

42 Abstract Train of Thought



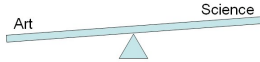














K.V. Nesbitt

Using visual forms to represent information, for the purpose of discovering patterns, or meaning, is a common theme for both artists and scientists. This exhibit examines the close links between art and science in the computer science field of *Information Visualisation*. Scientists in this field must deal with many of the same issues of perception and cognition that interest artists. These issues include the design of space, colour composition, the use of gestalt and the way symbols are interpreted.

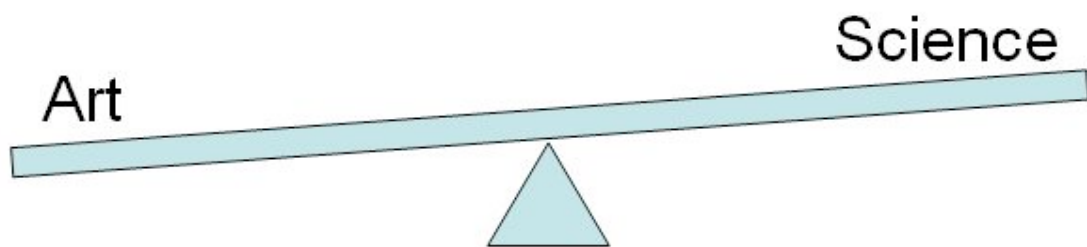


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The Art and Science of Visualising Information



The Art and Science of Visualising Information

Information Visualisation is an emerging scientific discipline that turns abstract data, such as, information from the stock market, into a graphical form. The intention is to take very large amounts of data (numbers) and create a picture that can be analysed for useful patterns. In the case of the stock market data these patterns could allow for successful trading on the market. This process of searching for useful patterns in a display has also referred to as 'visual data mining' as the viewer of the display is 'mining' the data for ideas. Despite being more constrained, the search for useful patterns in such 'scientific' displays has much in common to the search for patterns that some painters look for in their 'artistic' displays.

In terms of Information Visualisations, many people are familiar with graphs, pie charts or histograms of data. Such visual displays of abstract data are a surprisingly recent event in human history. The first such displays are attributed to William Playfair whose work entitled "*The Commercial and Political Atlas*", was published in 1786. The closely related field of cartography is a more ancient art. The first map of a Babylonian city is dated to around 6,200BC and the first map of the world was created into ancient Greece in around 550BC. Maps overlaid with more abstract geographic data arguably provide the earliest foundations for today's more abstract information displays where information is mapped to spatial structures and make use of both colour and symbols to add meaning.

The field of Information Visualisation is based in computer science, but is cross-discipline in nature, crossing over into the diverse fields of mathematics and human perception. Practitioners also benefit from a general knowledge of visual design principles more frequently associated with art and design. More 'artistic' or intuitive leaps are also required by scientists when deciding on the best mapping from the data to the visual elements of the display.

As with art, designers in the field of Information Visualisation must deal with the way humans 'perceive' information. The key to understanding the possible ways to represent the data is to be familiar with the various "units of perception". However, the designer must also understand the viewer's higher mental processes since displays are often designed to enhance the viewer's cognitive powers. Cognition and perception are closely related and both are important in determining how a viewer interprets "meaning" from the display.

The scientist of information visualisation is typically more constrained in design than the artist as there is the requirement to carefully consider the task for which the display is being designed. The type of data available and its priority in relation to the task are also essential considerations. But just like the artist, the scientist must consider how the viewer will interpret the colour, line, symbols and spaces in the display. Therefore ideas, such as, *colour theory* and *gestalt*, *metaphor* and *semiotics* all play an important role for the scientist, just as they do for the artist.

The artist in this exhibit has recently completed a Ph.D. Thesis entitled "Designing Multi-Sensory displays of Abstract Data". The thesis explores the design of multi-sensory displays for finding useful patterns in abstract data. The thesis deals with not only the visual design space but also the auditory and haptic (touch) design space. The thesis is directed to computer scientists, however, during this scientific work, a number of more "artistic" projects were used to explore the same principles. The paintings in this exhibit capture the more "artistic" trains of thought running through the thesis.

