

Pattern beyond fashion: creativity, complexity theory, ecological optics and enduring appeal

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Abstract

Whether considering education for fashion or clothing design, there are peripheral knowledge domains that can stimulate innovation and ground design decisions. Contemporary modelling of the conditions for creativity sees disciplinary knowledge as central, but also suggests creativity can benefit from understanding peripheral or 'boundary' fields. The authors suggest that there are new fields of knowledge or understanding that might usefully complement current subject knowledge forming the base of current fashion design study at undergraduate and postgraduate level. As a result of engagement in a project exploring new patterns types for a range of applications, several areas of new thinking about optics, pattern perception, complexity theory and colour recognition have been identified. These are all considered to have important implications for fashion and clothing design education in the future. Preferences for particular visual stimuli are understood to affect the drivers for the development of the human optical system. Recognition of visual 'affordance' – the propensity of something to give shelter, or to be potentially edible – gives important clues about the extent to which 'appealingness' can be designed into objects or items of apparel. Knowing about these alternative drivers for design decision-making will not replace established methods of design generation. However in the contemporary context stimulus for useful as opposed to superficial novelty could be a valuable commodity. The paper draws from the work of E. O. Wilson on evolutionary biology, from Sternberg and others in cognitive science in relation to the conditions for creativity, and from thinking on complexity led by Casti. The discussion will conclude that a review of fashion curricula may encompass new material from these fields at the boundaries of design knowledge, to enable a new generation of smarter design professionals who are able to carry the discipline forward in an ever more challenging context.

Keywords:
pattern,
aesthetics,
education

Setting The Conditions

The value of the 'creative economy' was recognised through the regeneration of UK cities like Glasgow, Scotland, in the late 1980's (Landry, 1990), and a vision for the future role of creativity in education was stressed by Robinson in 1999. By 2000, Coy declared in *Businessweek* that 'the Industrial Economy is giving way to the Creative Economy'. The continuing focus on creativity in relation to local and international economic activity has been fed by a deluge of books, papers and government initiatives, such as Richard Florida's *The Rise of the Creative Class* in 2002, or the European Union's Creative Economy Conference in 2005. The precursors to recognition of the economic importance of creativity have been identified as largely arising from attempts to use culture as a regeneration tool (Landry, 2006), but the increasing focus on the role of creativity in management skills might also have influenced thinking. It is suggested that may in turn have built upon the emergence of new models of creativity in the field of cognitive science and psychology throughout the latter part of the 20th Century.

What distinguished the new models of creativity arising by the 1990's was a view that it was a normal attribute of human endeavour, rather than a special gift. This perspective was embedded in the discussion of creative cities, in the literature of psychology, and in neuroscience (Landry, 2006, Csikszentmihalyi, 1996, Wilson 1998¹). Thinking in the field of psychology has still not resolved if specific thought processes are involved in creative thinking, with some people just being better at using those processes than others, or whether the thought processes involved in creativity are just the same ones involved in ordinary activity (Weisberg, 2006). However, it would appear to be appropriate for education in 'creative' subjects such as design and other practical arts, to take note of what might be learnt from this work.

What is clear from professional involvement in art and design education in UK universities over the past ten years is that this field has little awareness of the contemporary literature on creativity, and minimal incorporation of the strategies to support or stimulate innovative activity that could be derived from that literature. There has been instead an emphasis on strategies for stimulating creativity by letting go of past assumptions, 'creativity without preconception', or 'the

removal of method or model' (Singerman, p. 107). However a key aspect of the more recent literature that seems particularly pertinent for learning institutions in creative disciplines is the role of knowledge in creative activity. Csikszentmihalyi notes that knowledge, as the symbol-mediated extrasomatic information that constitutes culture, must be intentionally passed on and learned (1996, p. 37). He also notes that to be creative, one 'must first understand the domain' (1996, p. 340) in order to recognize novelty. This does actually reflect a standard expectation within contemporary art and design education – that students should become familiar with current work in the field – although this heuristic is largely un-theorised in practice.

