



This item was submitted to Loughborough's Institutional Repository (<https://dspace.lboro.ac.uk/>) by the author and is made available under the following Creative Commons Licence conditions.



CC creative commons
COMMONS DEED

Attribution-NonCommercial-NoDerivs 2.5

You are free:

- to copy, distribute, display, and perform the work

Under the following conditions:

BY: **Attribution.** You must attribute the work in the manner specified by the author or licensor.

Noncommercial. You may not use this work for commercial purposes.

No Derivative Works. You may not alter, transform, or build upon this work.

- For any reuse or distribution, you must make clear to others the license terms of this work.
- Any of these conditions can be waived if you get permission from the copyright holder.

Your fair use and other rights are in no way affected by the above.

This is a human-readable summary of the [Legal Code \(the full license\)](#).

[Disclaimer](#) 

For the full text of this licence, please go to:
<http://creativecommons.org/licenses/by-nc-nd/2.5/>

Design Education: Nurturing the designerly but at what cost?

Professors Ken Baynes¹, Eddie Norman¹ and Kay Stables²

¹ *Department of Design and Technology, Loughborough University*

² *Department of Design, Goldsmiths', University of London*

This presentation for T<2010 seeks to bring together a series of events and some parallel streams of thought in order to both celebrate the importance and begin to count the cost of design education.

The series of events are:

- Ken Baynes' 2009/2010 Modelling seminar series
- This presentation by videoconference for T<2010 (June 2010)
- Ken Baynes' John Eggleston Memorial Lecture at the Design and Technology Association Conference at Keele University, UK (July 2010)
- A reciprocal videoconference by Ron Hansen and Steven Petrina for D&TA2010

The parallel streams of thought are:

- Eddie Norman's paper presentation for PATT 2007 at Glasgow University
- Kay Stables' John Eggleston Memorial Lecture at the Design and Technology Association Conference at Loughborough University (July 2008)

During 2009/2010 the Design Education Research Group (DERG) at Loughborough University has organised a seminar series led by Professor Ken Baynes, which are intended to lead to an academic book entitled *Models of change: the impact of 'designerly thinking' on people's lives and the environment*. The ideas leading towards the book are being initially presented as 5 separate seminar presentations with each having an associated freely downloadable Orange Series publication i.e.

- Modelling and Intelligence [Orange Series publication](#)
- Modelling and Design [Orange Series publication](#)
- Modelling and the Industrial Revolution [Orange Series publication](#)
- Modelling and Society [Orange Series Publication](#)
- Modelling the Future

This presentation essentially concerns 'Modelling the Future' and has 3 phases:

- The development of a neo-Darwinian perspective
- Nurturing the designerly
- Modelling the future

We hope that these perspectives can add to the debate concerning the shaping of design education as a contributor to sustainable human futures.

1. A neo-Darwinian perspective of design education

In a 2004 paper, Langrish discussed the ideas associated with a Darwinian interpretation of product evolution and at the *2006 Design History Society Conference* concerning *Design and Evolution* presented the five basic requirements shown in Table 1.

1. The existence of variety – different kinds of things having mixtures of differing properties held in varying amounts
2. A competitive selection system which picks ‘winners’ from the different things, properties, amounts of properties or combinations of these
3. A system which replicates the ‘winners’ or some proxy for the winners. (e.g. male animals may compete but real competition is between the properties of the animals and only those properties which are linked to replicators get passed on). Preferential replication gradually replaces the ‘losers’.
4. There has to be a system for the generation of new varieties because the above three on their own lead simply to a steady state (including oblivion as an extreme steady state). New varieties take us back to 1 and the continuation of the process.

To which it is necessary to add a fifth:

5. Even with the addition of 4, the system of change would slow down through diminishing returns, unless we have a fifth feature viz. changing the rules of the competitive selection system. Without changes in the environment or some other form of rule change, evolution would stop.

Table 1 Towards a general theory of Darwinian change: five basic requirements (Langrish, 2006:9)

When Dasgupta was considering whether creativity could be considered to be a Darwinian process, the lack of randomness in the ideas which emerged was a key argument in his rejection of the idea (2004). He examined three case studies from the histories of natural science, technology and art¹ and concluded:

‘... a fecundity in the generation of variations on which the selection is supposed to work according to the variation-selection model is not evident in any of the examples.