Some of the relationships between the art and science are obvious, while others are more subtle and require some explanation. This exhibit is designed to present those paintings from both an artistic and scientific perspective. An explanation of the theoretical grounding from

the scientific field of Information Visualisation is provided, along with a more artistic interpretation.

For this artist the process of picture making also acts as a tool for data-mining his own mental processes. I describe this as finding 'patterns in my deepest thoughts' or 'data-mining the soul'. For me, the act of making the pictures is akin to deep meditation and the pictures also come to act as a 'memory cathedral' for my musings. Each brush stroke is a key to my developing database of thoughts. The painting process is very visual and tactile, but because I always paint while listening to music it always becomes a very multi-sensory experience. In this way the database of my ideas seem to become linked to subtle, subconscious, multi-sensory keys. Some thoughts may become linked simply because they overlap in time rather than because of some logical thought processes. In this way, seemingly disconnected ideas become linked by the picture. Whether you think of it as synchronicity or coincidence, the outcome is that typically unrelated viewpoints may be considered simultaneously. This can often lead me to a self-discovery of unexpected patterns in my thoughts.

The exhibit is titled "Abstract Train of Thought". This title is taken from the name of a painting made at the end of the thesis. At the most obvious level it depicts the abstraction process that saw the London Underground Map develop. Early maps of the underground showed the detailed geography of London with each twist and turn of the track depicted and each station placed with careful attention to its real geographical position. Harry Beck who controlled the London Tube Map from January 1933 to March 1960 simplified the map so that geographical relations were maintained but precise geographic details were removed. The result is a map that is no longer suitable for precisely locating the exact position of each station, but is instead, perfectly suited for navigating the London Underground network. The map has been so successful that it is now almost an international standard for showing transport networks and even perhaps of an icon of modern society. Indeed I'm sure Pop artists would have borrowed its imagery if such metro maps had been as prevalent in their time as they are now.

The London Metro map is often touted as an excellent example of the principles of Information Visualisation. Coincidentally, the metro map is metaphor is a particular favourite of my Ph.D. supervisor, Peter Eades. At the time of writing my thesis, one of the issues we were struggling with was how to present the 'roadmap' of my abstract ideas contained in the thesis. That is, how to visualise the information that was the thesis itself in such a way that first time readers could navigate the interconnected thoughts. I had just returned from London where I was using the Metro map frequently. I was also commuting from Newcastle to Sydney on the train to spend time with my supervisor. It was during these train trips that all my tracks of thought collided and I decided to draw my thesis as an underground map. It took a few trips and I had to buy some colour textas but the outcome was the metro map of my thesis.

Recently this visualisation was chosen by the University of Indiana in the United States as one of the top ten works of both cartographic and information science mapping and is being featured in an international exhibit.

The exhibit for the HR Gallop Gallery includes twelve works and a 42 minute movie for the plasma screen. Some consistent 'trains of thought' in these works are the idea of abstraction, information landscapes, finding patterns, and the use of metaphors. The show for the plasma screen describes the 'scientific' development of stock market landscapes for the purpose of finding patterns in stock market data. The electronic display is augmented by more 'artistic' animations and musical works that provide an alternative look at the same ideas. For each work on display there is a description of both the science and art.

City Escape



City Escape (1992)

(Oil on canvas)

Although "City Escape" was painted a long time before my thesis work began. I choose to include it in the exhibit because it brings to mind a familiar metaphor that was later to be used in information visualisation. That metaphor is called the cityscape.

