not necessarily similar for somebody else.”

There is a great deal of interest in what happens within different markets and a desire to maintain relevance across geographic boundaries. Many of the designers spoken to maintain an interest in trends that had their genesis in countries that are a long way removed, creating a reliance on intermediate sources to help discover the essential elements of those trends. The United Kingdom was popular as a source of design trends, mentioned by several of the designers. Clearly, gaining first-hand experience of such remote places is a costly and time-consuming process, which is not economically feasible for many employees.

### 4.3.6 Diversity of Media and Devices

There is a real diversity of information collected and used by the designers interviewed, covering a variety of media forms and including both physical and digital media. Some of the study participants collect physical objects as well, including toys, models, and various products. Pieces are collected and utilised either directly or to aid thought in the design process. There is also a diversity of digital devices involved in accessing content, such as laptops, tablets, and phones. Despite the presence of other computing devices in some of the studios visited, desktop computers still had a large and significant role in the design process and production of work.

### 4.3.7 Mood Boards

Many of the participants referred to the use or creation of mood boards (5, 6, 9, 10, 12, 14, 15). One of the designers (15) mentioned using mood boards at the start of the conceptual design work, as a space that provided “. . . one idea or an idea and

series of pictures that demonstrate what we are thinking, that we could talk through.” Similarly, participant 12 spoke of mood boards as providing a starting point for a project, although the size of the project may determine whether such a tool is used. Participant 12 also mentioned that more than one mood board may be utilised in the context of a single project.

Mood boards are intended to inspire and give direction to the design work and to incorporate a variety of information depending on the specific use of the board, such as trying to discover the aesthetic of the client or illustrating the state of the market. Mood boards were labelled and considered as a CA for the designer.

## 4.4 Requirements of an Ideation-Support System

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As mentioned, one of the main reasons for conducting this study is to understand better the process of ideation and the issues related to access and use of visual material during the ideation phase, with the aim of developing guidelines to assist the design of future systems to support the ideation process. The following sections identify a broad range of requirements for such a system, beginning with general requirements of the ideation process and then more specific requirements for collection and use of the different categories of visual information discussed earlier.

### 4.4.1 General Requirements of Ideation

Although text-based search is a common feature in all modern computer systems, image-based search is much less common. None of the participants in the study seemed to know about, or use, image-based search systems. This effectively limits the scope of non-indexed visual information that the designer can access when trying to discover the tastes of the audience, competitors or the market, or when seeking cognitive aids to inform different design ideas. The system must therefore provide an effective range of content-search mechanisms, including image-based techniques.

Support should be provided to help browse and retrieve examples from collections of design work that are kept by individual designers and their colleagues. This is a problem related to information visualisation, in which the user needs to be supported in understanding the content of the collection, formulating queries of the system, and interpreting the results returned from it. Collections of past design work



are potentially untapped resources that are not readily available to designers, because most existing software is unable to provide useful overview or query mechanisms to users.

Furthermore, although many design companies already make use of formal repositories of visual material such as stock photography collections and image banks, support for accessing image content in social media is limited, even though such material may be very important to some design projects. Access to such collections should ideally be allowed for the designer, perhaps through the aggregation of different collections into a single, accessible meta collection.

Finally, the diversity of visual material and media forms used by designers necessitates a system that supports both physical and digital media collections. A system to support ideation must also recognise and allow for differing modes of use, including the ability for the user to determine the level of interaction with it to accommodate differing working habits. Some of the participants interviewed expressed a desire to work in isolation from external influences, whereas others surrounded themselves with a variety of inspirational material. The proximity of the support system to the working place of designers, where they craft their potential solutions, is an important consideration. Some of the information, such as CA material, may be required in or near working documents as the designer works on potential solutions. Other information such as AM material may be required at evaluation points determined by the individual designer's workflow.

#### 4.4.2 Supporting PD Collection Activities

To be useful to designers, an ideation system must support or at least account for their collection habits. The kinds of personal development collections that were discussed consisted of a wide variety of different media types, including physical and digital media. It is therefore important that these media types are considered in an ideation-support system. Designers will likely continue to collect all kinds of media, including digital images, movies, clippings, books, magazines, artworks, objects, and toys. It is likely that such information is not going to be accompanied by metadata, tags, and appropriate file names, so it falls to the system to facilitate the adding of such information by the user or else attempt to discover the information from the appearance of the objects as they are added.

Physical collection activities are constrained by storage space, whereas digital collection activities are concerned less with physical storage space than with conceptual space. Larger collections incur problems with maintaining an overview and allowing efficient retrieval of their contents.

### 4.4.3 Supporting CA Collection Activities

As designers use imagery to help them think visually about their design problems, tools should support association between images and certain conceptual ideas. Images can have meaning, and that meaning is significant to designers. Although it should also be pointed out that identifying meaning in images is a difficult problem; meaning is often complex, open to variation, and not static (Dondis, 1973; MacLellan, 2015; Novitz, 1977).

Our study participants discussed how designers use visual resources to support their cognition based on many different needs; for instance, some were motivated to select images not for their overall meaning but for certain visual qualities that they had, such as textures, typography, or layout. It would be useful, therefore, to allow designers to seek images based on certain visual characteristics within the process. Although ideation is not an exact science, even some assistance in this process would be an improvement over existing text-based search or browsing methods.

### 4.4.4 Supporting CI Collection Activities

The process of design involves communication among different parties, within the design company and with the clients and external contractors. Images are both created and used to support communication during ideation, leading into ideation, and following ideation into production. An ideal tool would support the retrieval and use of images to assist in the communication process, particularly as ideation progresses. Again, the imprecise nature of ideation and designers' attitudes toward exploration suggest that designers would benefit from even partial assistance in the storage and retrieval of visual material for such purposes.

### 4.4.5 Supporting AC Collection Activities

Given that designers note and try to understand the visual tastes of their clients, tools to support ideation activities should account for, or at least allow, such

activities. Such allowance could be achieved in a variety of ways. Currently, some clients are asked directly to supply information about their tastes, whereas others are observed indirectly for clues as to their tastes. As an input into the ideation process, such information can be of great significance. Systems should therefore support gathering, representation, and retrieval of AC material at relevant points in the ideation process to aid the thinking of the designer.

*Table 3 Systems supporting the use of images in the design process*

<b>Name</b>	<b>Actions Supported</b>	<b>Description</b>
Freed	Layout assistance	Allows force-based layout of collection information providing visualisation of the state of a project (Mendels, Frens, & Overbeeke, 2011)
The Digital Scrapbook	Automatic aggregation, browsing	Prototype departmental scrapbook system for tracking works produced by students and aggregating into a web browser interface. (Swan, Tanase, & Taylor, 2010)
Prezi	Manual layout, presentation	Zooming user interface system with presentation focus. (Arvai, Halacsy, & Somlai-Fischer, 2009)
Cabinet	Augmented reality, visualisation	System for capturing and organizing collections of visual material. (Keller, Hoeben, & der Helm, 2006)
Funky Wall	Mood board presentation, review	System to capture and playback gestures related to mood boards. Facilitates client designer interaction, team interaction. (Lucero, Aliakseyeu, & Martens, 2007)
Adobe Collage	Mood board creation, mobile support	Cloud-based service facilitating sharing and transference of mood boards between devices. Online search support using text searching. (Adobe, 2012)
Moodboard 2	Mood board creation, mobile support	Tool to create mood boards on iPad (Tress & Nurre, 2010)
Moodshare	Mood board creation, beta software	Web based service supporting sharing and collaboration. Facilitates searching of multiple online resources simultaneously. (Moooodle Limited, 2012)
Polyvore	Online mood board creation	Fashion design focussed, community based creation and sharing tool. (“Polyvore,” 2012)
Sampleboard	Online mood board creation	Design focussed mood board creation tool. Uses tools like the Adobe Creative Suite. Allows sharing, universal access. (“sampleboard,” 2012)
Adobe Bridge	Asset management	Software included in the Adobe Creative Suite. Supports tagging and retrieval of information through text-based searching. (Adobe, 2012)

#### 4.4.6 Supporting AA Collection Activities

Knowing the aesthetic of the audience is acknowledged as an important part of the design process. As mentioned, some of this type of information is gathered from the PD collections, and additional external sources of information may also be sought. Therefore, accessing this kind of material involves retrieval from a potentially wide variety of sources. In the case of accessing material from earlier PD collections, there is generally a lack of labelling and formal categorisation of the collected material, which means that designers rely on a personal knowledge of their collections to interact with them usefully. Information about the aesthetic of the audience is not often incorporated into existing collections.

What is needed, therefore, is the ability to retrieve visual information that provides insight into the visual language that is appropriate to the defined audience. Questions about the audience would likely be about their fashion and style, would likely change frequently and would, therefore, have to be quickly adaptable and discoverable. Information that appeals to the audience is also likely to be sought directly, through excursions into the general environment and interactions with identified representatives of the audience. Ideation-support systems would have to allow for information gathered in such a way to become associated with groups or audiences. The system should allow for the smooth acquisition of such content into the system, with appropriate indexing or annotation as necessary.

#### 4.4.7 Supporting AM Collection Activities

Some of the information that supports knowing the market and competitors also comes from material in PD collections. Further information about the market is sought from the clients directly and from excursions into the marketplace. Study participants pointed out that currently they find this type of information through web searches (e.g., using Google), from information supplied by the client, or from their own reconnaissance. There appears to be an expectation of manual discovery and recognition of appropriate content by the designer. As with AC or AA material, the support system should assist the process of collection and retrieval of AM material.

#### 4.4.8 Existing Ideation-Support Systems

A preliminary review of existing software tools that are currently used to support the ideation phase of the design process was carried out: Table 3 provides an overview of some of the most commonly used systems. The review suggests none of these systems fully support the requirements identified. Future systems are, therefore, needed to facilitate collection and retrieval of the type of collections needed by graphic designers.

### 4.5 Conclusions

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The present study has identified a range of visual information-seeking behaviours demonstrated by the interview participants in terms of collection, management, and access to different kinds of digital and physical material that contribute to the ideation phase of the graphic design process. The study has further revealed what type of visual information the designers seek, where they attempt to gather this information, and what type of tools and methods they adopt for these tasks. None of the existing computer systems appear to support this process of ideation in graphic design.

The study presented in this chapter has reported a range of visual information-seeking behaviours employed by the participants in forming collections, managing those collections, and subsequently accessing their content for ideation.

Beginning with the process of the study participants, Section 4.2 confirmed the relative position of ideation within the broader design process, and the general similarities with published models of the process. Section 4.2.2 then identified the types of images and other visual media mentioned by participants as playing a role in inspiring them, revealing a very broad array of media and formats of interest. Of particular relevance to this thesis, six distinct image roles and types of image associated with those roles were described in Section 4.2.3.

