Changing Conceptualisations of Creativity in Design

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ABSTRACT

A critical dimension of a designer's work is the search for novel or original solutions to problems; it is about imagining and synthesising new possibilities. As such, a key element of design is creativity. Understanding creativity and how to enhance creative performance is therefore of great importance to the design disciplines. Nonetheless, questions regarding the concept and phenomenon of creativity as it relates to design remain relatively underdeveloped. This paper considers the main approaches to creativity within the design disciplines and the changing nature of conceptual thinking regarding creativity in design.

Keywords
Conceptual thinking, creativity, design

INTRODUCTION

McLaughlin [45: 43] states that '[a]n implicit objective of much design activity is the development of a creative outcome. The highest achievements of most design disciplines are those products acknowledged to be creative.' Creativity is the *raison d'etre* of design, nonetheless, disciplinary research on the phenomenon of creativity and discussions of the concept are limited. Furthermore, engagement with the extensive body of research about the field of creativity that exists beyond the field of design is restricted. As a result of this, questions about the nature of creativity are rarely answered in any definitive way and definitions of the concept tend to be vague and ambiguous.

The most common definition suggests that creativity in design relates to the development of ideas or work that has the quality of being both useful and original [5, 23,

44, 51, 60]. This definition of creativity emphasises the balance between form and function, novelty and appropriateness, which guide most design efforts. In contrast to other disciplines, like the sciences, which are concerned with the analysis and description of existing realities, design is about the conceptualisation, communication and proposition of new realities; that is, the essence of a designer's work is a search for novel, original or singular solutions to problems. This search for originality is 'essentially guided by human purposes and is directed towards the fulfilment of intended functions' [2: 623], subsequently distinguishing design from fine arts in its emphasis on appropriate and influential solutions.

Within the field of design research, most activities directly or indirectly deal with a type of design where goals and requirements are known [26, 54]. However, the resulting models of design have been criticised as they contain little, if any, accommodation of creative processes. Considering the literature on the design process, the design product and design creativity, it is clear that a critical problem within this field of research is the implicit assumption that there is a close relationship between creativity and design. Thus, rather than critically and directly engaging with the concept of creativity, creativity is considered indirectly through analysis of design problems, design processes and design products. Different perspectives are then proposed each of which are dependent on the authors' emphasis on design methodology [e.g. 21], the design product [e.g. 32, 45], the designer [e.g. 8-12, 22, 34, 36, 37, 39, 48], the design process [e.g. 1, 13, 14-16, 20, 25, 28, 30, 32, 33, 35], or the use of knowledge based systems [e.g. 27, 50, 54].

This paper reviews and categorises the main approaches to creativity in design and in doing so identifies how the nature of conceptual thinking regarding creativity in design has changed over time. The paper forms part of a two year research project concerning the question of creativity in design education in Australia.[1] The paper is

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[1] The research project, *Assessing Creativity. Strategies and Tools to Support Teaching and Learning in*

based on the initial phase of the project, an extensive literature review, and it is informed by discussion with a small group of designers from the fields of architecture, interior design and industrial design. It begins with a brief consideration of key paradigms of design creativity as identified in the design literature. This is followed by a more general analysis of creativity as it is presented in the design literature. The last section of the paper draws together the issues identified throughout and begins to answer the question of how the nature of conceptual thinking regarding creativity in design has changed over time.

PARADIGMS OF DESIGN CREATIVITY

Logan and Smithers [40] claim that it is possible to differentiate between a process-oriented view and a product-oriented view of 'creative design'. The process-oriented view, they argue, 'characterises creativity as an absolute, inheriting in the nature of particular kinds of processes' [40: 140], whereas the product-oriented view 'is essentially relativistic in emphasizing that creativity is recognizable only within a particular context' [40: 140]. A similar separation is suggested by Dorst [21] in his discussion of the key paradigms of design methodology. Dorst distinguishes between the positivist paradigm of design introduced by Simon [58], which positions creativity as a rational problem solving process, and the paradigm of design as reflective practice proposed by Schön [56, 57]. In contrast to Simon's theoretical framework, which emphasises rigour, objective observation and logical analysis in the development of design solutions (creativity), Schön's theory accentuates the unique qualities of every design problem. It describes design as a 'reflective conversation with the situation' [21: 205] and, subsequently, emphasises the relative nature of creative solutions to design problems.