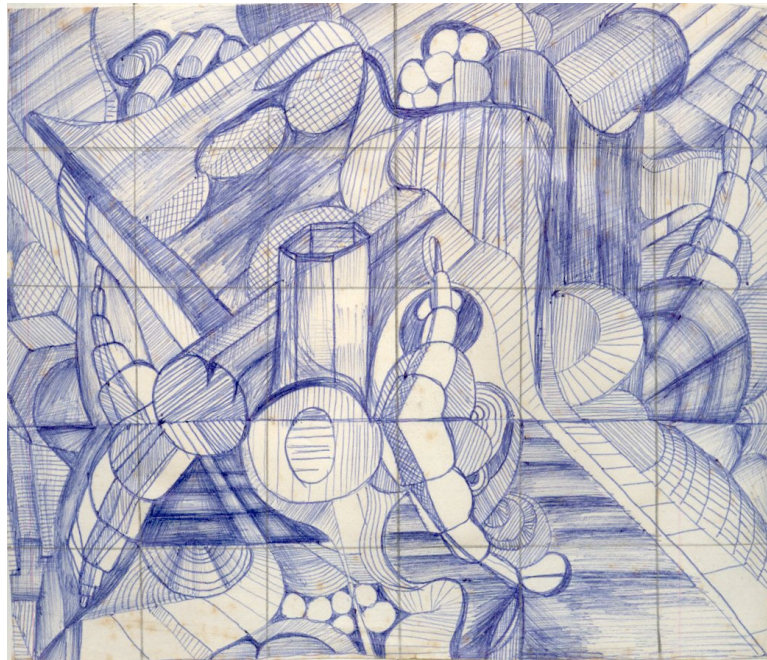
The idea is that abstract data, such as stock market data, can be mapped to the typical elements of the city. For example, the height of a building can represent some important attribute of the data such as price. Likewise the width or general shape of the building, perhaps the construction materials, the number of windows or even it's location within the city can represent some other aspects of the underlying data. In the case of stock market data, stock volume or price momentum might be represented in the visual attributes of the building. Other aspects of the market might be encoded in the arrangement of buildings. For example all resource stocks might be in the same part of town.

Metaphors are an important idea in information visualisation as they provide a familiar structure or model that people using the display can relate to. This can assist the viewer to navigate and interpret relationships in the data. Because abstract data has no real structure it can be very difficult to navigate and interpret if no order or model is imposed on it. Unfortunately metaphors or models can also be constraining and force the viewer to see the data in only the limited way provided by the designer. One way designers overcome this problem is to design some level of interaction. This allows the viewer to control or experiment with the final mapping of data to the individual parts of the picture. But in summary, the basic idea is that a person can move naturally through the familiar city landscape and perhaps uncover unexpected patterns in the data using the perceptual inferences and experiences they have developed from interacting with a real city environment.

City Escape

A jungle of rising steel
and the layers of hard grey
blend into the sensual curve
of the deserted freeway lines.

The real world collides
at the corners of imagination
where a promise of blue sky
tempts the unwary to wake
and look for a city escape.



Original sketch for *City Escape*.