Specific issues relating to the use of images and other visual material were discussed in Section 4.3, including management and access to collections of both physical and digital works (Section 4.3.1), the limitations imposed upon inspiring the ideation process imposed by the time and cost required to gain inspiration material (Section 4.3.2), the speed with which gathered inspiration becomes

outdated (Section 4.3.3), concerns over negative effects resulting from exposure including fixation (Section 4.3.4), being aware of where the images are sourced from and which social or geographical group they belong to (Section 4.3.5), the diversity of media forms required to support collection habits (Section 4.3.6), and the use of specific image-based artefacts for communication purposes (Section 4.3.7).

In Section 4.4, the study presents commentary on what is required to support ideation based on the findings, including both general requirements for ideation support (Section 4.4.1) and specifically for the roles identified (Sections 4.4.2–4.4.7), finding that none of the existing ideation support systems meet the requirements (Section 4.4.8).

It is acknowledged that this study is based on limited observation of behaviours as well as reported claims by the participants, and that there is a need to understand better whether these reported behaviours are indeed what designers do or if they represent an idealised perception of design activities.

In conclusion, considering some of the tools and prototypes that have been produced to date to support ideation in the graphic design process, there is an assumption that the designer will select the source material for inspiration largely based on key word searches and browsing, and that it is the designer's task then to arrange the retrieved information as they come to know the design problem. What appears to be missing are any attempts by the system to aid the designer in the discovery of new information, even though the conceptual space for visual design is continually populated with content from professionals and amateurs alike. Current tools are not supporting the collection-forming habits that designers are encouraged to have and are demonstrated as having through this study. The designers themselves appear to establish coping mechanisms, typically through enforcing small limits on the collected visual material, which is not a particularly sustainable or beneficial approach.



## Chapter 5

### Image Influence on Ideation Output

In the previous chapter, findings were presented from a study of graphic design professionals regarding their image use within their design process. Based on the findings of that study (Chapter 4), this study<sup>3</sup> was developed to seek evidence of the influence of the Aesthetic of the Client and the Aesthetic of the Market upon the ideation of designers, using graphic design students as test participants. Students were selected as a sample of convenience.

Noting the lack of empirical evidence regarding the exact nature of the influence of visual images on graphic design practice (see Section 3.4), this study sought to measure the influence of images on the creative behaviour of graphic designers and their output when exposed to images associated with a client (AC) as well as the market competitors of the client (AM). Two study conditions were setup to compare the effects on the creativity of individuals exposed to or denied visual images, while attempting similar graphic design tasks. More specifically, the study aimed to answer the following questions:

- 1 Does exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation have an influence on the graphic design process?

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<sup>3</sup> This chapter contains portions of an article already published (Laing & Masoodian, 2016)



- 2 Does exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation have an influence on the creativity of the graphic design outputs?

The chosen approach required the creation of realistic design tasks that would be treated as similar by the study participants, while being different enough to prevent fatigue or transference between study tasks. This process is described next.

## 5.1 Study Methodology

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This study required the development of authentic graphic design tasks for participants to respond to in a creative way, supported by information about aesthetic tastes of clients (AC) and their markets (AM). To test the research questions proposed above, two study conditions were developed:

1. Test condition: the participants were provided with:
  - AC images and written description of the client and their tastes
  - AM images and written description of the company
  - Written description of the task
  - Sample task images.
2. Control condition: the participants were provided with:
  - Written description of the client and their tastes
  - Written description of the company
  - Written description of the task
  - Sample task images.

The outputs of the design task were collected and assessed for creativity by expert judges and potential clients using supplied criteria. Additional data obtained through commentary from the judges, clients, and participants supplemented the assessed outputs.

### 5.1.1 Aesthetic of the Client (AC)

As discussed in Chapter 4, graphic design professionals frequently seek images and visual cues to the tastes of their clients to assist them in determining design suitability (see p.49). Therefore, in this study it was necessary to identify images associated with the aesthetic of the client (AC).

Two people were approached to act as clients, each having business experience at managerial level. The clients had different business backgrounds, but both were of the same gender and a similar age. The business experience claimed by the two clients was Management, and Information Technology respectively.



Figure 3 Example set of visual stimuli provided relating to task B in the test condition of the study. Clockwise from top left: design task images; AC images; written descriptions of client, business and task; AM images.

To establish credible reference information for the design participants the two clients were interviewed separately and 20 images were gathered in consultation with them, representing their tastes. Clients assisted through making explicit their likes and dislikes, hobbies and interests, for which representative images were sought. Clients provided both words and images to assist in the process. Images received from clients were reviewed and minimally altered or replaced to ensure confidentiality of the clients. Some images were added to substitute for words or low quality pictures supplied by the clients. In addition to the images, a single A4 page written description of each client was prepared, in consultation with them. All client material used in the study was shown to them for approval and commentary to ensure accuracy. The images were printed in colour onto a single A3 sheet of

paper, labelled as “Client ([A/B]): Images relating to the preferences of client [fictitious name of client]” (see Figure 3).

### 5.1.2 Aesthetic of the Market (AM)

To match each client, a single A4 page description of a fictitious business was written, featuring brief information about capabilities and services taken from similar business types in the local or national area (see p.50). The two resulting documents were matched in length and level of detail to appear similar to the study participants and shown to the corresponding client to confirm general suitability. From these descriptions, twenty images of websites of similar businesses operating in the local or national area were selected by the researcher; the images were arranged in a 4x5 grid layout and labelled as the “Business ([A/B]): Images relating to the competitors of the business”. Each business description and accompanying set of images was then treated as a set. Again, these images were printed in colour onto a single A3 sheet of paper (see Figure 3).

### 5.1.3 Design Task Images

As graphic design literature frequently encourages designers to gather and surround themselves with inspiration (Curtis, 2002; Heller & Ilić, 2007; Meggs, 1992), it was considered potentially disadvantageous to deprive the participants of any visual reference material during the study. Therefore, a set of 20 images within the task domain were assembled, selected from a collected work of logo designs (Chase et al., 2008); and those chosen were manipulated to all appear in greyscale. The selection avoided logos that appeared directly related to the business type or client preferences. Only a single set of images was prepared and was made available in the workspace during both study conditions. The images were presented in the A3 page format and labelled as “Unrelated logo designs” (see Figure 3).

### 5.1.4 Study Design Tasks

The two design tasks (referred to as A and B) for both companies were stated as follows:

With consideration for the information in this brief and any additional supporting information provided, your task is to create as many unique,

high-quality logo concept ideas for the business described above within 30 minutes, using the supplied resources. In creating the identity mark you should consider the suitability of the solution to the client, as well as the business and its clients. The drawings that you create will be assessed for their creativity and the quality of the ideas they represent, and may be seen by the client at the conclusion of the research. The quality of finish of the drawings created is not the primary concern in this experiment, however your drawings should be sufficiently detailed to enable a third party to understand their basic intent.

Graphic design teaching staff from The University of Waikato were approached to help identify example projects that the participants had likely encountered. Basic graphic design tasks simple enough to provide a meaningful test of creative output were sought, based on these examples. Other criteria for selection of the task were that they could be completed in a relatively short space of time (30 minutes), and that they required no specialist hardware or software that might complicate the task for participants. The final task description was also discussed with members of the teaching staff for their feedback, prior to proceeding with the study.

### 5.1.5 Study Participants

Eighteen design students voluntarily participated in this study. Most of the participants were completing their third year of a bachelor's degree in graphic design, four were studying at graduate level or higher, and two were equivalent to a second-year level of experience. There were eleven female and seven male participants, with most being in the 20–30-year age range.

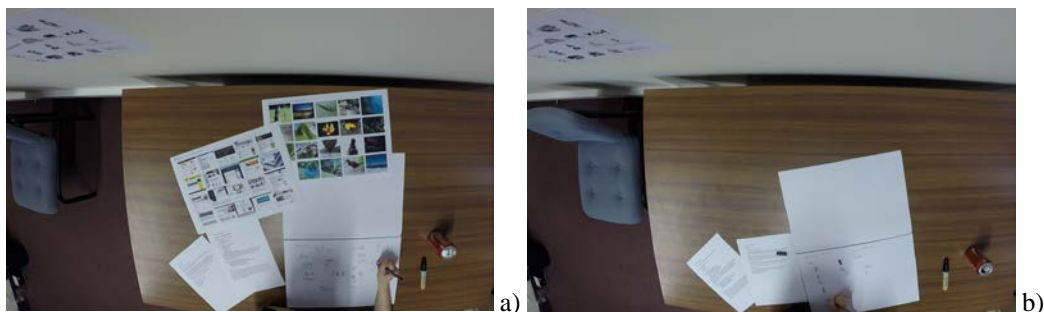
Participation was by invitation to suitable class groups. A \$50 book voucher prize was offered for the work selected as most creative by the judges as an incentive for the students to produce highly creative work. During the task, students were provided with small quantities of snack food and drink. Participation in the study was not a requirement of any courses the participants were enrolled in. The study was approved by the Faculty of Computing and Mathematical Sciences Ethics Committee (see Appendix A).

## 5.2 Study Sessions

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Each of the participants performed a different design task in each of the two study environments. All sessions were conducted within an empty office space that featured a video camera, bare walls, and the provided visual stimuli. Participants worked on a bare desk using A3 drawing paper and a variety of black pens with which to sketch. The design task images (i.e. logo examples) were mounted in front of the participants on the wall above and to one side of the desk to be in view, but not be intrusive. A video camera was positioned above the head of the study participant, recording the drawing surface, with the sketches and provided material (see Figure 4). Recordings captured the pre-task briefing and post-task interviews, and included audio. In addition, participants were observed directly, with notes taken as necessary.

The order and condition of each task was counterbalanced to minimise order effects. Each study session proceeded in the same general order: a short introduction to the overall study was provided and the tools and features of the space pointed out and general questions answered; participants were then given the stimuli for their first task and were allowed unlimited time to become familiar with the material, including asking questions about the task. Once the participants indicated they were ready to begin, they were given 30 minutes to complete the task. After the first task was completed, a short (~5 minute) debrief was conducted, during which the participants were invited to comment on the difficulty of the task and the usefulness of the stimuli provided for it. In addition, they were asked to label their favourite design concept, their most creative concept, and the concept they felt was most



*Figure 4 Overhead view of desk in study space, showing participant sketching with the provided AC and AM images (a) and without the images (b)*

likely to suit the client. The participant then completed the second task, followed by the same post-task procedure.