Though these paradigms propose theoretically developed definitions of creativity, the question of what creativity is in relation to design remains vague. Is it, for example, a quality of particular products or the outcome of certain processes? Is it the result of rigorous problem solving or of play and improvisation? Is it a matter of objectivity or is it subject to interpretation?

APPROACHES TO CREATIVITY IN DESIGN

In this section the questions previously raised are considered by exploring the perceptions of creativity embedded in the design literature. The discussion is structured in line with Mel Rhodes' [53] categorical

scheme of the 4Ps, which classifies studies of creativity according to their emphasis on one of four categories; the creative *process*, the creative *person*, the creative *product* or the creative *press*. In brief, the four categories refer to:

- Process – studies that emphasise behavioural aspects and that include empirical and sub-empirical referents such as ideas (initial, critical, composite), idea generation, creative leap, use of technology, restructuring and combining, and social and physical environment.

- Person – studies that consider personal characteristics such as personality variables, intelligence, values, personal attributes, intrinsic motivation, expertise and skills.

- Product – studies that focus on the outcome of the creative process, often classifying products according to a list of properties indicating their creative value.

- Press – studies that emphasise the pressure on the creative process or on the creator. Press refers to 'the relationship of human beings and their environment' [53: 220], or, more specifically, general influences that 'perhaps operate through implicit valuation and tradition (as would be the case of cultural, organizational, or familial presses) or more specific [influences] (as would be the case in interpersonal exchanges or environmental settings)' [55: 662].

It should be noted that whether or not the studies referred to below place their emphasis on process, person, product or press, they all rely on the same definition of the design problem as 'wicked' or 'ill-defined' problems that require creativity to solve. The underlying definition of design problems as problems requiring creativity has consequences for how creativity is approached in the design literature. As is suggested in the following quote by Casakin [7], perceptions of creativity are often indirectly presented through discussions of the design problem. Casakin [7: 22] argues that 'the exploration of unfamiliar and unconventional design solutions requires creative skills [...] Creativity enables the talented designer to transcend conventional knowledge domain[s] so as to investigate new ideas and concepts which may lead to innovative solutions'; it enables the designer 'to perceive a problem from unorthodox and innovative perspectives' [7: 21]. Arguments like this lead to the question of whether or not it is possible to discuss creativity independent of the design problem and the design process? This question will be revisited at the end of the paper.

Creativity and the Design Process
In general, it is possible to differentiate between those people who describe the design process as a descriptive, linear model [e.g. 6, 24, 31] and those who depict the design process as an integrative system through which problems and solutions, sub-problems and sub-solutions co-evolve [e.g. 1, 15, 20, 28, 30, 35]. The descriptive

models 'usually identify the significance of generating a solution concept early in the process, thus reflecting the solution-focused nature of design thinking' [15: 29]. This emphasis on the final solution has been criticised because of its unidirectional nature, its lack of flexibility and potential disregard for factors that become evident during the process. Logan and Smithers [40], for example, argue that such models fail to address the fundamental objective of the design process; namely 'understanding the structure of the problem (rather than the solution), and analysing the interrelationships between criteria to gain some insight into the relationships between each individual design decision and all of the other decisions that together define the solution' [40: 144].

The difference between the descriptive, linear models and the integrated models is encapsulated in the distinction between routine and nonroutine design processes [26].[2] Routine designs are those 'that are recognized as not being different from previously produced designs in their class in any substantive way' [26: 2]; that is, as Rosenman and Gero [54: 113] explain, 'design which proceeds within a well-defined state space … [where] all the design variables and their possible range are known and the problem is one of instantiation.' In such circumstances the process is predictable and the design evolves through pre-defined stages in a linear fashion. In contrast, nonroutine designs are those 'that are recognized as being different from previously produced designs in their class in some substantive sense' [26: 2]. At least one function, structure or mapping will be unknown at the start of the design project. The ill-defined nature of such a design suggests that stability and monotonicity is problematic and that new elements, operators, requirements, structures and potential solutions are introduced throughout the process.