In none of the case studies presented here is there any evidence whatsoever of blind variations being generated. On the contrary, the cognitive process in each instance was goal driven and knowledge driven’.

(411-412)

¹The case studies were in natural science, Jagadis Chandra Bose (1858-1937) and his ‘Monistic Thesis’; in technology, James Watt (1736-1819) and his ‘Separate Condenser’; and in art, Pablo Picasso (1881-1973) and his ‘Picture from Afar’ (Guernica)).

At the same 2006 conference, Norman discussed the strength of the product evolution analogy in the context of the development of the guitar in order to explore this issue of the existence of variety, or in Dasgupta's terms randomness and blind variations. In order to provide a framework for the analysis, Thistlewood's (1990) categories of design innovation were employed: namely, artefactual, evolutionary and historicist. Artefactual forms are those that evolved closely with human patterns of use and are therefore difficult to alter significantly. Evolutionary designs represent a step change from their predecessors and historicist designs relate to cultural influences where there is no essential, or artefactual, form.

One product family - guitars - was discussed and it was possible to identify all three of Thistlewood's categories of design innovation (1990). Artefactual designs, which have essentially ceased to evolve and where at least some designers have re-presented familiar forms. Evolutionary steps constantly being sought, and when no essential form is required, for example with electric guitars, abundant variations ensue (historicist designing).

The development of the guitar seems to be characterised by issues relating to 'technical and cultural lock-in' of particular designs, but with a constant probing at the boundaries of the guitar family. Whether it is re-presenting archetypal designs, seeking new evolutionary steps or generating more historicist possibilities it seems never ending. Why do designers constantly re-examine the existing boundaries of the guitar family? And particularly when many guitarists (consumers) essentially regard innovation as either unnecessary or impossible? Certainly the reality that at least some of them do provides supporting evidence that the first of Langrish's five basic requirements for a Darwinian model can be met.

One way of explaining such variety is through the Lamarkian notion of progress that each new design is a result of some perceived dissatisfaction with an aspect of its predecessor's performance? (Petroski,1993). However ideas like Doyle's concept of 'technicity' (2004) can provide an alternative and more fundamental explanation. It appears that some evidence from the field of evolutionary psychology suggests that technicity, rather than language, can be seen as the driving force underpinning the evolutionary success of humans. So the seeking out and exploration of new possibilities is at least partly 'simply what humans do'.

'Technicity might best be characterised by a creative capacity to:

- a) deconstruct and reconstruct nature, and
- b) communicate by drawing' (Doyle, 2004: 67)

Doyle's hypothesis was that 'innovation is to be expected [and that] technicity is its intellectual driver' (*ibid*: 71).

A neo-Darwinian perspective on design and technology education: learning by doing

Human decision-making is an expression of the art of making judgements based on incomplete information about existing factors and future consequences. This is the essence of design activity, and hence then of the existence of products and their associated technology. In the same way that each game of chess is highly likely to be different, so with product design dependent on a multitude of sequential decisions, the designs will inevitably be different. So, in some respect, every resolution of a design problem could be seen as innovative, in the sense that with respect to some factors it is a 'better fit' for the design intentions than its predecessors. It is a matter of judgement as to whether the better fit is of more value than other better fits. Hence product evolution can be considered the survival of the most valued.

The constant probing at the boundaries of the guitar family could be seen as a demonstration of technicity, perhaps a 'curiosity gene', or, given the potential planetary consequences, even a 'self-destruction' mechanism. Variety is certainly being generated and it is really a question of how this is viewed. What at a micro-level might see as goal-directed creative responses might at a macro-level also be perceived as the random generation of variety. One focus of Baynes's research in the 1990s was understanding the behaviour of very young, pre-school children when designing (1992, 1994, 1996)². The playful behaviour of the young of a species is often strongly indicative of what the adults must do to survive, and the exploratory behaviour of young children demonstrates the fundamental nature of 'learning by doing'.

Learning by doing is one of the ways in which designers develop the 'recipemes', a form of memes (Dawkins, 1976) which Langrish describes as transmittable ideas about how to do things' (2004:17). He uses Abu-Risha's concepts (1999) in order to describe designing in terms of the 'purposive pattern recognition (PPR)' between the recipemes and the 'selectemes', which are 'ideas about the sorts of thing you want to do. Selectemes are involved in making decisions between alternatives. They provide motivation; they are values' (*op cit.* 17). As Langrish noted both recipemes and selectemes can 'sometimes be transmitted without formal language' (*ibid*:17), and this view of designing is supportive of Doyle's technicity analysis. Some of the replicators of product evolution are the products themselves, which embody the thinking of their designers, and hence the importance of museums for design education. Similarly, other replicators are embodied in the skills and know-how which are passed from one generation to another through 'teaching by showing' (Norman, 2000).