Participants attempted each of the two tasks, with exposure to the AM and AC images determined by the task condition. Under the test condition, the participant received a copy of the written information about the company, the client and the task, as well as the twenty images from the client and from the competitors of their business. In the control condition, participants were provided only the written copies of the information about the client and the business, with no AM or AC images.

During each phase of the study, participants were encouraged to freely use the resources at their disposal and were asked not to destroy any design concepts they produced. Participants could freely reposition the provided images and descriptions upon the working surface. One participant asked, and was allowed, to reposition the design task images mounted on the wall to provide closer inspection. Some participants attempted to destroy design concepts that they felt were unsuitable, but were prevented from doing so.

### 5.2.1 Interviews

To try and capture the participants' perspective on the design process as well as their design output, short interviews were carried out with them after the first and second stages during each study session. After the first task, participants were invited to comment on the ease of the task and to raise any questions or concerns that they had in relation to the study task and supporting visual and textual task material. During the interview, comments were invited through open-ended questions such as “Was there any information that you felt was missing from what was provided that you feel would have been helpful in completing the task?”

Once participants had concluded the second study task, they were again invited to comment on the task, like the procedure used in the first interview. However, during the second interview, notes from the first interview were used to prompt comparisons between the two tasks. Participants were also invited to review visual material that had been denied to them under the control condition and asked to comment on the potential value of such material to the participant's design process, asking them to imagine it had been available during their work.

## 5.3 Design Output Reviews

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Assessment of the design task output was carried out independently using three different reviews: review by the participants themselves, review by two expert judges, and review by clients. This is consistent with the work of Kerne et al., (2007). All the design concepts created by the participants were gathered and labelled using an anonymous identification number and the corresponding condition under which they were created. The judges received digitally altered copies of the participants' designs from which any information about the study condition was removed, as well as any additional notes written by the participants that indicated their preference or self-critique, etc.

### 5.3.1 Expert Reviews

Two experienced educators in graphic design were invited to act as expert reviewers. The judges were not involved in the programme of study the participants were enrolled in and did not know the clients. Each of the judges had at least a master's degree level education in graphic design and a combination of teaching and practical experience in the subject.

The expert review process involved providing a verbal briefing and copies of the written client descriptions, business and task descriptions to each of the two judges, as well as grading sheets for assessing the design output of each participant. Each judge then worked with their own copy of the designs produced by the participants and briefing material to assess the design outputs.

Grading sheets used by the judges had the following criteria for each design task (A and B), which were selected from the literature (see p.17):

- Fluency (number of ideas),
- Flexibility (number of categories of ideas),
- Originality (7-stage discrete visual analogue scale, comparing unoriginal to highly original),
- Practicality (7-stage discrete visual analogue scale, comparing impractical to practical),
- Suitability (7-stage discrete visual analogue scale, comparing unsuitable to suitable).

In addition to the individual ratings for each participant's output for each task, judges were asked to indicate which study task resulted in the most creative design output, using the questions “Most creative work produced within: brief A [or] brief B” and “Most suitable work produced within: brief A [or] brief B”. Written comments were invited from the judges, as well as an overall ranking index position, which was used by the judges to indicate the best design output in the entire set.

Following the reviewing of the design outputs, the judges were asked to provide their own commentary on the task they had completed and any overall observations that they had about the design outputs. Once commentary had been received, the judges were shown the additional AC and AM images the participants had been provided with for each client and were invited to comment on the perceived influence that the images had on the quality of the design outputs.

### 5.3.2 Client Reviews

The two clients were also asked to review and comment on the anonymised design outputs created by the study participants. The clients then selected from within the design output their preferred designs, using a modified version of the grading sheets used by the expert judges. The clients were invited to comment on the overall apparent suitability of the designs that had been produced. Once their commentary had been received, the clients were made aware of which of the designs had been created while the participants had been exposed to their AC images or not.

The clients rated the designs using the grading sheet; however, unlike the judges, each client only saw one design produced by each participant; therefore, there were



no comparisons possible between different attempts at the two different tasks (A and B) by the same participant. The criteria used by the clients were:

- Originality (7-stage discrete visual analogue scale, comparing unoriginal to highly original),
- Practicality (7-stage discrete visual analogue scale, comparing impractical to practical),
- Suitability (7-stage discrete visual analogue scale, comparing unsuitable to suitable).

As with the judges, the clients were given the opportunity to comment on each of the design outputs.

## 5.4 Data Collection

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Data collected from the study took a variety of forms. Participant data included video recordings of them performing the study tasks, observation notes, participants' design outputs, participants' post-task self-ratings, and commentary. Data from the expert reviews provided ratings on the criteria measures and commentary on the task. Client reviews provided rating data for each participant's output and commentary on the suitability of the design outputs.

### 5.4.1 Participant Data

The participant viewpoint captured in the transcripts was sought to help understand what conscious role (if any) the visual images played in the design process. Data from the video recordings was transcribed with emphasis placed on the task introduction and post-task interviews. Some of the routine information introducing the task and providing instructions was summarised in shorter form, while questions and responses were recorded in more detail. Certain elements of the conversations involved non-verbal communication, which was noted from the video recordings.

From the transcripts, a thematic analysis (Braun & Clarke, 2006) was performed, supplemented by notes made during the interviews. The transcripts were used to make a discrete determination of which of the task conditions was perceived to be the easier, and a coding scheme was developed that considered how the participants responded to the images supplied to them. Interest was paid to comments where

participants did or did not appear to utilise the supplied images. The coding scheme was then applied electronically to the original transcript data, with like markings collected into single files for further scrutiny.

The thematic analysis results gave contextual information to assist in answering the question “Does exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation have an influence on the graphic design process?”

### 5.4.2 Expert Data

Both experts produced the rating data for the participants' design outputs and provided their comments during a single session. Commentary was recorded in note form during the interview, with recorded notes read back to the experts for clarification where necessary. No video or audio recording was made of the interviews. An email exchange with one of the judges was used to clarify interpretation of the commentary received, particularly observations made regarding the response of the study participants to the task briefs.

Data from the expert reviewers was particularly relevant in determining an answer to whether exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation has an influence on the creativity of the graphic design outputs.

### 5.4.3 Client Data

In a similar process to the expert reviews, both clients rated the participants' design outputs, as well as providing some comments during an interview with them individually. As with the expert interviews, it was decided that a full transcript of these interviews was not necessary, but notes were taken during the interviews for analysis purposes.

## 5.5 Results

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Statistical analysis of the ratings provided by the study participants, expert judges, and the two clients was carried out to identify any perceived differences between the test and control conditions. The results of these analyses are given below. This

is followed by the findings from the thematic analysis of the interviews and commentary provided by the study participants, judges, and clients.

### 5.5.1 Statistical Analysis

Most of the study participants (12 out of 18) considered the test condition (with AC and AM images) to be easier than the control condition (without AC and AM images), four participants considered the control condition to be easier, while two considered them to be the same. Surprisingly, a similar result was also noted for the differences between the two study tasks, with 13 out of 18 participants considering Task B to be easier than Task A (three considered Task A to be easier, and two considered it the same). Since the study tasks and conditions were counter-balanced, the perceived differences between the two tasks would not have impacted participant perception of differences between the study conditions. However, it seems that despite efforts to make the two tasks similar, the study participants felt more familiar with the business concept presented in Task B (for a discussion of this issue see the Thematic Analysis section below).

In terms of the analysis of the ratings provided by the expert judges, no reliable data was provided by the two judges for Fluency (number of ideas) and Flexibility (number of categories of ideas) of the design output. The judges either did not fill in these fields in the grading sheet, or did not provide any useful information; therefore, these measures were ignored in the analysis.

Figure 5 provides graphs comparing the mean ratings given by the two expert judges for the design outputs of each of the study participants in terms of their originality, practicality, and suitability. No statistically significant differences were found between the test and control conditions for any of these three subjective measures. The judges' ratings for the participants' design outputs for the two study tasks (A and B) were also compared. Despite the participants' perceived ease of Task B, the judges rated their design outputs to be similar in terms of their originality, practicality and suitability. One of the judges, however, rated design

outputs for Task B to be significantly more original than those produced for Task A ( $M=2.89, SD=1.23$  vs.  $M=2.11, SD=0.96$ ).

Figure 6 shows the graphs comparing the ratings given by the two clients for the design outputs of each of the study participants in terms of their originality, practicality, and suitability. Once again, the statistical analysis found no significant differences between the test and control conditions for any of the three subjective measures. Similarly, no significant differences were found between the design outputs of the two study tasks (A and B). However, one of the clients (associated with Task B) more often preferred design output created under the test condition (i.e. when AC and AM visual imagery was available).

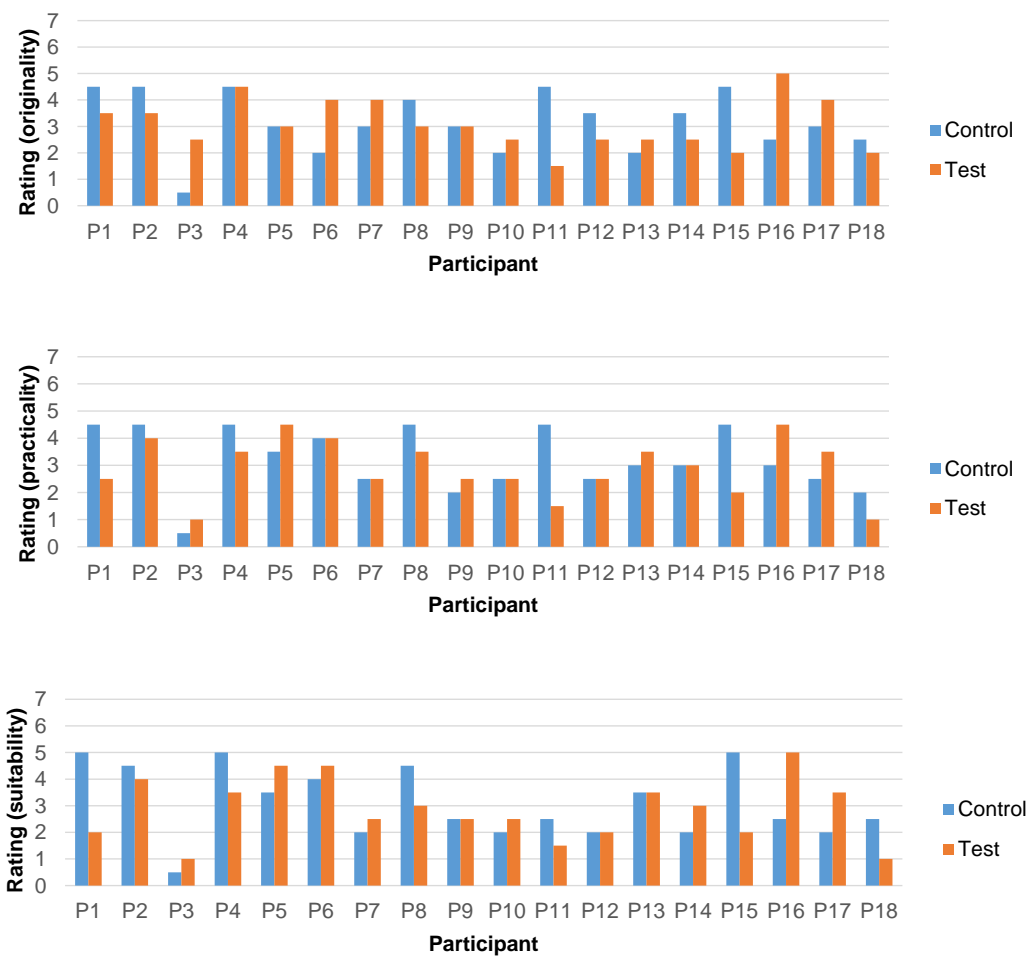


Figure 5 Mean ratings by the expert judges (graphs by M. Masoodian)

Therefore, based on these analyses, there is very little observable difference (if any) between the design outputs produced by the participants under each of the two study conditions in terms of the subjective measures of creativity defined by creativity, practicality and suitability.