It gets more interesting when the role of knowledge is considered alongside other conditions for creativity. Lubart and Sternberg (1995) established that there are six attributes required to support creative activity: knowledge and practical skill are seen to be accompanied by motivation, particular learning and personality styles, supportive contexts and idea-generation heuristics. By 1999 they had refined this set of required conditions as knowledge, accompanied by intellectual ability, thinking style, personality, motivation and environment. Weisberg (1999, p. 227) concluded that 'extensive domain-specific knowledge is a prerequisite for creative functioning' and provides a robust rejection of the 'tension view', that too much knowledge inhibits creative action, through case studies of renowned artists and scientists (2006).

If we accept these arguments, the achievement of extensive subject knowledge would be a key learning outcome for university education, particularly in creative design. Csikszentmihalyi's case studies indicate also that intellectual excursions across domain boundaries provide additional stimulus for innovation (1996, p. 89). If these key notions are combined with the other conditions noted by Lubart and Sternberg, we have a persuasive tool for curricular development.

Exploring at the boundaries

The challenge set up by this model of creativity and knowledge is to ensure that design curricula incorporate opportunities for the development of subject expertise as well as exploration at the discipline's boundaries. The identification of topics with generic design utility and those with specific subject applicability will be driven from within the academy, based on understanding of professional and

academic experience. However, it is suggested that the academy does need to be alert to advances in other fields that may have generic or specific utility, or which may provide creative stimulus.

To reinforce the potential of this model, the following account looks at a particular case of creative activity where subject and boundary knowledge were explored in relation to a practical design opportunity. The focus of this work was not within the fashion apparel field, but in the related arena of two dimensional designs for textile and surface pattern applications. An exploration of tone and saturation in colour theory models, and of links between recognition of landscape forms on well-being, led to work on non-periodic but self similar patterns. The project is now moving towards consideration of visual complexity, pattern perception and neuro-aesthetics, and is being applied to a range of surface applications within the domestic, retail and commercial environment. The work now also forms a key element in a study of aesthetic complexity in digital patterns. A distinguishing aspect of the body of work has been a conscious focus on finding the latest thinking occurring within domains beyond art and design fields, on topics pertinent to the central themes.

The original stimulus was the development of a colour palette and suite of Jacquard patterns for the AXIOM Textile Programme, for the Norwegian furniture manufacturer Hov+Dokka. The principle underpinning the palette development was a combination of 'earth' and 'synthetic' pigments, used to generate a set of light to mid-toned non-saturated colours. The key aspect of the Jacquards was the large repeat field of complex small scale pattern elements developed from natural forms. A post-facto theorization of the rationale for the design solutions (Mottram, 2004) involved checking current thinking in a range of disciplinary fields, to determine if there was a basis for the 'success' of the range, which was awarded a Norway Design Council Award for Design Excellence in 2001.

The scholarly exploration of recent studies on environmental influences on behaviour, and on colour perception and discrimination, was undertaken alongside a curatorial project at the interface of computing and the visual arts (Mottram, 2002). This stimulated current work on non-periodic but self-similar patterns, which is the focus of a university spin-out company and is providing a context for doctoral supervision.

The experience of seeking exposure to related fields of thinking has supported creative experimentation by providing a basis of core concepts. Understanding the fundamental principles of genetic algorithms enabled the conception of self-similar patterns that could replicate the complexity of natural patterns. Familiarity with the development of colour-naming schemata within linguistic development, combined with the discussions on the veracity of the dual-opponent process model of vision, brings new understanding to colour palette development.

Reflection upon the experience of stretching the boundaries of subject knowledge led to a consideration of the extent to which art education has maintained its currency with other fields, and the extent to which it is becoming removed from the base knowledge of the discipline. Focusing specifically on colour, this concern was tested through interviews with two successful contemporary artists, Catherine Yass and Liam Gillick (Mottram, 2006), who confirmed that while their standing in the field was exemplary, their mastery did not really reflect the expertise suggested by Weisberg. A fundamental attribute of the fields of art and design is that they are perceived visually, and the expertise of the practitioner is their ability to manipulate the visual. Without understanding of vision, or of one of the discriminatory tools within the visual array such as colour, is it conceivable that mastery can be achieved?