In the design literature, nonroutine design is further divided into innovative and creative design. Innovative design results in products or processes that display solutions that were not previously known, though the difference is due to change in the values of existing design variables. Creative design may incorporate innovative design but it involves a substantial difference due to the introduction of at least one new design variable. In contrast to routine and innovative design, which involves generation of new/alternative subtypes, creative design generates entirely new types [26, 54].

In their discussion about design prototype schemas, Roseman and Gero [54: 122] argue that it is impossible to initiate a creative process from nothing; any 'new structure must be produced from some starting point or foundation.' They contend that there are two basic approaches for creative design: it is possible to (a) 'start from existing elements either in the domain or outside it

and modify them to produce elements that did not exist before' or (b) 'configure the new elements from basic "building blocks"' [54: 122]. The first approach includes design by combination, design by analogy and design by mutation, whilst the second approach refers to design from first principles. As is often the case, Roseman and Gero's scheme does not say anything about creativity or the creative process as such, but rather reflects different methodologies that may support the designer in the development of creative products. Within their scheme, the creative process is essentially reduced to problem solving, though they expand it from a process of searching for solutions to a problem to a process that involves exploration (i.e. finding new goals, states, and state transition processes). Similarly, Logan and Smithers [40: 141] argue that 'design is the activity of "solving" design problems'. It involves 'the modification of both the problem goals (the design requirements) and the means available to achieve these goals (the design knowledge)' [40: 141]. The defining characteristic of design, however, is 'that they are not amendable to purely search-based problem solving techniques' [40: 141]. There is a wide variety in complexity and scope, and the fundamental problem in any design task is how to generate (as opposed to select) a solution. Accordingly, design processes must be identified from the kinds of problems they attempt to solve and any *a priori* decision about the nature of the design process must be avoided [40: 142].

Creativity and the Designer (Person)
As previously suggested, discussions about the creative process often result in a definition based upon the problems that the process addresses. Similarly, many studies of successful designers return to the question of the ill-structured nature of the design problem, emphasising the need for particular characteristics and skills when dealing with design problems. Cross [15], for example, highlights the importance of intuition, of being able to work at different levels of abstraction at the same time, and of sketching and drawing skills to enable a conceptual thinking process based upon the development of ideas through external expressions. The role of two- and three-dimensional representational skills (using drawing, sketching, clay and other modelling tools) as a vehicle for creative design has also been emphasised by Mitchell [50], Hasirci and Demirkan [28], Milton and Hughes [49], and Yamacli, Ozen and Tokman [61].[3]

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[2] For the purpose of clarification it should be noted that the notion of routine and nonroutine design can be applied to both the design process and the design product.

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[3] The idea that designers require particular skills and personality traits have been affirmed in studies beyond the design discipline. In a psychological study of American architects, for example, MacKinnon [41-43] found that successful (creative) architects would be intuitive, open minded and attracted to rich, complex forms

An issue of creativity research that has gained significant attention both within and beyond the field of design relates to the question of how intelligence and creativity are related. Gero and Maher [26: 4] state that creativity 'is rarely the result of naivety, but rather it results from the ability of a highly intelligent person to put different ideas together and recognise their value.' The correlation between creativity and intelligence is also identified by Lawson [38] who, in his efforts to demystify the design process, contends that creativity requires both divergent and convergent thinking. One of the major challenges of design, he argues, is the very balance of divergent and convergent thinking needed to produce a creative design. The requirement of divergent and convergent thinking skills is embedded in the common perception of design creativity as the development of ideas or work that are novel, useful and appropriate; whilst novelty requires divergent thinking, usefulness and/or appropriateness require convergent thinking and knowledge of the field and domain in which the creation takes place.