## 5.5.2 Thematic Analysis

While the statistical analysis revealed little effect of the provided stimuli upon the creativity of the design output, a thematic analysis (see Section 3.2.1) of the

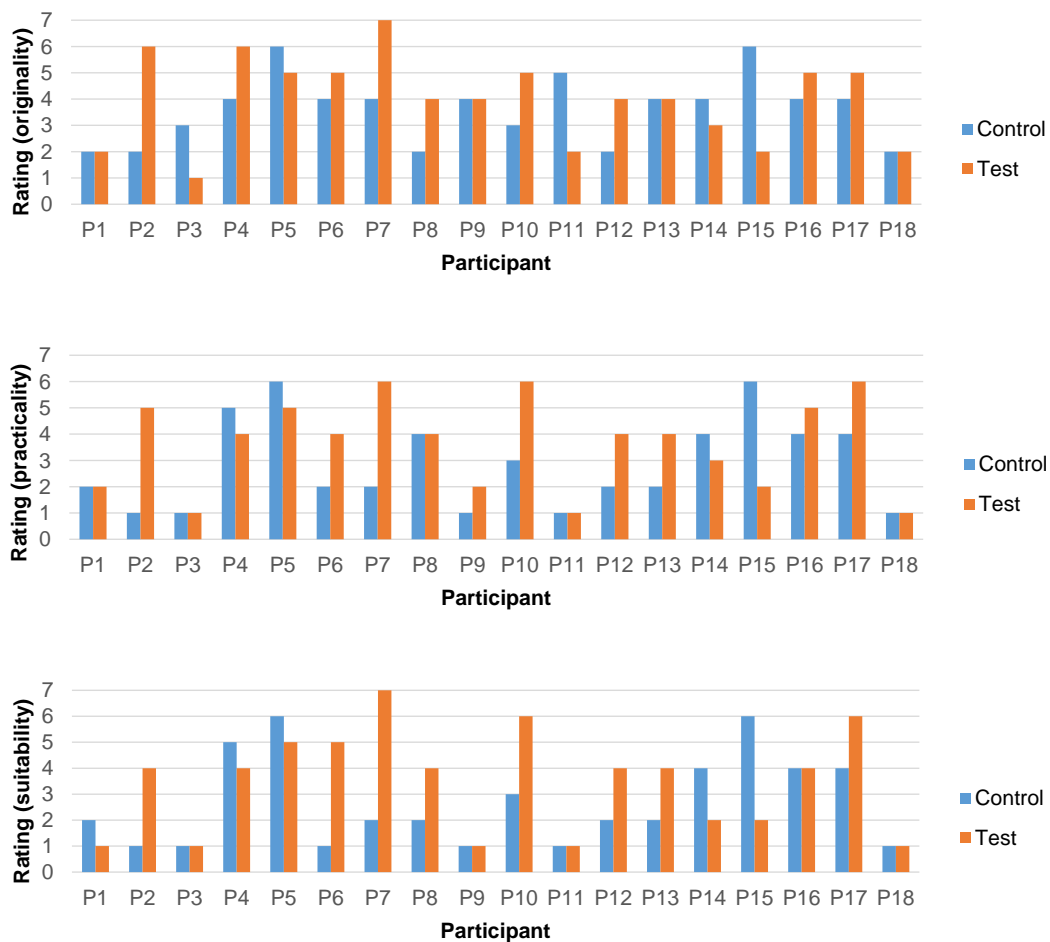


Figure 6 Graphs comparing the client ratings of the design outputs (graphs by M. Masoodian)

participant interview data suggests that the AC and AM imagery did have some effect on their design process. Differences were sought within the reports given by the participants after they performed their first and second tasks, with interest in any indications of the task being easier, more positive or encouraging creative

feelings. The analysis also provided indications of how participants perceived the usefulness of the provided images to their tasks.

### Indications of Ease of Task

During the interviews, participants were asked to give indications as to the easier task of the two attempted through questions such as “How difficult was the task?” or “Which of these two [tasks] did you find easier?” Coding of the responses revealed that only one of the participants reported no perceptible difference between either of the two tasks; however, the differences often appeared to be perceived as slight. Considering the two client tasks separately, there was a difference between Task A and Task B under the control condition, with no participant finding Task A easier, whereas four participants reported Task B easier. These results suggest perception of difficulty was task dependent, with example responses attributing the differences to lack of familiarity with the business type such as “I think I found [the B task] easier because there were more symbols that I could think of with relation to the business” (8), or to the name of the company, “Well yeah, the name of the company makes it a lot easier...” (18).

The test condition results also demonstrate bias in favour of Task B, with all nine participants performing Task B in test condition reporting it as easier, versus only four for the nine participants performing Task A under the test condition. While the bias was visible in statements made by the participants, it appeared to also be true that exposure to the AC and AM images had an effect. For example, one participant described being uncertain of the exact cause, attributing it to either “trying to think creatively, or if it was just because I was given more things, and things to run with” (17). In a similar mode, another participant described the test condition as being easier because “[it] just stimulated me a bit, gave me few more ideas” (13), with another commenting, “I felt it was a lot easier to be creative on this one. A lot more ideas” (7). Yet another participant explicitly mentions the bias in task difficulty, but also attributes some of the difference to the provided images: “compared to the last one, easier, due to having some research done on the competitors and actual imagery [indicating the AC images] to guide you, and see. The actual business I understood more than the other one, and the name invited more to play with...” (10).

### Indications of confidence in creative output

Looking at the positive or creative feelings regarding the tasks reflects similar results to the ratings given by the judges, in that few of the participants distinguished their outputs under either of the study conditions as being more creative, or inducing a more positive response. Indeed, there was only one example from the participants' comments in favour of the test condition and none for the control condition.

### Indications of usefulness of the provided images

During interview discussions, feedback was sought on the adequacy of the provided task information and the supplied images. Analysis of the responses for the control condition revealed that thirteen of the participants explicitly wanted access to images to help their process. In contrast, seven of the test condition participants thought some of the provided images were not useful to the process, and there were no cases in which images were not wanted at all.

In the control condition, images wanted by the participants did appear to relate strongly to the AC and AM images provided in the test condition, though it appeared that different or greater quantities of images would be needed by some to satisfy their needs. One participant described the need as being for "better reference material ... that would relate to IT or what the client likes, so I would get an idea about the shape or relationships or [such things]" (13). Another participant suggested "maybe some ideas from the client? Before we had pictures, I would have liked to have a couple of those images so I could go oh, and get a rough idea of what he might like" (15). Not all the participants wanted to see images from the client though, with one stating that "maybe the identity of the competitors as well, to see how they present themselves. Nothing else" (1). Participants appeared to experience the lack of images as a difficulty: "It was really hard to come up with imagery with nothing to refer to. Having to come up with everything in your own mind. Like for some of the things, for example his interest in certain logos... I don't know what they are... I would like to have a look at them, and see what kind of style they were" (12).

Looking in closer detail at the interview responses to the test condition, only two of the participants felt that the AM images provided were not useful. One participant thought the AM images were not useful for the stage of the graphic design process

the study measured: “the competitor information, I think it was good, but at a different stage, at least for me personally, because I looked at what they did, and I thought, ooh, they are all doing really boring stuff, and the main difference between them is the use of colour here and there, and a different use of font” (14). Another participant only referred to the provided images for part of their design process, while hiding them the rest of the time. No participants were observed to find the AM images to be of no value to the overall process.

While the value of the AM images was attested within the interview data, the AC images were not as frequently considered valuable by the participants. Seven participants considered the aesthetic of the client to be either completely irrelevant to the given task, or a duplication of knowledge that they had already received. One of the participants remarked that “I looked at them [the AC] but I didn’t really use [them]. I thought of the items in my own head” (2). Another participant stated that “these [the images], this [the AM] definitely helped. I didn’t find the [AC] any help” (5). The difficulty appeared to be in finding a way to incorporate the ideas into the work, or even whether such a thing should be attempted: “I guess that was the interest stuff, the settings [indicating an image within the AC showing a beach scene] because they didn’t really have anything to do with the business. So it wasn’t something you could easily incorporate into the design so much.” (8). Despite the apparent difficulty in determining their usefulness, there were indications that the AC could well be useful “because a lot of the words in [the client description] are already things I can visualise myself. So, like the water, the sea, things like that. Whereas in the other one I couldn’t visualise finance and things. [...] But then again, I don’t know how I would have done without the [images]” (10).

## 5.6 Conclusions

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Based on the statistical and thematic analyses of the study data, it is concluded that although exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation has some influence on the graphic design process, exposure to images conveying information about the aesthetic of the client (AC) and aesthetic of the market (AM) during ideation has much less (if any) influence on the measurable creativity of the graphic design outputs.



The statistical analysis of the rating data provided by the expert judges demonstrated no strong differences between providing or withholding either aesthetic of the client or aesthetic of the market images from the participants. Considering the rating data from the clients, on the other hand, suggests that there was some perceived benefit by one of the clients because of exposure to such images. Therefore, this study does not allow for a stronger recommendation regarding the influence of AC and AM imagery on the design outputs.