² These 'Orange Series' publications are downloadable from Loughborough's Design Education Research Group website at <http://www.lboro.ac.uk/departments/cd/research/groups/ed/index.htm>

Langrish also describes a third type of meme.

‘... the “explaneme,” must be added because of the human propensity to ask “why?” As long as humans have had a language, they have told stories, and good stories get replicated. If someone discovers a new recipe, people will ask why it works. Explanemes are the ideas that provide the basis for answering the “why” questions. They range in sophistication from simple stories to complex mathematical concepts, but they have two things in common, they offer an explanation and they need a language to be transmitted’. (2004:17)

The designers’ judgements (Norman 2006b) and the discipline of the market provide Langrish’s second basic requirement for a competitive selection system, and design education can be seen as providing the third ie a system ‘which replicates the ‘winners’ or some proxy for the winners’.

Probing at product boundaries and the generation of alternatives can be seen as inevitable consequences of human behaviour. No design ‘strategy’ or process, singular or plural, is needed for this to be the outcome, and design education can perhaps be best seen as taking the form of ‘sports coaching’. ‘Sport for all’ programmes from which the most talented emerge, and the recipes available to these few are gradually increased until the ‘PPR’ associated with highly skilled designing becomes routine. Technological literacy is largely about the understanding of the selectemes that enable participation in a democratic society. Technological capability, if this concept is interpreted as the ability to intentionally bring about a specified outcome, requires ‘PPR’, and bridging the gap between technological literacy and technological capability could be considered to be the ultimate goal of design (and technology) education. Explanemes are the province of science, and on such a neo-Darwinist view, they are not always an essential feature of designing or product evolution, and consequently neither are formal languages a necessary requirement.

Returning (briefly and for the last time) to guitar development, many people have relevant selectemes which could define worthwhile goals (literacy), a small minority have the recipes required to do anything about them (capability). Science provides few explanemes and their foundations are not secure (Norman 2006a). That is why luthiers exist.

2. Nurturing the designerly

This section aims to consider the ideas presented in the first section by Eddie Norman from the particular perspective of nurturing designerly thinking and acting. In doing so, I will intentionally be shifting the stance from a consideration of products and their evolution to a consideration of human motivation to engage in designerly activity – a shift from exploring instrumental purposes of design

education to more general 'liberal' (Hirst, 1974) educational purposes – a shift from exploring products to exploring people.

The stance that I am taking is based on my fundamental belief that all humans have designerly potential and that education has a distinct responsibility to develop this potential – in us all. My concern first and foremost is for what I have called elsewhere (Stables, 2008) “little d designing” (a phrase derived from the idea of little c creativity – see e.g. Csikszentmihalyi 1996, Craft, 2001). In essence, it is the development of the whole person and all facets of potential that makes design education so critical in developing balanced and fulfilled humans. In this I am arguing for the importance of what might be called “designerly well-being” that comes from the satisfaction of employing the designerly capacities of imaging and modelling with creativity and imagination, for example in what Whitehead described as

‘... creative experience while you think, experience which realises your thought, experience which teaches you to coordinate act and thought, experience leading you to associate thought with foresight and foresight with achievement’.
(Whitehead, 1929:54)

This is closely linked to Doyle’s technicity and the inevitability of innovation, to what Cross characterises as “ill-behaved problem solv[ing]” (Cross, 2004:439) and to what Eddie Norman hints at above – the human ‘curiosity gene’. In short, the unstoppable designing, latent in us all, and clearly witnessed in small children as they go about the serious business of play.

However, seeing education’s role (and particularly but not exclusively general education’s role) as adopting a ‘liberal education’ standpoint in developing the designer in us all, could imply a kind of design ‘laissez faire’ that ignored such things as societal imperatives – such as the need for designing to proactively contribute to sustainable human and planetary futures, embedded in Ken Baynes’ view that it

‘... has now become urgently necessary that society should better understand how this [designing] mental capacity ‘works’ and how it can be focused on imagining the existence of an alternative lifestyle capable of being sustained into the future’.
(Baynes, 2009a:5).