The visual field

The emphasis upon the visual attributes of designed objects and the designed world in general has been overshadowed in the postmodern period by an increasing focus upon meaning and identity. Subject knowledge is downplayed, in favour of personal interpretations. These are preferable because of their ability to dislocate 'dominate' regimes of power and thus construct new ones (Swift, 1999). In a review of one event during London Fashion Week in February 2007, a columnist noted that:

Maybe fashion's big secret is that it is not about clothes at all, but about presenting an elaborate and tense index of gender identity and anxiety

Orr's comments were stimulated by the antagonism of the interplay between model and photographer acted out at the catwalk show for

Biba at the Freemason's Hall. Of the clothes themselves, she notes 'by the way', that they were 'absolutely and bewitchingly beautiful'.

The achievement of the 'absolutely and bewitchingly beautiful', or of designs which have attributes that could be described as meeting aesthetic parameters, would appear to be a sensible goal for design training. Recognition of 'bewitchingness' or other aesthetic attributes requires visual discrimination, or the ability to distinguish the bewitching from the bland. It is suggested that while the un-theorised admonition to know what other designers are doing is implicitly along the right lines, a stronger application of knowing that, and knowing how and why some designs are particularly appealing or successful, might provide a more substantive basis for future achievement in design fields.

To know why a design works in visual terms might benefit from an understanding of how the visual system works. Contemporary models of design education are largely derived from those developed within the Bauhaus, and Singerman (1999, p. 77) describes Gropius' interest in *Gestaltung* as 'the experimental search for a psychological foundation of good forms'. He also cites Moholy-Nagy's emphasis on the 'basis means of visual impact – shape, size, position, direction, point, line, plane, colour, rhythm' (1999, p. 91), describing them as the 'elements and grammatical rules of a language of vision', that have formed the fundamentals of modernist teaching in art and design. Singerman's account of the development of modernism often notes the linkage between various conceptual positions and current thinking in other fields: the Bauhaus and Gestalt psychology, Moholy-Nagy and the emergence of linguistics, Mondrian and psychological optics, Stella and structuralism. The question today is whether there is new knowledge and understanding about the visual system that might usefully be applied to design fields in order to increase the capacity for generating design that has visual coherence and appeal.

It is suggested that two key topics which might be considered for greater embedding within contemporary fashion and clothing design education are ecological optics and complexity theory. An understanding of models of thinking about optics and perception has the potential to re-situate the role of visual stimuli within design, to counter the emphasis on the interpretive and meaning. Complexity theory is more of an intriguing 'other' – a boundary excursion into

adaptive systems of descriptions, predictions and prescriptions, which respond to information content and its degree of organisation (Gell-Mann, 2003). As a means of modelling the way in which the world works, at all levels from atomic physics via biological evolution to the operation of a business, complex adaptive systems provide an overarching framework that has certain regularities amongst chance events. By locating design innovation and design decision-making within such a system, a different sort of meaningfulness could then be ascribed to the field of fashion.

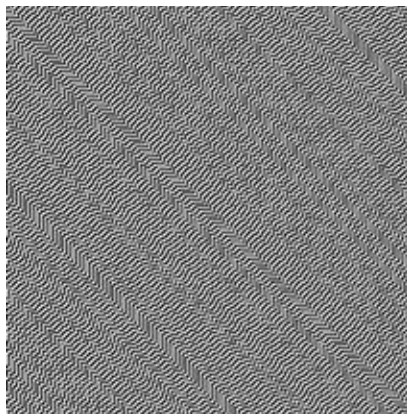
Complexity theory and design

We employ the word 'complex' in lieu of a better description of a system with many interacting elements. Complexity theory is the name given to the study of how such systems arise, with the aim of describing that which was previously indescribable. This interdisciplinary field was borne from explorations in meteorology, cybernetics, artificial intelligence, and chaos. Understanding of complexity is now driving research not only in physics and biology, but also in the social sciences, economics, and even business management. The wide applicability of these concepts is a measure of the ubiquity of complex systems. The weather is a good example of a complex adaptive system (CAS), because it clearly demonstrates some characteristics. 'The butterfly effect' is a popular expression for what is called non-linear behaviour, where changes have consequences of irregular proportions. This situation is common when there are many interacting forces. However, weather is not random because it has definite causes (temperature, pressure, humidity) and has stable features (seasonal changes, local patterns), but at the same time it is highly unpredictable. Unfortunately, complexity theory cannot help us make more accurate weather forecasts. What it can do is tell us what type of system the weather is, how we can measure it, and why these measurements are limited.