However, the thematic analysis of the participant interview data has shown that the provided images did have some influence on the way participants approached the tasks and their satisfaction with the other task brief information provided. While it was surprising to note that there was no effect on the apparent creativity of individuals exposed to images, the response from the clients and participants does suggest merit in further study.

Given the limited nature of the test and the differences between the responses from the two clients, the results do not show clearly which different design tasks or client types are most likely to benefit from AC and AM image exposure during ideation. It may be that different clients would respond quite differently in similar circumstances; however, the lack of a strongly negative effect on the creative output artefacts suggests a worthwhile risk. Further study is likely needed to help clarify how well the observed results generalise.

## Chapter 6

### Image Influence in Ideation Process

The study documented in Chapter 5 found few ideation output effects resulted from exposure to aesthetic of the market (AM) and aesthetic of the Client (AC) images, while suggesting that there may have been effects upon the design process of the participants. To develop a better understanding of that influence, focus was shifted to the influence of the AC images alone, while treating the AM images as equivalent to the notion of examples discussed in literature (see Section 2.3), for which some evidence of influence already exists (see Section 3.3). Therefore, this study<sup>4</sup> has investigated only the influence of AC imagery on the graphic design ideation process. In doing so, the main research question was:

1. How does the provision of AC images during design ideation influence the process of graphic design ideation?

In addition, the following question was considered to allow comparison with the results obtained in the study described in Chapter 5:

2. Are there measurable effects on the creativity of the design ideation outputs produced in the presence or absence of AC images?

To gather the necessary data, comparisons between the cognitive processes of individual designers engaged in similar tasks under different conditions were used,

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<sup>4</sup> This chapter contains portions of an article already published (Laing, Apperley, & Masoodian, 2017)

as described below. Non-identical tasks were again selected to minimise both learning and fatigue effects for participants, while still allowing meaningful comparisons between study conditions.

## 6.1 Study Methodology

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Two experiment conditions were chosen:

1. **Test condition:** participants were provided 20 printed AC images, a printed textual document containing the task instructions, information about a real study client, a list of client interests, a description of a fictional business supposedly owned by the client, names of potential competitors of the business, and a list of the services the business provides.
2. **Control condition:** participants were provided with the printed textual document (as with the test condition) without the AC images.

Graphic design tasks were chosen that would allow participants to respond creatively to the set tasks within the limited duration of the study sessions.

Personal and business information was gathered from two people (both male, similar age) acting as the clients. Each client was then treated as the owner of a fictitious business requiring a logo design, while the business descriptions were developed to reflect enterprises of which the participants had actual experience. The textual documents provided to the participants referred to the clients and their corresponding design tasks as Task A and Task B.

### 6.1.1 Aesthetic of the Client (AC)

A set of 20 images were prepared for each client for the AC component; no images depicted the clients directly, but the images were otherwise representative of their tastes and interests. Each set of AC images were printed in colour in a simple A4 booklet that included a cover page with the label “Images relating to the preferences of client (fictitious client name)”, a page showing thumbnails of all images in the AC set, and separate pages featuring larger copies of the images printed four per page (the AC images provided are the same as those seen in Figure 3).

## 6.2 Study Design Tasks

Individual briefs for each task were created, one per client, with the following instructions:

Part 1: with consideration for the information in this brief, and any additional supporting information provided, create as many high-quality logo concept ideas as you can within 30 minutes, using the supplied resources. The logo ideas that you create should take into account the personality, aspirations, motivations and preferences of the client as shown in the supporting information.

Part 2: create a single digital vector-based version of your preferred option from the first task, for recommendation to the client. This task should take about 15 minutes.

In addition to the above, participants were advised to “note that the quality of finish of the drawings created is not the primary concern in this experiment; however, they should be sufficiently detailed to enable the client or a third party to understand their basic intent.”

The logo design task was chosen as most likely familiar to all participants. Participants were not expected to complete all ideation for such a task within the timeframe allocated; however, it was anticipated that a useful sample of work would be produced.

## 6.3 Participants

Twelve volunteers participated in the study; all had formal training in graphic design. Seven males and five females participated; eleven were aged 20–29 while one was in the range 30–39. Seven participants were enrolled in their third year of a bachelor’s degree, four were classified as either enrolled in a fourth year of study (honours degree) or had completed an undergraduate degree. One participant was enrolled in their fifth year of study (master’s degree).

Participants were sought from year level groups via electronic messaging systems and verbal invitations; those who completed the study were paid \$30. As an incentive, an additional \$50 book voucher was awarded to the design participant

who produced the best work, as determined by an expert judge. It was not a requirement of any course to participate in the study, and the study was approved by the Faculty of Computing and Mathematical Sciences Ethics Committee (see Appendix A).

## 6.4 Study Sessions

All sessions involved a single participant working in the space, each completing a pair of sessions. The individual sessions took approximately one hour to complete. Each participant was directly observed as they worked in a room with no external windows, bare walls, and minimal furniture for completing the task; the main working surface for Part 1 being a circular table positioned beneath a small camera (see Figure 7), while another camera attached to a wall overlooked the area (see Figure 8). A computer was provided for completion of Part 2 of the task. Participants worked with their back to both the observer and the computer during the ideation process (Part 1).

The format of each session included an introduction to the space and familiarisation with task material and provided equipment. Prior to the ideation task, participants had unlimited time to examine the briefing material and could ask questions, after which their flow state was sampled and the thirty-minute timer started. During ideation, participants were encouraged to think aloud, with flow state sampling occurring at ten-minute intervals. After the completion of Part 1, participants completed a design flow questionnaire developed from that used by Dorta et al., (2008).

In Part 2, participants used the computer and provided software to create a vector-based drawing of their choice of the most suitable logo design. While working in Part 2, they were not required to think-aloud, nor were any time limits enforced. On completion, participants were encouraged to comment on the task. After they had completed both sessions, all briefing materials were used to facilitate commentary, including all associated AC images denied in either session.



*Figure 7 Overhead view of the workspace, showing participant working on Part 1.*



*Figure 8 Secondary view of the experiment, showing participant (foreground) working on Part 1.*

## 6.5 Data Collection and Analysis

Video recordings from both cameras were analysed and think-aloud activities transcribed verbatim; other recorded dialogue was summarised, where not directly related to the study. Think-aloud prompting generally occurred when participants were silent for more than thirty seconds, though some participants did not produce actual verbalisations of thought for periods longer than thirty seconds. Prompting took the verbal form, “Can you tell me what you are thinking about?” During Part

1, interaction with participants was kept to a minimum to limit the influence upon design behaviour to the provided stimuli. However, some participants asked questions during the ideation task, including requests for clarification of meaning of words within the brief and for general help in generating ideas; one participant was, therefore, provided a formal definition, otherwise no additional assistance was provided.

Processing of video data involved digital tools including FFmpeg<sup>5</sup> and ELAN software<sup>6</sup> packages; the latter primarily for determining timing of speech segments. All transcript segments were processed into a single file, using a spreadsheet application for further segmentation and coding. Segmentation boundaries were manually determined using pauses in speech and apparent changes in participant intentions.

Segmentation and coding was performed using codes from Gero and Mc Neill (1998), with reference to the work of Salman et. al., (2014). An initial round of coding assigned a single code to each protocol segment, which were then refined in a second round of coding. Test and control sessions for each participant were coded during the same coding session. The second round of coding used segments sorted by the first assigned code, then their alphabetical content; either the initial (first) codes were then confirmed or new codes were assigned to the segments. Both coding sessions referred to video data where necessary.

Participant design flow state sampling used ratings proposed by Dorta, Pérez & Lesage (2008); however, their “flow panorama” was not used to assess participants’ perception of challenge and skill. Instead, participants rated two questions: “How much SKILL does the task require?” and “How much of a CHALLENGE is the task?”, using 10-point scales with anchors at *low* and *high*. NASA Task Load Index data was collected in a similar way to Dorta, Pérez & Lesage (2008), including weighting data. All rating scales presented ten major divisions, each subdivided in half.

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<sup>5</sup> FFmpeg Software retrieved from <https://ffmpeg.org/>

<sup>6</sup> ELAN Software retrieved from <http://tla.mpi.nl/tools/tla-tools/elan/>

*Table 4 Codes applied in the protocol analysis based on Gero & Mc Neill (1998) and Salman et al., (2014)*

<b>Micro-strategies</b>	<b>Code</b>	<b>Definition</b>
Analysing problem	1	Analysing the problem
	2	Consulting information about the problem
	3	Evaluating the problem
	4	Postponing analysis of the problem
Proposing Solution	5	Proposing a solution
	6	Clarifying a solution
	7	Retracting a previous solution
	8	Making a design decision
	9	Consulting external information for ideas
	10	Postponing a design action
	11	Looking ahead
	12	Looking back
Analysing solution	13	Analysing a proposed solution
	14	Justifying a proposed solution
	15	Calculating on a proposed solution
	16	Postponing an analysis action
	17	Evaluating a proposed solution
Explicit Strategies	18	Referring to application knowledge
	19	Referring to domain knowledge
	20	Referring to design strategy

### 6.5.1 Design Output

Copies of the digitised sketches from Part 1 and vector drawings from Part 2 were provided in printed form to an expert judge and both clients for assessment of creativity. All output identified participants by numeric code only and had study conditions removed for assessment.

#### Expert Assessment

The graphic design expert was approached from the Faculty of Computing and Mathematical Sciences, held formal graphic design qualifications equivalent to a master's degree, and had experience as both a teacher and practitioner of graphic design. Participant identities were not revealed to the expert at any point in the



study, nor was the expert directly involved with the teaching of the participants. Assessment began with a briefing that included all documentation for both clients along with AC images, and was performed using rating sheets provided for the purpose. The two task outputs from each participant were reviewed simultaneously to encourage comparison; the judge was aware the task review order did not necessarily match the order of completion.

The rating sheets listed Task 1 (Brief A) first and then Task 2 (Brief B), with the following instruction: “Considering both the sketches and the vector drawings produced by the participants for this task, please rate the overall output for each of the following creativity measures.” Rating was performed using three, seven-point semantic differential scales, labelled as Originality, Practicality and Suitability. The opposing ends of the Originality scale were labelled “unoriginal” vs. “original”; for Practicality, “impractical” vs. “practical”; for Suitability, “unsuitable” vs. “suitable.” Following rating of each pair of tasks, the judge was asked to indicate “Which task appeared to inspire the more diverse exploration of ideas from the participant?” and “Which task appeared to generate the most ideas from the participant for solving the brief?”, with the provided options for each being “Task 1, Brief A”, “both equal”, and “Task 2, Brief B.”