This would be the case if the ‘liberal’ perspective were seen to be entirely egotistical. But this is unhelpful and so a further layer is added to nurturing the designerly – that of social responsibility.

But before considering the responsibility issue, I want to return to the notion of designerly well-being, the linked idea of humans as innovators and the major theme of neo-Darwinian evolution. Through the ideas presented above and in earlier papers, Eddie Norman has drawn together some fascinating ideas about

product evolution, illustrated lucidly with reference to the development of a particular product – the guitar. This provides valuable and interesting insights into the different ways products have evolved and the distinguishing insights into what might be seen as ‘watershed’ evolutionary moments of high levels of creativity and innovation that have changed the course of development of particular products at particular times. But this tells us more about the products than the motivations and the processes of the people involved – apart from the few ‘celebrity’ innovators who instigated the step-changes (or possibly major mutations) that changed the course of history of that particular product. What can be gleaned from such insights about the motivation and the designerly well-being of those who (to use Thistlewood’s categorization) made minor modifications to an ‘archetypal’ product or who created new products within an explicit historical continuum? How does understanding these categorizations help us as design educators?

There is undeniable value in a ‘learning through objects’ approach to the curriculum. A great deal of understanding can be gained about the social, economic and cultural context in which objects have been developed and utilising Thistlewood’s categorization provides a useful framework for design education. However, there are also dangers lurking in such a route. These can be evidenced by looking at the outputs from some design curricula – wherein learners are all following a basic product template to which they can add their own minor modifications in the shape of colours, materials, or personalising one small aspect, or where the starting point for design activity is to analyse particular products and/or design styles, resulting in replicatory or derivative outcomes. Whilst in the hands of a good teacher both approaches may result in learning taking place, to what extent is the learning activity an optimized one that is this really nurturing the designerly? In addition to the danger of everything graduating towards the ‘norm’ – or to (willfully corrupted) Langrish’s ‘unsteady state’, how likely is it that the process learners have been engaged in has been as satisfying as that characterized above by Whitehead? For me, two things are missing. One is the opportunity to flex and develop creativity and innovation (possibly Doyle’s technicity and Langrish’s recipemes). The second aspect missing is the broader socio cultural context – and the challenge of engaging with the range of conflicting value positions that might be embedded in the design challenge – Langrish’s selectemes.

This brings us back to the social responsibility issue. Shannon writing as far back as 1990, in exploring the relationship in design between values, intention and judgment concluded that “design implies accountability” (1990:37). If when nurturing the designerly in general education we pay no attention to this, then we have to assume that this accountability lies with specialist designers – “designer” knows best. Shannon considered that the level of specialization was, indeed, disenfranchising the general population.

'No one *has* to discover or design any longer, and those who might be inclined to are discouraged by the high levels of specialized knowledge required. Many people feel isolated, unfulfilled, unable "to make a difference" ' .
(Shannon, 1990:36)

What he appears to be describing here is the opposite of what I am referring to as designerly well-being. By focusing design challenges on both recipemes and selectemes we stand a stronger chance of developing more rounded, holistic designerly thinkers and doers – possibly bringing together what might be defined as capability and literacy, as suggested by Eddie Norman in the section above. In doing this, we stand the chance of creating a more democratic view of design. We also create the possibility of enabling young learners to develop the experience of dealing with the notion of conflicting values and develop in them a thoughtfulness and sense of responsible design. For me, critical in this is maintaining the relationship between the 'thinking' and the 'doing' – such that young people are able to act as designers whilst critiquing design.

At the outset of this paper, reference is made to the need not just to celebrate the importance of design education, but also to count the cost. This 'counting of the cost' reflects Ken Baynes' suggestion that, given the more disastrous impacts of consumer culture on our world, "designerly thinking – is one of the most dangerous of all human characteristics" (Baynes 2009:5). If product evolution is dependent on human decision making and 'better fit' – literally the survival of the most valued products - then we need to create an arena in which young people can not only question the values of the past, but be equipped with the advocacy to act in designerly ways to influence the values that might be seen as more appropriate to sustainable futures – possibly what Princen (2010) calls 'the new normal'.