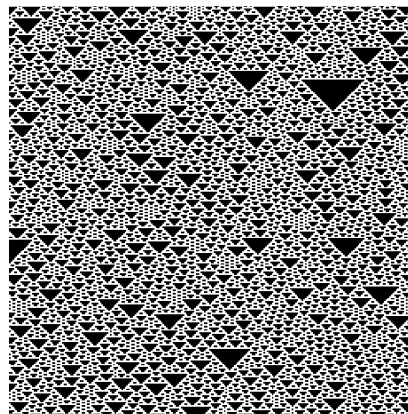
Complexity theory has enriched questions about the appearances of things and our perceptions of them, and as such is pertinent to visual creative practices. By visualising a model of a CAS, we can learn about how patterns are formed. Cellular automata, for example, can model the formation of a snowflake, the flow of traffic through a city, and the arrangement of leaves in plants. Wolfram (2002) studied many such models and proposed a classification of complexity based on their visual

features. The illustration Figure 1, a-d shows the differences between these classes. Fractals occupy one part of this spectrum of complexity (Figure, 1b). Taylor has demonstrated that Pollock's drip paintings are fractal (2003), and also that certain fractals can have a calming effect on us. Chaotic images (Figure, 1c) are perceived as random, and we tend to lose interest in them, while the ones that hold our attention tend to display a mixture of order and randomness (Figure, 1d). The features identified as interesting depend on who is observing and on the level of detail in the description. This context-dependence is one of the things that distinguish complexity theory from traditional science, and what makes it amenable to application in more creative domains.

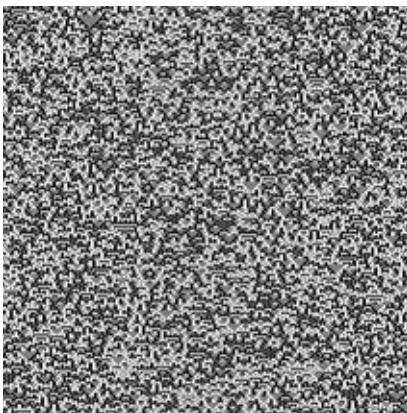
The complex adaptive system identifies regularities, or information held in common. We could describe these as those elements with some order, or relationships that can be discerned. As Gell-Mann notes (2003,



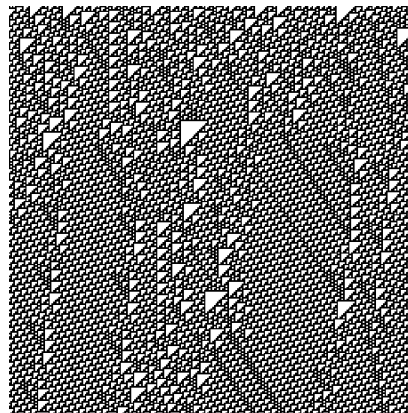
a. Periodic



b. Fractal



c. Chaotic



d. Complex

Figure 1. Different types of pattern from cellular automata

p. 55), this finding a sense of order, or discovery of regularity, 'is certainly what a person does in looking at a work of art or listening to a piece of music or reading a work of literature.' Crutchfield (2003, p. 39) noted the key modelling dichotomy between order and randomness – he characterizes this as the questioning of what part of what is seen is that which makes it 'meaningful or functional', by virtue of a structure or pattern that enables usability.

Artificial intelligence has had a major influence on how the theoretical models of complexity were derived. This field measured complexity by the length or size of the data file that a computer would need to describe the entity, but this did not distinguish the random from the complex. Another way of thinking about complexity is to look at the size of the program needed to recreate a set of data (known as algorithmic information content, or AIC), but this approach suffers the same problem. Gell-Mann's solution is to capture what he calls 'effective complexity' (EC) by measuring the description of a system's pattern of regularities. Random data has no regularities, and so it gets a low value of EC, as opposed to complex patterns which score highly.