Another dimension of the creativity debate, which is associated with the idea of the creative person, relates to the question of pre-existing knowledge and knowledge structures. In their discussion about the use of design prototypes, Rosenman and Gero [54: 115] argue that '[c]reative design deals with the formulation of new structure, that is, new vocabulary elements or new configurations of existing vocabulary elements in response to either existing or new functional requirements.' The notion of re-creation embedded in this perception of creative design is the foundation of their model for creative design based on design prototypes; that is, generalisations of design elements that provide a framework for storing design experience and information about functional, behavioural, and structural elements. Rosenman and Gero suggest the use of an external knowledge base in design. Though this does not encapsulate the knowledge and experience of the designer, it reflects the paramount role of knowledge and experience in design. They argue that the 'creative leap', the moment of inspiration and divergent thinking on which the creative process depends, 'can only be achieved by recourse to prior experience' [54: 135]. The notion of the existence of idealised, previously experienced prototypes in design, has been criticised by authors such as Logan and Smithers [40]. However, their critique is not about the emphasis on pre-existing knowledge and the role of experience, but the view of the design process as a series of transformations that are governed by a set of rules or codes and the use of an organised body of *a priori* knowledge. In contrast to Rosenman and Gero, they contend that the unique nature of a design problem suggests that schemata and strategies must be developed in the context of the current design problem rather than those of the past [40].

Creativity and the Design Product

The notion of design prototypes, as it is developed by Roseman and Gero [54], ultimately connects the creative person's knowledge and experience, as well as the creative process, back to the design product; existing knowledge structures and experience from which future creativity and design evolve relate to particular products. Rosenman and Gero [54: 111-2] define creative products as any product that 'exhibits the properties of being novel, having value and/ or having richness of interpretations'. They argue that '[d]esign requires that the form of an artefact, or more precisely, a description of structure of an artefact, be produced' [54: 112], subsequently separating creative design from creative thinking. Design, they propose, is a cognitive activity that employs creative thinking [54: 112], but creative thinking does not translate to creative design unless a new structure is created.

In another publication co-authored with Maher, Gero argues that a design product can be evaluated as creative if it is novel, has utility and value [26]. Novelty and appropriateness rise from the fact that design is a purposeful act, and value is therefore the important distinguishing criterion in the evaluation of creativity in design. They propose two factors that measure value: transformation and concentration. Transformation refers to the power of a product to transform the constraints of reality through combination of 'elements in ways that defy tradition and yield a new perspective … These products involve a transformation of materials or ideas to overcome conventional constraints' [26: 3]. Concentration, on the other hand, refers to products 'that warrant close and repeated examinations … [that] offer something new each time we experience them … They have about them an intensity and concentration of meaning requiring continued contemplation.'

The implications of Gero's and Maher's scheme is that the creative qualities of a product can only be evaluated after it has been produced. Similarly, McLaughlin [45: 44] argues that the requirement of originality 'imposes a constraint that the value embodied in the product cannot be fully stated at the outset of the process of developing that product.' She refers to the value that presents itself through the creative design process as 'emergent value'. Emergent value is dependent on, but not identical to, existing knowledge, and the recognition of emergent value is 'a function of the construction of a distinct set of relations between aspects of existing knowledge, facilitated by the presentation of a creative product' [45: 54]. Any classification of either a person or a product as creative, she argues, 'must start with a classification of product' [45: 52]; 'a necessary condition of any process that can in itself be called creative is selection based on recognition of emergent value' [45: 76]. An important characteristic with emergent value is that it is relative rather than absolute; the basis for evaluation varies across individuals, societies and time [45]. This argument posits creative products as something that is socially defined,

subsequently acknowledging the role of the field and domain in which creativity occur.[4] However, as will be shown hereafter, the social field and domain does not just play a role in evaluation or judgement of creative products, they can also affect the creative process and the creative individual through the requirements and expectations they pose.

Creativity and Press

Tom Heath [29] is one of the few authors writing on creativity and design who address the social in relation to the generation of innovative outcomes. He proposes a 'constraint model of design', arguing that personal skills and abilities 'do not become effective, or creative, unless they are harnessed in an appropriate social figuration or field' [29: 11]; that is, creativity requires opportunity. He contends that constraints, or lack of opportunity, are not inherently 'fixed'; it is to a large extent socially defined, expressing the resolutions, aspirations, values, beliefs and, at times, speculations of people within a particular field. They derive from the designer's specialist knowledge (education) and their personal (professional) experience, as well as from consultants, clients, users and others. This model resembles the socio-psychological concept of creativity with its intrinsic and extrinsic motivation or internal and external press [e.g. 3, 4]. Heath's proposal emphasises the exploratory character of design by which designers more or less systematically locate constraints and demands and gradually focus in on the solution space.