The concepts of recipemes and selectemes are useful in providing a framework for considering the ways in which design (and technological) 'literacy' and 'capability' can come together. But the challenge is not to be underestimated – and I believe requires radical shifts towards more critical models of design and pedagogy, alongside more understanding of how humans enact designerly thinking.

3. Modelling the future

Langrish's 4th and 5th requirements were for a system to generate new varieties and means for changing the rules of selection. It is possible to shed some light on these issues by considering how designers do what they do. In particular what is the nature of the dynamic – 'creative' – interactions between what is in the designer's mind and how it is represented – that is modelled - externally. Further, how are the externalised models used to bring others into the design action? These could be members of a larger design team, clients, manufacturers and, of special importance in a democracy, the users.

A key point is that the mind is in no sense an abstraction. It is a physical, biological structure within a living being. Each living being is plugged into and reacts to the environment, which is itself constantly changing. The brain depends on sensory data for its information about the environment and can only respond to the environment through physical actions or, in our own and a few other species, tools. The whole system is dynamic: mind; body; environment evolving together. To capture the reality of this Gregory Bateson (1972) coined an evocative phrase: 'the ecology of mind'. The nature of the human mind is that it is in an ecological relationship with the natural world.

Causal models of the world

Evolutionary biologists describe *homo sapiens* as occupying the 'cognitive niche' in the natural world. In *How the Mind Works*, Steven Pinker (1997) highlights the way our 'big brain' operates within and on the surrounding environment. Its unique capacity – the one which has given us our current dominance – is to be able to construct, manipulate and respond to a cognitive 'causal model' of the world. It is this mental construct, formed from sensory data and experience, which enables us to act in ways which are highly unusual in animals.

Many species display extraordinary powers. Navigation by migrating birds, for example. Dam building by beavers. The social organisation of ants. But these are highly specialised attributes, closely fitting the species involved to one highly defined niche. Humans are unique in displaying more generalised kinds of intelligence. The 'cognitive niche' provides for more than a single pattern of behaviour. Its strength and effectiveness is that it can produce behaviours which change creatively to fit changing circumstances.

Pinker writes:

'The manipulations [used by people] can be novel because human knowledge is not just couched in concrete instructions like "How to catch a rabbit". Humans always analyse the world using intuitive theories of objects, forces, paths, places, manners, states, substances, hidden biochemical essences, and, for other animals and people, beliefs and desires. People compose new knowledge and plans by mentally playing out combinational interactions between these laws in the mind's eye'.

The mind's eye of *homo sapiens* has evolved in such a way that we can remember and model the past, consciously experience the present and speculate and model possible futures. This past, present and future perspective is a powerful cultural construct used by humans to give meaning to their lives and purpose to their social groupings.

It is easy to see the importance of a 'causal model' of the world for designerly activity. Designerly thinking is the use of mental models to image and develop ideas and proposals for the future of material culture. Designerly thinking is, if you like, a further cognitive niche within the broader cognitive niche represented by *homo sapiens*' big brain. As it turns out, designerly modelling, imagining the future of places, products and communications, is crucial to our occupation of the broader cognitive niche and our unique situation in the natural world. The designers' niche clearly relates to Doyle's technicity but of course uses many forms of communication in addition to drawing, vital though this has been.

Using a causal model to second guess events in the natural world is one thing: it was a step change in evolution to attempt to create a made world within the natural world, a world specially adapted to the needs and desires of our species. At the deepest level this is exactly what design activity is about. Physical adaptation of the environment depended on the use of tools, power sources and control mechanisms. Social and cultural adaptation of the environment depended on the use of symbolism, aesthetic qualities and the understanding of motivation and aspiration. The adapted environment created by humans is itself a source of evolutionary change, providing hugely improved diet, extensions of human capacities and more and more time in which to expand and utilize the cognitive capacity of that extraordinary big brain. Even more time to devote to designerly thinking and the realisation of the world open to human control.

It is salutary to recognise that our 'big brain' is not a reliable creator of causal models. Over history our minds have constructed some highly erroneous causal models. Dreams of the future have sometimes proved to be nightmares. Humans have been prone to devote their lives to utopian or ecstatic visions of the future and to expend much savagery in trying to force others to believe the same. Europe in particular has been riven by such competing causal models leading to years of warfare and human suffering.

On a less catastrophic level our causal models of the natural world and our own bodies have changed only slowly. The emergence of new models often meets cultural resistance and this process is strongly present in the world today. Even the idea that our minds are at least partly the way they are because of evolution and the physical structure of the brain is not a wholly accepted causal model.