It is interesting to note also the etymology of the terms being used. Complicated derives from the Latin roots of *com-*, meaning 'together', and *plicatus* meaning 'folded'; whereas complex derives from *plexus*, meaning 'plaited', giving the meaning of 'woven together'. A jet aircraft, for example, is a complicated machine, but it is not a system capable of adaptation. Thus it is of less interest than complex systems in which spontaneous organisation arises, such as consciousness does in a human brain.

Even at the level of language, complexity as an intellectual construct provides a framework for designerly thinking. It is suggested that the more developed concepts of complexity, such as those derived from weather forecasting, might be particularly useful to studies of fashion trends, as well as providing a model for evaluating appealingness. Both Wolfram's and Gell-Mann's measures of complexity are designed to reflect the tendencies of human perception, and thus distinguish between randomness and complexity.

Wilson (1998, p. 95) reminds us that the painting of a flower is a very different entity from the real thing, as the algorithms that created it are

radically different – chromosomes and cells are physically different from oils, pigments and the surface they are upon, although the visual image is still generating the same, or a similar, aesthetic response. Being aware of what order might be discernable, of ways in which one's contributions to the visual environment might be read, or compared with other existing entities, is a key capability for self-critical evaluation by the designer. Boden reminds us (1992, p. 8) that the 'intriguingly crazy', or the generation of randomness, does not require the capacity for critical evaluation that is required for the generation of creative innovations.

Ecological optics, design, and evolutionary biology

Ecological optics is the label given to the approaches to understanding perception that have built upon the work of J.J. Gibson (1986). The distinctive feature of his work was to propose that perception is active, direct, situated in an environment and not based on learnt experience or memory. Instead, he asserted that human perception drew upon the 'hard-wired' feature of recognizing 'invariant' features within the surroundings, such as horizons or boundaries. He also suggested that there were 'affordances', or recognized potential for interaction with the environment, that could be applied as schemata as a basis for understanding new visual encounters. These ideas have a direct application to design issues, as not being able to see how to use a designed object can clearly become either a barrier or a distinctive enhancement for users. The link between Gibson's optics, design and evolutionary biology is somewhere in the parallels that may be present between those schemata and Wilson's notion of the meme as the node of semantic memory (1998, p. 147-8). The condensing tendency of the brain, to collapse episodic memory (direct perception of actual events, things or people) into semantically accessed symbols, could be linked to the invariant features, or those that suggest affordance. Thus we may have a robust case, if we plan to engage in a critical interrogation of the fitness for purpose of any design solution, to consider the extent to which the visual attributes of our solution might correspond to shapes, sizes, positions, directions, combinations of points and lines, plane intersection, or colours, that constitute environmental invariants within the relevant context.

Wilson rejects the postmodern denial of universal human nature, arguing that great works may be understood with knowledge only of

‘the biologically evolved epigenetic rules’ that guided the maker (1998, p. 237). These rules are fundamentally those same environmental features that Gibson refers to. The model of ‘consilience’ presented by Wilson sees a clear role for brain science, psychology and evolutionary biology in understanding the creative mind, with the goal being an enduring theory of the arts. He suggests that innovation is a ‘concrete biological process’, of intricate nerves and neurotransmitters, not randomly-generated outpourings which are then sorted and evaluated (1998, p. 240). In addition, he proposes that evolutionary development can predict the underlying epigenetic rules that are most likely to be encountered in the arts, and guide us towards particular forms, images and narratives. The pioneering ‘bioaesthetic’ study of levels of dysynchronicity in alpha waves, when viewing abstract designs of varying complexity, suggests that the highest states of arousal are found in response to images with redundancy-repetitiveness elements of 20%. Wilson reports (1998, p. 254) that this is the level of complexity found in two turns of a logarithmic spiral, is that which stimulates the longest periods of gazing by newborn infants, and which is close in order to the written pictographs of a range of Asian languages.