### Client Assessment

Each client separately assessed the design output in a process like that of the graphic design expert; however, the clients did not have paired outputs, as they only reviewed work related to their design brief. Each client was briefed for the assessment and shown all briefing materials, including their AC images. Clients rated the design outputs per participant, using a rating sheet with the same seven-point, semantic differential scale as that used by the expert judge; however, the clients were not asked to indicate which task generated more diversity or ideas. Comparisons between non-paired tasks were made in comments by clients.

## 6.6 Results

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A comparison of participants’ design flow rating between the two study conditions was carried out using a paired t-test (see Table 5). Statistically significant results ( $p \leq 0.05$ ) were found for only two of the 14 statements rated by participants; “I get involved” and “I get anxious.” These results indicate exposure to AC images (test

condition) inspired a greater sense of involvement in the task combined with greater anxiety in the participants.

*Table 5 Paired t-test of participants' design flow ratings*

<b>Statement</b>	<b>Test Mean</b>	<b>Control Mean</b>	<b>P-Value</b>
Inspiring you or suggesting things you hadn't thought of?	6.42	5.71	0.42
Validating your concepts?	6.21	6.17	0.95
I get involved	7.67	6.96	0.05
I get bored	2.92	2.25	0.22
I get anxious	5.75	3.92	0.03
I have to make an effort to keep my mind on what is happening	5.08	3.92	0.25
I clearly know what I am supposed to do	6.92	6.04	0.19
I would do it even if I didn't have to	6.63	6.96	0.59
I get direct clues as to how well I am doing	2.96	2.88	0.82
I get distracted	2.92	2.88	0.96
I feel I can handle the demands of the situation	6.33	6.75	0.47
Time passes (slowly ... fast)	6.96	7.08	0.86
I feel self-conscious	4.42	3.58	0.37
I enjoy the experience, and / or the use of my skills	7.08	7.71	0.16

Comparison of participants' NASA TLX ratings by t-test (Table 6) indicates no statistically significant differences ( $p \leq 0.05$ ) between the test and control conditions.

*Table 6 Paired t-test of participants' NASA TLX ratings*

<b>NASA TLX</b>	<b>Test Mean</b>	<b>Control Mean</b>	<b>P-Value</b>
<b>Measure</b>			
Mental demand	7.79	7.83	0.89
Physical Demand	2.25	1.71	0.20
Performance	6.13	5.96	0.70
Effort	6.33	6.21	0.79
Frustration level	4.75	4.29	0.67
Temporal demand	5.75	6.42	0.60
<b>Weighting</b>			
Mental demand	4.42	4.42	1.00
Physical Demand	0.08	0.33	0.19
Performance	3.08	3.08	1.00
Effort	3.17	2.67	0.34
Frustration level	1.75	1.75	1.00
Temporal demand	2.50	2.67	0.59

Data from the 10-minute sampling of flow state during Part 1 (Figure 9) show perceptions of differences between sessions; however, the median values are at or near zero. This result suggests no consistent effect on perception of challenge or skill during any sampled period within the sessions.

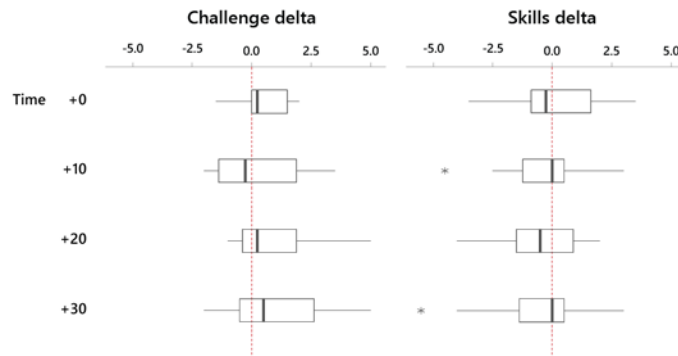


Figure 9 Boxplot of the delta between participant ratings of challenge and skill (test minus control), for each of the 10-minute intervals sampled

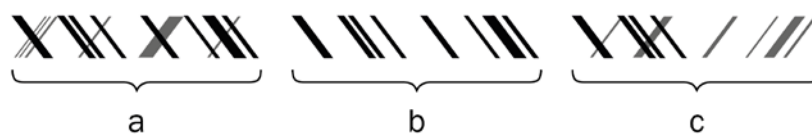
Regression analysis of the participant responses for “I get anxious”, “I get involved” and the sum of the expert ratings of the output are shown in Table 7. The analysis shows that “I get anxious” (test) vs. judge rating sum (test) is the only comparison to achieve statistical significance ( $p = 0.04$ ). This data is interpreted as evidence of a positive correlation between the reported feelings of anxiety and the expert judge’s assessment of creativity that, in combination with the result observed in the absence of the image, implies causation.

Table 7 Comparison of regression analysis for anxiety and involvement versus expert judge’s rating sum

Regression Analysis (a vs. b)	S	R-Sq.	P	Equation
“I get involved” (control) vs. judge rating sum (control)	1.23	19%	0.16	$a = 8.52 - 0.17 b$
“I get involved” (test) vs. judge rating sum (test)	1.46	4%	0.55	$a = 6.94 + 0.08 b$
“I get anxious” (control) vs. judge rating sum (control)	2.79	0%	0.93	$a = 4.14 - 0.02 b$
“I get anxious” (test) vs. judge rating sum (test)	2.46	35%	0.04	$a = 1.14 + 0.49 b$

## 6.6.1 Protocol Analysis

Numerical analysis of the coded protocol data showed the number of codes assigned to the test condition protocols were consistently higher than the control condition (average 13% more codes in test condition). Therefore, visual analysis based on patterns of code distribution were used instead of comparison of code counts. Visualisations of the data were developed to allow comparison between control and test protocol data per participant (see Figure 11), inspired by the work of Salman, Laing & Conniff (2014). Figure 10 demonstrates how the visualisations are interpreted: each coded segment is represented by a slanted stroke of fixed height, where stroke thickness indicates duration of the segment; direction of the slant indicates either test condition (\) or control condition (/); horizontally-aligned strokes correspond to the same code number. The leftmost point of each stroke indicates the time at which the segment was coded; the rightmost point corresponds with a time one minute after the end of each coded segment. The vertical lines in each visualisation demarcate the ten-minute intervals that correspond with the session flow state sampling.



*Figure 10 Example depicting coded statements for a single participant for a single code for both the control (/) and test (\) conditions; (a) shows statements for the code “matched” in both conditions; (b) and (c) show statements either totally or partially “unmatched”.*

Using Figure 11, the interaction of the segment representations was examined per code in each ten-minute interval of the study sessions, looking for “unmatched” patterns of activity in the protocols. To be considered significant, unmatched patterns had to include at least two represented segments in either of the conditions within the same ten-minute interval. A single representation of a segment in either condition could “match” any number of segments in the opposite condition that were touching or intersecting. To avoid bias, segments coded with code 9 (see Table 4) were ignored, as the code was almost exclusively applied in the test condition. Analysis was avoided for the first ten minutes for Participant 4 (see Figure 11) due

to a lack of paired-protocol data resulting from a long period of silence at the beginning of one of their sessions.

All visualised protocols featured matched, as well as unmatched, regions. The visualisations show not all codes from Table 4 were assigned, and some were assigned with greater frequency. Common areas where participants experienced unmatched coded activity between the study conditions are identified in Table 8. Unmatched activity is interpreted as a difference in design process between the study conditions. Many participants show a difference in the first ten minutes in codes 1 and 2. In the final 10 minutes, nine participants show unmatched activity occurring in code 2. Six participants had unmatched activity for code 5 in each of the 10-minute segments of the study conditions. From 10 minutes on, six participants had differences in design process related to codes 12 and 14. Finally, for code 20, six participants demonstrated unmatched protocol activity within the first 10 minutes and five participants in each of the remaining intervals.

Relationships between differences in the protocols and the combined originality, practicality and suitability of the expert-assessed output were investigated. Table 9 shows the comparison of protocol differences for two groups: the five highest and five lowest scoring participants. Both groups show unmatched activity in codes 1 and 2 within the first ten minutes; however, the highest scoring group show differences in the final ten minutes that differ from the lower scoring group. Similar patterns occur within other codes, though not as many as codes 1 and 2.

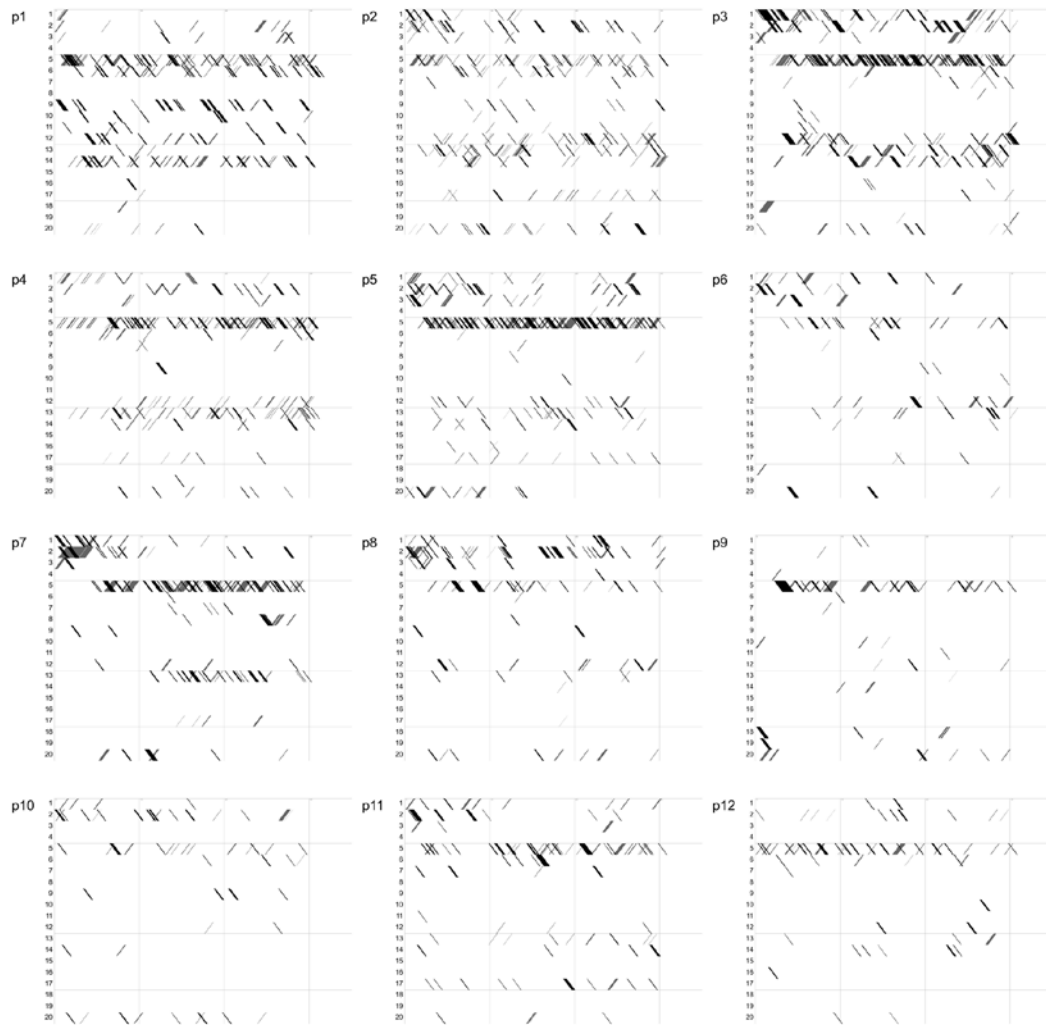


Figure 11 Comparison between test (\) and control (/) sessions, all participants

*Table 8 Number of participants who experienced differences in their process between the two study conditions*