Causal models are not given. They have to be created and preferably tested against experience and their usefulness. To my mind it remains an open question whether or not the experiment of building a human-made environment within the natural world can be brought to a happy ending.

Designerly models

Anyone engaging in design activity needs to use 'causal models' because what is being envisaged does not yet exist. So far, it has not been easy to characterize

what the designer 'sees' in the mind's eye but we know that writers think in words and musicians in music. There is good evidence that engineers have been able to manipulate structures and gear trains in their heads and that a genius such as Brunel could literally 'see' the course of the future Great Western Railway as he rode his horse up the Thames Valley. Much more modestly, I can take a mental walk round an exhibition I am designing and get some sense of the impact it will make: I can make mental changes if I don't like it.

In fact non-designers also have to use designerly models. They are essential in order to navigate and understand the designed world. People use them regularly to plan ahead for the future of their own personal environments and needs: bedrooms; houses; vehicles; gardens and again as citizens when community projects are planned. Today design understanding is needed in order to consider new national enterprises such as the UK Government's proposal for the high-speed railway. What could life be like in the future? That's the question designerly models try to answer. You could say that they attempt to foresee and direct our evolutionary development within the environment we have made for ourselves. So far as I know, the typology of mental and externalised models is not well developed. We can however deploy some useful definitions, which, as it happens overlap.

What is a MODEL? As used here it is something which stands for something else: for example a drawing for a product or a mathematical formula for the future performance of a structure. MODEL in this sense is identical with its use in Science and Mathematics. Design activity frequently uses language and number as modelling or explanatory media. Number is crucial in predicting the performance of structures and machines and for giving quantitative reality to the design proposals. Language is often used for explanations and for persuasion, for explaining the values of the project and for bringing the future alive as a narrative. Words and numbers are involved in trying to establish the economic and social outcomes of the proposals.

However, as Langrish and Thistlewood both understood, design also deals with aspects that cannot be modelled in words and numbers. Spatial relationships, physical properties and aesthetic meanings can only be handled in those media which design has made its own: drawings; plans; mock-ups; prototypes; scale models; simulations; story boards; thumbnails; mood boards and hundreds of others. What more precisely is it that they can model that cannot be done in other ways. Here are some examples:

COLOUR
SPACE
FORM
MOVEMENT
STRUCTURE
DISTANCE
PROXIMITY
TEXTURE

PATTERN
RELATIONSHIPS
SCALE
PROPORTION
VISUAL RHYTHM

To these essentially visual/spatial properties we could add those to do with sound/noise and, indeed, any properties of the natural or made world that impact on our senses and so our minds and behaviour. For the designer these properties underlie and translate precisely into the specific forms and constructions found in of the made world:

LANDSCAPES	ROAD SYSTEMS
TOWNSCAPES	VEHICLES
TOWNS	CLOTHES
VILLAGES	MACHINES
HOMES	EQUIPMENT
PUBLIC BUILDINGS	ENTERTAINMENT MEDIA
SHOPS	GRAPHIC IMAGES
PRODUCTS	

A further list would move from abstraction and physical things to deal with qualities which people might value in their own lives.

PRIVATE	METROPOLITAN
CONVENIENT	RURAL
BEAUTIFUL	HIGH-SPEED
EXCITING	GLOBAL
IDENTITY	LOCAL
TRADITION	GREEN
MODERN	RESPONSIVE
PROGRESSIVE	COMMUNAL
COST	CLEAR
PURPOSE-BUILT	SIMPLE
HOME MADE	EASY TO USE

Being able to model such humanly-significant aspects of the made environment is what makes possible the creation of a humanly-significant environment within the natural environment. Designerly thinking is essential to human evolution because it can create 'causal models' of an environment adapted to the specific needs of *homo sapiens*.

Step changes

In *homo sapiens*' short history there have been significant step changes in the evolution of modelling capacity. The invention of writing and the use of number are powerful examples. The development of objectively accurate systems for maps and plans is another. Baynes (2009b) argued that the Industrial Revolution depended for its inception not only on economic and technological changes, but also – and crucially – on the creation of new modelling media in which to design revolutionary machines and engines. Engineering drawing was the project

modelling medium for Nineteenth century industry and it is possible to trace its intellectual roots back through the Enlightenment to the re-discovery of perspective in the Renaissance.