From looking at vision, we have taken a turn that leads right back to complexity and adaptive systems, via the biological basis of creativity and innovation. There would appear to be some basis for incorporating these areas of thinking within design education. It is suggested that whilst there is some anecdotal evidence that topics like colour or vision continue to be incorporated within curricular design, there is little evidence of systematic review of boundary fields. An initial review of material published via the UK Higher Education Academy Subject Centre for Art, Design, Media (2007) indicates that their focus is predominantly upon how we teach and learn in those disciplines. As indicated earlier, it is clearly appropriate for disciplines to determine the components of knowledge that support both subject-specific and generic learning outcomes. From that, it is appropriate to question why there may even be an expectation that the material under discussion in this paper might be incorporated into current curricular. The response can only be, at this stage, that it might enable innovation within the curriculum, and that by presenting the material to a subject-specific audience, consideration of the material can be initiated.

The concluding section of this paper considers why the topics of evolutionary optics and complexity theory might be particularly relevant to education in fashion and clothing design, and considers the extent to which they are already embedded within the field.

Fashion: free choice or fundamental preference?

From outside the discipline, as an interested consumer, it might appear that we could describe fashion as fickle. However, on reflection it is conceded that within the global textile and apparel market there is relative stasis in the types of garments that constitute the major focus of activity. Standard forms such as the trouser or jean, the T-shirt or shirt, conform to expectations of standard body shapes and sizes. These have changed in various parts of the world over time, with an increase in both height and girth in developed countries reflecting increasing affluence and different lifestyles. In these markets where consumers are often in the position where they can make choices about what garment they purchase, the issue of design obsolescence could start to pose disposal issues. From thinking about the sustainability of manufacturing in the clothing industry, it is a short step to mapping strategies to contain excess and mitigate against obsolescence. Clearly the ability of garments to continue to withstand wear and maintain their functional properties of providing warmth, dryness, coolness, cover etc. are key aspects that contribute to extended use. If it is possible to manage the drive to acquire the 'new', continued appeal to the wearer might be a useful attribute for garments.

In order to think about the qualities that might make an object visually appealing, or appealing in other ways, it is useful to track back to check on what we understand about how we discriminate forms in the visual world, and those formal relationships and degrees of visual complexity that are particularly satisfying or which engender particular emotional states. This is the starting point for thinking about how a greater understanding of the fundamental attributes of being human might benefit design students.

However, the achievement of current curricula in presenting well-rounded and highly skilled designers into the professional context is not to be underestimated. Clearly any inclusion of new material requires integration into existing models. From an initial review of the Fashion Design programme at one university², it is evident that the focus on

developing subject knowledge and upon embedding strategies to support practice in that field gives a sound basis for expert-level performance. By establishing disciplinary skills and principles at the early stages of the programme, parallel exposure to the wider world of ideas, markets and manufacturing gives a basis for contextualization of the emergence of design signatures. A clear sense of the components that make up the initial disciplinary portfolio – 2D and 3D drawing, illustration, fashion research, pattern cutting and manufacturing techniques – contrasts strongly with the absence of curricula specification that is common within fields such as the Fine Arts. A continuing emphasis on the benefits of work in a hands-on manner with historical archives is understood to be particularly beneficial to creative innovation, as it enables students to understand, through direct interaction, the ways in which different fabrics and cutting techniques can generate particular forms.

Summary

As in most well-established Art and Design Schools, robust approaches to curricula content have developed over significant time frames, with a combination of continuity and change in the people constituting the academic leadership. What has changed over the past thirty years has been the increasing emphasis upon research within the field, and the emergence of opportunities for intellectual exchange among academics from across the globe. In the past, innovation in curricula would be local, and news of such changes or their impact might spread slowly through the movement of academic staff or the achievement of graduates. Now there are opportunities to present ideas for consideration by the subject community, and this paper constitutes one such contribution. There is no conclusion to this discussion, only an invitation for the subject community to reflect upon the content and upon its usefulness for their activities in the field.

Notes

- ¹ Wilson was referring to work on the development of the brain in the musically gifted. G.Schlan, 'Increased corpus callosum size in musicians', *Neuropsychologia* 33: 1047-55, 1955, and 'In vivo evidence of structural brain asymmetry in musicians', *Science* 267: 699-701, 1995
- ² Interview conducted with Academic Team Leaders for Fashion and Fashion Management and for Applied Design, at Nottingham Trent University, 19 February 2007

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