	Code	Time (minutes)		
		0-10	10-20	20-30
<b>Analysis</b>	1	9	7	4
	2	10	6	9
	3	6	1	2
	4	0	0	0
<b>Synthesis</b>	5	6	6	7
	6	3	4	5
	7	1	1	1
	8	0	0	1
	9	0	0	0
	10	2	2	0
	11	2	0	1
	12	4	7	6
<b>Evaluation</b>	13	3	8	6
	14	3	6	7
	15	0	0	0
	16	0	0	0
	17	1	5	3
<b>Strategy</b>	18	0	0	0
	19	0	0	0
	20	6	5	5

*Table 9 Comparison of the differences in design process between the five highest and five lowest scoring participant groups. Groups based on the expert judge's combined assessment ratings for originality, practicality and suitability*

Code	n/5 highest judge scores			n/5 lowest judge scores			Difference (absolute)		
	0-10	10-20	20-30	0-10	10-20	20-30	0-10	10-20	20-30
1	4	4	3	4	3	0	0	1	3
2	5	3	5	4	2	2	1	1	3
3	3	1	2	3	0	0	0	1	2
4	0	0	0	0	0	0	0	0	0
5	3	3	2	2	2	4	1	1	2
6	1	1	1	2	2	3	1	1	2
7	0	1	1	0	0	0	0	1	1
8	0	0	1	0	0	0	0	0	1
9	0	0	0	0	0	0	0	0	0
10	1	0	0	1	2	0	0	2	0
11	1	0	0	1	0	1	0	0	1
12	2	2	2	2	3	3	0	1	1
13	2	4	3	1	2	1	1	2	2
14	1	3	3	2	2	2	1	1	1
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	2	1	0	1	1	0	1	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0
20	2	2	2	4	3	2	2	1	0

## 6.6.2 Design Output

Paired t-test analysis of the assessment ratings for originality, practicality and suitability by the expert judge showed no statistically significant ( $p < 0.05$ ) difference between the control and test conditions (see Table 10).

*Table 10 Paired t-test analysis of assessment ratings given by the expert judge for originality, practicality and suitability of the design outputs*

Measure	Control		Test		P-Value
	Mean	SD	Mean	SD	
Originality	2.42	1.38	3.42	1.56	0.11
Practicality	3.25	1.36	2.92	1.56	0.58
Suitability	3.42	1.24	3.00	1.41	0.45



Ratings from the clients were compared using a two-sample t-test; however, no statistically significant differences were observed between the two study conditions (see Table 11).

*Table 11 Two-sample t-test analysis of assessment ratings given by the two clients for originality, practicality and suitability of the design outputs*

Measure	Client	Control		Test		P-Value
		Mean	SD	Mean	SD	
Originality	A	4.50	1.64	4.33	1.86	0.87
	B	4.17	1.47	4.33	2.34	0.89
Practicality	A	4.00	2.19	5.17	1.83	0.34
	B	3.67	2.66	3.50	1.76	0.90
Suitability	A	3.67	2.34	4.67	2.42	0.49
	B	2.50	1.76	2.83	1.94	0.76

### 6.6.3 Other Observations and Comments

Post-task commentary from participants suggested the relationship between what was depicted in the AC images and the assigned task was not clear to all. Participant 9 explicitly rejected the AC images as unrelated to the task and therefore did not reference them further after forming that opinion, while all others interacted with the images at some level. Participant 11 revealed that some of the images were already familiar to them and therefore were not useful within the process.

Reflecting on AC images denied during their tasks, two participants (5, 12) stated that while unsure about the relevance of the images, they would expect exposure to them would have influenced their output, though they were unsure of the creative value of that influence. Participant 8 suggested a negative effect on their output would have resulted from AC exposure: “the colours would have thrown me off as well [...] Because [for] this one I [hadn’t] thought of colours, so I wasn’t worried too much about [them].” Participant 4 was concerned they had been over-reliant on the AC images during the test condition and thought not having the images would force them to spend more time generating ideas; however, they appeared surprised by one of the images denied them during the control task and saw in it potential for ideas they had not considered. Similarly, participant 6 saw over-stimulation and too many resulting ideas as possibilities, had they seen the AC images denied to them

in the control condition. Participant 9 saw potential for the images to provide information about an unfamiliar subject area, while participant 3 saw AC images as more powerful sources than the words. For participant 2, they felt the images had potential to influence their process; however, mostly they were a confirmation of information already in the written brief. Participant 10 saw the potential of the images in provoking ideas when having trouble and as both memory and sketching aids.

The expert judge commented that the short duration of the ideation process (Part 1, thirty minutes) would have been difficult for inexperienced designers and would explain the poor quality of some participants' output; they advocated for a period of incubation in such tasks to improve output, allowing participants time to embed the provided content and additional information to be fully prepared for the tasks. While such advice is agreed as suitable for practical projects, such an approach was rejected for this study due to difficulties controlling for external influences upon the process.

Each client shared mixed responses to the output for their design briefs; both clients saw evidence of superficial readings of the design brief and a lack of familiarity with the respective business area, while some outputs showed potential. Client B identified the output of participant 7 (control condition) as being a positive and surprising result; four other preferred works favoured the control condition, however, this was not the experience of Client A.

## 6.7 Conclusions

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The study presented here aimed to identify any potential influence AC images may have on the ideation process of design, as prior studies have shown minimal effects upon ideation output alone. Not surprisingly, the results have partially confirmed the findings of the study in Chapter 5, showing no statistically significant differences between design outputs generated in the presence or absence of AC images, as assessed by a graphic design expert and two potential clients—at least in terms of the originality, practicality or suitability of those design outputs. The results in relation to the process of design were much more interesting, showing some differences between the two study conditions; these differences were

observed both in the participants' perception of the design process, as well as the protocol analysis of their think-aloud behaviour during the ideation process.

Participants' ratings of their design flow state showed statistically significant effects on both anxiety and involvement during this study, which is attributed to the presence of the AC images. In both anxiety and involvement, the average reported ratings were higher in the presence of the images, irrespective of task order or design brief used. The greater effect observed was regarding feelings of anxiety, with the difference in averages between conditions being more than 18% for image exposure, whereas the average sense of involvement only increased by 7%. Further analysis also showed evidence of a positive correlation between the reported feelings of anxiety and the expert judge's assessment of the creativity of the resulting design outcome.

Similarly, the protocol analysis of the think-aloud data provides evidence that the participants experienced an effect upon their design processes when exposed to AC images. This analysis suggests the effects were manifest at certain periods during the ideation process (particularly the beginning and end) and more related to some aspects of the process (particularly the analysis). Further, in combination with the results of the expert judge's assessment of the design output, it is possible to observe (though not statistically) different influence effects between highly and lowly rated output by the participants.

It is, therefore, concluded with some certainty that the aesthetic of the client images play a role in affecting the designers' perceptions of the ideation process, as well as the process itself. However, it is noted that, as with any laboratory-based study of this kind, there are limitations that affect the scope of its findings. These include the limited sample size, use of student participants, and synthetic nature of the design tasks in the study. Nevertheless, these findings provide a compelling basis for further investigation within this area.

## Chapter 7

### Conclusions

As discussed in Section 1.2, this thesis asked whether it is possible to support graphic design ideation through provision of images and, further, to describe the expected influence in terms of the output and experience of the process for the designer. To do so, the thesis examined existing literature and identified knowledge gaps (Section 3.4), which included: the need for studies that are based within the field; the need to test and, if possible, expand existing knowledge of image use during ideation; and the need to discover what role, if any, client images play within such ideation.

From the identified gaps in recorded knowledge identified, a sequence of studies was designed and implemented, building upon the results of literature and of prior work, and were described in Chapters 4–6.

The first study, documented in Chapter 4, identified six distinct image roles, as well as visual information-seeking behaviours used by graphic design professionals from various design companies, along with problems that they encountered while trying to manage and access images to fill those roles using the computer systems available to them. It was reported that the tools needed to better support the designers as they formed their collections of the various image types; inadequate tools limited the usefulness of collected resources within subsequent design activity.

In the second study (Chapter 5), the influence of two of the image roles identified in Chapter 4 was examined through controlled experimentation with graphic design students; the image roles tested were the AC and AM images (Sections 5.1.1, 5.1.2). Reported results showed little or no influence on the creativity of the participants' output; however, there was some evidence that the design process of the participants was influenced. Analysis of the client responses to the creative output showed that client attitudes to the output may also have been positively influenced; however, the data was not conclusive.

The final study reported in this thesis (Chapter 6) investigated the influence of the AC images alone upon both the design process and creative output, again gathering data through designed and controlled experimentation with graphic design students. Results of the expert assessment of the creative output of the participants were consistent with the findings of the second study, while the design process of the participants showed evidence of an influence in both participant ratings of the sessions and in the analysis of the design protocols employed. Unlike the second study, however, client responses to the creative output were not shown to be influenced by the presence of the client-supplied images.

This thesis has, therefore, investigated what images are sought by graphic designers and what effects result from exposure to such images, with the key finding being that images representing the aesthetic of the client (AC) and market (AM) alter the experience of the process but do not consistently alter the output; from this finding, it does appear possible to support graphic design ideation through provision of images.

Based upon the evidence gathered from the literature and the studies reported in this thesis, a more detailed response to the research questions are presented in the next section.

## 7.1 Answers to Research Questions

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As identified in Section 1.2, the overall question of whether graphic design ideation can be supported through provision of images was approached by asking the following related questions:

1. What image types do graphic designers seek while designing?

2. For what roles do graphic designers report using the images?
3. Is there a measurable effect seen in the graphic design ideation output resulting from image use?
4. Do designers experience the ideation process in a measurably different way when exposed to images?