CHANGE IN CONCEPTUAL THINKING

The importance bestowed upon the social environment by Heath [29] and McLaughlin [45] illustrates how creativity cannot be seen simply as a quality of particular products or the outcome of set processes. Neither can it be seen simply as the result of rigorous problem solving or of spontaneous improvisation. Creativity is a complex phenomenon in which aspects related to person, process, product and press intercede. As Margaret Portillo [52] suggests in her study of implicit theories of creativity in beginning design students, creativity is a multidimensional construct involving person, process, product and place (press). Portillo [52] argues that essential to understanding creativity is an understanding of the creative person and how personal factors intercede with the three other aspects of creativity (process, product and place). Understanding creativity requires an understanding of cognitive characteristics as they relate to the creative process (aesthetic taste, imagination,

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[4] This argument reflects the transactional approach to creativity first presented by Morris I. Stein [59] though most commonly associated with Mihaly Csikszentmihalyi [17-19] and what has been known as 'system theory'. The system theoretical framework proposes that creative ideas and creative performances originate with the individual, but the creative value of any idea reflects the particular field and domain to which the individual relates.

integration and intellectuality, decisional skills and flexibility), motivational attitudes as they relate to the creative product (goal-orientation and seeking recognition for creative work), and personality traits as they relate to place (being unorthodox, challenging societal norms). Portillo's theoretical framework illustrates a change in the nature of conceptual thinking regarding creativity in design. However, this change has taken a different course to that followed in other fields of creativity research.

A highly generalised categorisation of psychological and pedagogical approaches to creativity distinguishes between first- and second-generation concepts [46, 47]. The main characteristics of these concepts are summarised in Table 1.

First-generation creativity concepts	Second-generation creativity concepts
'Soft', serendipitous, non-economic	'Hard' and an economic driver
Singularised	Pluralised, team-based
Spontaneous, unconscious	Rational, dispositional, contextual
Requires freedom	Requires rules and boundaries
Arts-based	Generalisable
Natural or innate	Learnable
Not amendable to teaching	Teachable
Not amendable to assessment	Assessable
Trait of few	Potential in all

Table 1: First and second generation concepts of creativity [adapted from 46: 282].

As Table 1 shows, first-generation concepts refer to the romantic notion of creativity as being 'soft', serendipitous, non-economic; singularised; spontaneous; outside the box or any other metric; art-based; natural or innate; not amendable to teaching and not amendable to assessment. Second-generation concepts, on the other hand, reflect the rationalist paradigm of creativity as 'hard'; an economic driver; pluralised or team-based; dispositional and environmental; dependent on rules and boundaries; generalisable across disciplines; learnable, teachable and assessable [46, 47]. Whereas the idea of creativity within disciplines such as psychology, pedagogy and sociology, have developed from the so-called first-generation concepts, modern theoretical and practical approaches to creativity in design have always been, to some extent, removed from this paradigm. This has to be understood in relation to the particular nature of design problems and the conflicting requirements of function and form; though creativity is embedded within the disciplines of design, so is the necessity to adhere to the constraints posed by the particular context in which the design activity takes place or to which it relates. This

emphasis on function and constraints can be seen as underpinning theories that suggest creativity as a rational problem solving process. However, alternative theories such as the reflective paradigm and approaches that emphasise the integrated nature of creative processes do not dismiss the role of boundaries and rules. Conversely, they remain committed to the importance of contextual factors, but acknowledge how these factors themselves are subject to variation and change.

What seems apparent is that there has been a gradual change towards the idea of design creativity as being the result of an ongoing process of negotiation and transformation of problems and sub-problems, solutions and sub-solutions. Design creativity is accordingly intimately connected to the ill-defined nature of design problems and it is through the problem that the boundaries and rules that guide the creative process are set. Creativity is, however, not simply a rational or a relative problem-solving process; nor is it the outcome of a process or a characteristic of a product. Instead it is increasingly perceived as a multidimensional concept that can only be understood by acknowledging process *and* product, as well as the social and individual aspects that guide them.

CONCLUSION

A multifaceted conceptualisation of design creativity acknowledges and positions creativity relative to conventional stereotypes and academic theories. This approach may go some way to resolve the ambiguity that exists in relation to the concept of creativity in design, and, as such, may positively inform design education and practice.[5]

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