All step changes in modelling media appear to have one thing in common. Writing in *Design Methods*, J C Jones (1970) said of Nineteenth century 'design by drawing' that it 'increased the designer's perceptual span'. To this we could add that by increasing the designer's perceptual span it also increased society's collective perceptual span. Although the immediate effects of 'design by drawing' were within industry, they facilitated the division of labour in manufacture, the creation of wealth on an unprecedented scale and the creation of a completely new kind of environment: the modern city. People living in the Nineteenth century knew that they had at their command 'causal models' geared to innovation and, as they saw it, progress. Their perceptual span stretched into the future and they began to take it for granted that they could master the environment. It is no accident that the first stories of space travel emerged at this time.

A further step change is being brought about by the computer. In evolutionary terms, computing is extraordinarily new. Yet it is dramatically relevant to the cognitive niche and the designerly niche within a niche. Digital modelling has not only exponentially increased the designers' perceptual span, it has the potential to make the means to model alternative futures available throughout society.

The Twentieth century saw the rapid development of broadcast mass media. Film, TV and mass publishing all handled ideas about the future. It is claimed, for example, that the British weekly *Picture Post* was partly instrumental in creating the popular vision of 'modern' Britain that ultimately helped a Labour government to power in 1945. Similarly, *Woman* magazine, at the height of its influence in the 1940s and 50s had a circulation of 3.5 million and a readership more than twice that figure. It reflected particular aspirations about domestic life but equally helped to form its readers' views about lifestyle.

These media were what we might call 'normative'. They were also 'formative'. They set out to represent shared values and gave visibility to widely held ideas and ideals about the future. They were centralized and industrial in scale.

By contrast digital media are dispersed and accessible. They are capable of representing an extraordinary variety of views and viewpoints. They are multifaceted as opposed to normative. However, they can be powerfully formative, allowing diverse groups to come together to support a campaign or viewpoint. Most significantly they are powerfully egalitarian and subversive, operating in personal dimensions beyond the direct control of state, corporations or institutions.

Digital media are a step change in the scope and complexity of the made environment. They envelop *homo sapiens* even more fully in an environment designed to reflect humankind's desires and values. Possibly, the existence of virtual worlds is simply the next stage in the creation of a made environment within but separate from the natural environment. Its creative potential as a medium for the 'big brain' is as yet unknown but the prospect is exciting. The irony is, however, that virtual worlds exist within a natural world that is directly threatened by humans.

In a recent seminar series Baynes (2009, 2010) described our ability to use mental and physical models as a medium for changing the environment as 'one of the most dangerous of all human characteristics'. Digital media simply multiply our 'perceptual span' to a new level of scale and scope. The predictive quality of our 'causal models' has never been more important. Designery thinking will determine the success or failure of the evolutionary dynamic between *homo sapiens*, the made and natural environments.

There are important implications for education. Most obviously, the need to teach designery thinking and to help children and young people navigate and understand the potential and limitations of the causal models we use to make visible proposals for the future. There is here a challenge to traditional pedagogy in Design and Technology and more broadly to teaching across a number of subject areas: Art and Design; Mathematics; Geography; History and, of course, Science.

4. Some reflections for the TL&T2010 Conference

The 2010 *Technological Learning & Thinking Conference* has set out a challenging agenda.

Technological accomplishments characterize and transform cultures, and yet their relevance is undervalued and their place remains obscure in today's learning institutions, in government policy, and in the public mind. With implications for culture, design, sustainability, and ingenuity, the conference and exposition explore how technological learning and thinking are celebrated, dismissed, taken for granted, or mystified. What mechanisms work for, or against, the integration of technological learning and thinking in democratic societies? What are their implications for culture, design, sustainability and ingenuity? What is the nature of technological learning and thinking?

This paper set out to address aspects of this agenda by exploring the credibility of a neo-Darwinian model of design education. If it is a credible causal model, then it is powerful, in the same way that Darwin's extraordinary insights provided a framework for unifying and exploring the science of Biology. Darwin's essential thesis was that through understanding some fundamental rules governing living

processes, major biological phenomena could be understood. Can then some of major issues challenging design and technology educators be addressed through developing understanding of the rules governing the nurturing of the designerly? In particular, can greater understanding of the role of modelling, and those human capacities that make it possible, lead to the articulation of such rules? And, if so, can some of the risks that arise from nurturing the designerly be mitigated to better support the prospects for sustainable human futures? We hope so.