From the evidence gathered in the literature (Chapters 2, 3) and from the study conducted in Chapter 4, this thesis identifies that professional graphic designers seek a broad range of image types, which are used in six different image roles within the ideation process. The image roles are: personal development (PD), cognitive aid (CA), communication of an idea (CI), aesthetic of the client (AC), aesthetic of the audience (AA), and aesthetic of the market (AM). The results provide a response to questions one and two, and both support and extend knowledge in literature.

To respond to question three, this thesis again draws upon the literature and the results of study (Chapters 3–6) to conclude that there is insufficient evidence to determine a consistent or predictable effect upon the creativity of the output of graphic design ideation that could be attributed to AC and AM image use, despite individual cases of creative influence being observed. The findings of the studies in Chapters 4–6 report only on the AC and AM roles identified and do not provide new evidence for the ideation influence of any other image role.

In response to question four, the studies described in Chapters 5 and 6 present evidence for an effect upon graphic design ideation process resulting from both AC and AM image use; in particular, the evidence for AC image influence derives from participants' own reported experiences, as well as analysis of data using two different methods of analysis.

Based upon the answers to the individual questions, it is concluded that it is possible to support graphic design ideation through provision of the image types identified in this thesis: evidence presented in Chapters 5 and 6 indicates that the effects of AC and AM image provision are measurable in the design process of graphic designers. It is acknowledged, however, that the ability to generalise from this conclusion to subjects and conditions not tested is necessarily limited by several important considerations, which are described in the following section.

## 7.2 Limitations

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While the results of this thesis provide evidence for effects upon ideation process, the methods applied and data obtained place necessary limits upon the ability to generalise from the findings; the following section makes these limitations explicit.

First, attention is drawn to the small sample size of the studies presented in the thesis: in each, results are based upon data collected from less than twenty participants, and thus are unlikely to be representative of a statistically significant trend within the broader population of graphic designers. The small samples were a consequence of the methods selected for use within the studies, which are known to be resource intensive and therefore difficult to implement on a larger scale. While the implications of the sample size are acknowledged, the broader question was not focussed on determining effects of image exposure with accuracy, but rather sought evidence that influence is possible during design ideation.

Additional limitations concern the image roles identified in Chapter 4, based on data gathered from practising professionals, while the later studies (Chapters 5 and 6) were conducted with student participants. It is acknowledged that there are significant differences between the behaviour of professionals and students, and thus it is not claimed that the effects observed in the student participants necessarily will apply in the professional context. What is claimed, however, is that effects were observed resulting from image exposure using the methods described: it is an unanswered question as to whether the same stimuli and methods may reveal similar effects in professionals.

It is noted that the findings of this thesis do not include formal evaluation of the influence of all the image roles identified in Chapter 4, nor has it considered the implications of providing different subsets or combinations of the image types upon either the process or the output of design ideation: consequently, this thesis does not identify potential effects upon the output of the process as a whole. While it does not falsify the assertion that it is possible to support graphic design ideation through provision of AC and AM images, it remains untested whether the other image types identified in Chapter 4 have a measurable influence, or may be measured using similar methods.

Further limitations concern the image types developed from the study in Chapter 4, which carry into the studies in Chapters 5 and 6: the AC images collected and used for the clients in the later studies were not verified as being the same as those that professional designers might find useful. While the AC images used in those studies followed the principle derived from the study in Chapter 4, their usefulness to professionals was not evaluated.

Other factors that limit the applicability of the findings of this thesis include the small sampling of clients and task types, and the short duration of the design tasks undertaken in the studies (Chapters 5 and 6). Nor has any evidence been provided of a relationship between the number of images supplied during ideation and their effect on either the output or the process. Nevertheless, it is argued that the results still provide credible evidence that support of design ideation using images is possible, despite the need for further study to answer questions such as which client and task types may be influenced, whether longer duration tasks may be influenced, and what the optimal number of images are to supply for best effect.

### 7.3 Future Work

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As identified in Section 7.2, there are several limitations on the general applicability of the findings that remain to be answered before a definitive guide can be provided for supplying images during ideation for optimum effect. Example questions that are considered not yet addressed are:

- Is it possible to measure an influence resulting from AC and AM image exposure in graphic design professionals?
- Is it possible to measure the influence of exposure to different combinations of image types upon graphic designers during ideation?
- What task types are best suited to being supported through providing AC or AM images during ideation?
- Does the timing of the AC or AM image provision during ideation influence the process and the output of design ideation?
- Does the number of AC or AM images provided during ideation influence the output or process of a graphic designer?



## 7.4 Summary

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The overall purpose of this thesis is to provide a response to the question: is it possible to support graphic design ideation through provision of images. To provide necessary context, this chapter described the sequence of studies performed for this thesis, along with brief statements of their key findings, which were then matched to the related questions in Section 7.1. The responses to the questions included: identification of several image types used by graphic design professionals within ideation; a finding that there was insufficient evidence of AC and AM images having an influence on ideation output creativity; and, that both AC and AM images influence ideation process. It was further identified that AC images influence the design process of participants producing high and low rated outputs in different ways.

Following on from the responses to the research questions, the limitations of the findings were presented in Section 7.2, including the effect of small sample sizes leading to limited generalisability; the unknown influence of images upon the output and process of graphic design professionals; and the unknown influence of combinations of image types upon ideation output and process. These limitations are addressed through further study questions identified in *Future Work* (Section 7.3), which include studying the influence of the AC and AM image types on professionals, evaluating combinations of image types and their effects, and identifying task types best suited to AC and AM image types.

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## Appendix A

### Ethics Approval for Study 1

This appendix contains the letter of approval from the Faculty of Computing and Mathematical Sciences Ethics Committee, for the University of Waikato, as issued for the study reported in Chapter 4.

Computing and Mathematical Sciences  
*Rorohiko me ngā Pūtaiao Pāngarau*  
The University of Waikato  
Private Bag 3105  
Hamilton  
New Zealand

Phone +64 7 838 4021  
www.scms.waikato.ac.nz



THE UNIVERSITY OF  
**WAIKATO**  
*Tē Whare Wānanga o Waikato*

10 June 2010

Simon Laing  
C/- Department of Computer Science  
**THE UNIVERSITY OF WAIKATO**

Dear Simon

**Request for approval to conduct interviews for your PhD research project “Image Retrieval in the graphic design process: an investigation into the role of imagery in influencing ideation”.**

I have considered your request to conduct a research study with human participants for the purpose of gaining insight and necessary background information into the working practices of graphic designers in order to undertake development of tools that will support the process of design.

The procedure described in your request is acceptable.

I note that participants will be selected from creators within graphic design companies but will not involve administrators, managers or other such positions. Also, that the information gathered will form the basis of written reports that are intended to contribute towards the writing of a doctoral thesis and it is likely that articles and presentations will be created and published in local and international journals or conferences.

No participants will be named in the resulting publications, their identities will be protected through recoding of the information into an anonymous form at the analysis stage. All notes, recordings and documents will be kept securely in the FCMS Data Archive and destroyed at the conclusions of the PhD.

The research participants' information sheet and consent forms meet the requirements of the University's human research ethics policies and procedures.

Yours sincerely,

A handwritten signature in blue ink, appearing to read "Mike Mayo".

**Mike Mayo**  
Human Research Ethics Committee  
School of Computing and Mathematical Sciences

## Appendix B

### Ethics Approval for Study 2

This appendix contains the letter of approval from the Faculty of Computing and Mathematical Sciences Ethics Committee, for the University of Waikato, as issued for the study reported in Chapter 5.

Computing and Mathematical Sciences  
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THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

12 August 2014

Simon Laing  
C/- Department of Computer Science  
**THE UNIVERSITY OF WAIKATO**

Dear Simon

**Request for approval to conduct a user study with human participants**

I have considered your request to conduct a further study with human participants for your PhD research project *Measuring the effects of stimuli on the ideation of graphic designers*

The procedure described in your request is acceptable.

You state that you will use fake names, numbers and a single letter to protect participant identities and reports or publications will contain anonymous data and sketches only. The information will be securely stored in the FCMS secure data archive until processed or destroyed.

The research participants' information sheets, and consent forms, meet the requirements of the University's human research ethics policies and procedures.

Yours sincerely,

**Mike Mayo**  
Human Research Ethics Committee  
School of Computing and Mathematical Sciences

## Appendix C

### Ethics Approval for Study 3

This appendix contains two letters of approval from the Faculty of Computing and Mathematical Sciences Ethics Committee, for the University of Waikato, as issued for the study reported in Chapter 6.

Computing and Mathematical  
Sciences  
*Rorohiko me ngā Pūtaiao Pāngarau*  
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THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

8 April 2016

Simon Laing  
C/- Department of Computer Science  
**THE UNIVERSITY OF WAIKATO**

Dear Simon

**Request for approval to conduct a user study with human participants**

I have considered your request to conduct a further study with human participants for your PhD research project "An investigation into the effect of providing different stimuli during Graphic Design Ideation".

The procedure described in your request is acceptable.

You state that design participant responses will have numbers to protect participant identities and that identity information will be removed from any material they create, false names will be used in the briefing documents. Reports or publications will contain anonymous data and sketches only. The information will be securely stored in the FCMS secure data archive until processed or destroyed.

The research participants' information sheets, and consent forms, meet the requirements of the University's human research ethics policies and procedures.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Bernhard Pfahringer'.

**Bernhard Pfahringer**  
Human Research Ethics Committee  
School of Computing and Mathematical Sciences

Computing and Mathematical Sciences  
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THE UNIVERSITY OF  
**WAIKATO**  
*Te Whare Wānanga o Waikato*

23 June 2016

Simon Laing  
C/- Department of Computer Science  
**THE UNIVERSITY OF WAIKATO**

Dear Simon

**Request for approval to conduct a user study with human participants**

I have considered your revised application for your PhD research project "An investigation into the effect of providing different stimuli during Graphic Design Ideation", the changes being

- (a) the payment of a cash incentive to all participants, and
- (b) the expansion of potential design participants to include members of the broader community in addition to Computer Graphic Design students.

I note you have carefully considered the financial and ethical guidelines set out in the Ethical Conduct in Human Research and Related Activities Regulations and will conduct your research accordingly.

I therefore approve your request to provide a cash incentive to participants at your personal cost.

Yours sincerely,

A handwritten signature in blue ink, appearing to read 'Mark Apperley', with a long horizontal flourish at the end.

**Mark Apperley**  
Human Research Ethics Committee  
School of Computing and Mathematical Sciences