References

Abu-Risha M (1999) *Purposive pattern recognition*, PhD thesis, de Montfort University

Bateson G (1972) *Steps to an ecology of mind*, University of Chicago Press, USA

Baynes K (1992) *Children designing*, Department of Design and Technology, Loughborough University, UK

Baynes K (1994) *Designerly play*, Department of Design and Technology, Loughborough University, UK

Baynes K (1996) *How children choose: children's encounters with design*, Department of Design and Technology, Loughborough University, UK

Baynes, K (2009) *Models of change: the impact of 'designerly thinking' on people's lives and the environment. Seminar 1: modelling and intelligence*, Department of Design and Technology, Loughborough University, UK

Baynes, K (2009) *Models of change: the impact of 'designerly thinking' on people's lives and the environment. Seminar 3: modelling and the industrial revolution*, Department of Design and Technology, Loughborough University, UK

Baynes, K (2010) *Models of change: the impact of 'designerly thinking' on people's lives and the environment. Seminar 4: modelling and society*, Department of Design and Technology, Loughborough University, UK

Craft, A. (2001) 'Little c creativity'. In A. Craft, B. Jeffrey & M. Leibling (Eds.), *Creativity in education*. London: Continuum.

Cross, N. (2004) 'Expertise in design: an overview'. *Design Studies*, 25(5), 427-441.

Csikszentmihalyi, M., (1996), *Creativity: Flow and the psychology of discovery and invention* Harper Collins, Michigan, USA

- Dasgupta S (2004) 'Is Creativity a Darwinian Process?', *Creativity Research Journal*, 16(4), 403-413.
- Dawkins R (1976) *The selfish gene*, Oxford University Press, 189-201
- Doyle M (2004) 'The evolution of technicity: whence creativity and innovation?'. In Norman E W, Spendlove D, Grover P and Mitchell A eds. *Creativity and innovation: DATA International Research Conference 2004*, Design and Technology Association, Wellesbourne, 67-72
- Hirst, P., (1974) *Knowledge and the curriculum: a collection of philosophical papers*. Routledge and Kegan Paul, London, UK
- Jones J C (1970) *Design Methods: Seeds of human futures*, Wiley Interscience, London
- Langrish J Z (2004) 'Darwinian design: the memetic evolution of design ideas', *Design Issues*, 20(4), 4-19
- Langrish J Z (2006) 'Natural selection and the history of design: Darwin not Spencer', *Design History Society Conference: Design and Evolution*, TU Delft, [CD-ROM]
- Norman E W L (2000) 'The teaching and learning of technology for design'. In R Kimbell (ed) *Design and Technology International Millennium Conference 2000*, The Design and Technology Association, Wellesbourne, UK, 128-134
- Norman E W L (2006a) 'The evolution of the guitar as a product species'. In de Rijk T and Drukker J W, eds. *2006 Design History Conference: Design and Evolution*, Delft University, 1-22 [CD-ROM]
- Norman E W L (2006b) The Professor John Eggleston Memorial Lecture 2006: Values, human judgement and sustainability in design and technology education, *Design and Technology Education: an International Journal*, 11 (3), 11-34
- Norman E (2007) 'A neo-Darwinian view of technological literacy: a curiosity gene, technicity and 'learning by doing''. In Dakers, J.R., Dow, W.J., and de Vries, M.J. eds. *PATT 18: Teaching and Learning Technological Literacy in the Classroom*, Faculty of Education, University of Glasgow, 365-362
- Petroski H (1993) *The evolution of useful things*, Pavilion Books Ltd, London
- Pinker S (1997) *How the mind works*, Norton & Co, New York
- Princen, T, (2010) *Treading softly: paths to ecological order*. MIT Press, Massachusetts, USA

Shannon, M (1990) 'Towards a rationale for public design education', *Design Issues*, 7(1, Educating the Designer), 29-41.

Stables, K., (2008) 'Designing matters; designing minds: the importance of nurturing the designerly in young people'. *Design and Technology: An International Journal*, 13(3), 10-18

Thistlewood D (1990) 'The essential disciplines of design education', in D Thistlewood (ed), *Issues in Design Education*, Longman, London,14-29

Whitehead, A. N. (1929). *The aims of education and other essays*. New York: The Free Press.