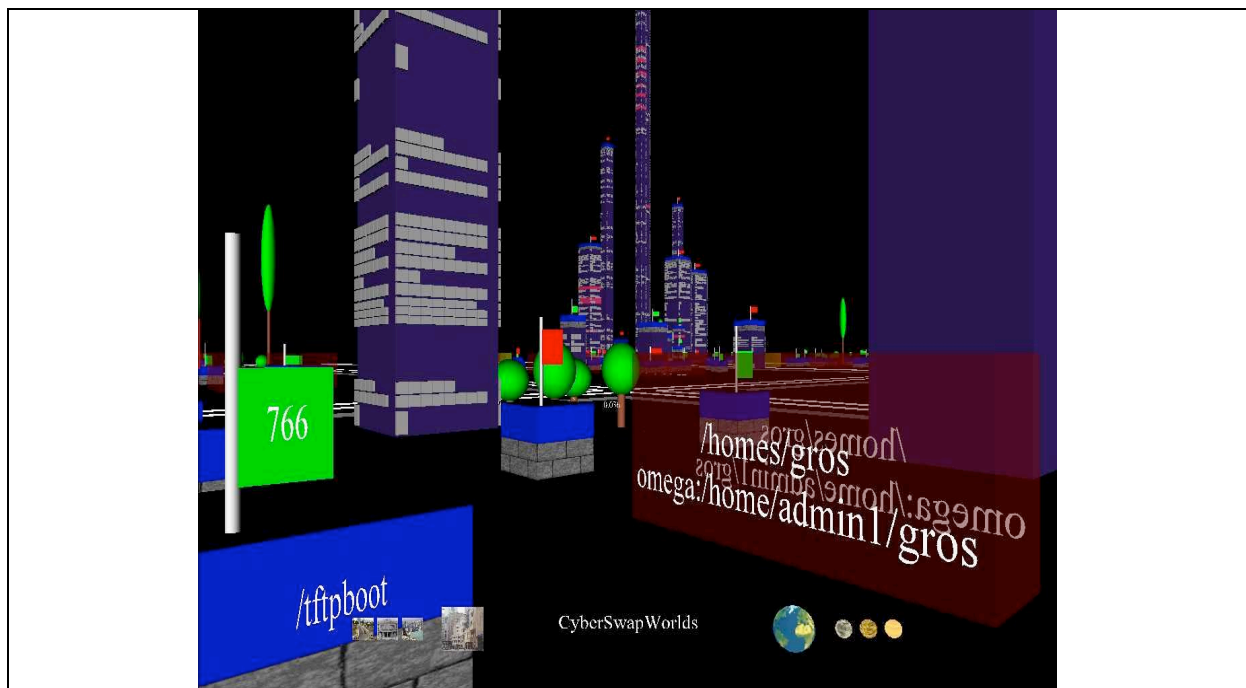
At the time I painted the picture I had no idea where the image came from, I was simply painting an image that had emerged in my mind many years before. It was only later that I realised it was representative of my time navigating the chaotic Sydney cityscape. Between 1978 and 1980 I was studying medicine at the University of NSW. However, I never really got used to the city lifestyle and seemed to be constantly trying to escape the chaos back to the Newcastle beaches of my youth.

City Escape is a good example of what I had come to think of the mixed viewpoints that often make up my pictures. The city image is formed from a juxtaposition of many perspectives. Many people see an influence of cubism, which also presents multiple viewpoints of objects. I can see this relationship but I also see some subtle differences. For example, I am more interested in the way that memory works, the way we recall and identify objects and scenes. I suspect the different perspectives of my pictures assemble themselves in my subconscious. This assemblage is based on memories and structured in a way that is unrestrained by any physical reality. That is, my previously captured viewpoints arrange together and then unexpectedly emerge as some kind of encoding of the scene.

William Gibson was a science fiction writer who popularised the idea of Cyberspace. The cityscape metaphor builds upon his original vision, described in his 1984 novel, *Neuromancer*.

"A graphic representation of data abstracted from the banks of every computer in the human system. Unthinkable complexity. Lines of light ranged in the nonspace of the mind, clusters and constellations of data. Like city lights, receding." [Gibson 1984].

At the time of my thesis, I happened to meet a researcher, called Cristina Russo Dos Santos from the Institut Eurécom in France. Amongst other things Cristina was working on the Cityscape metaphor and below is a picture which shows data about a computer network after it was mapped to the cityscape metaphor. This is very much a realisation of William Gibson's cyberspace vision. It was about this time that I made the connection between this particular painting and the ideas of a cityscape metaphor.



Network Data represented as a Cityscape, C. Russo Dos Santos, Institut Eurécom, France

Ride on Wave of Magic



Ride on Wave of Magic (1979)

(Oil on shaped canvas)

While most pictures in the exhibit were painted during my Ph.D. (Permanent Head Damage) time, this picture was made much earlier. I included it because it introduces the concept of time. *Temporal* metaphors along with *spatial* and *direct* metaphors form the basis of my approach to designing information displays. The idea behind these three categories is relatively simple and is typical of the type of abstraction that often occurs in the field of software engineering.

Spatial metaphors concern the way our senses interpret spatial properties such as position, scale and orientation. These spatial concepts are independent of each sense, though the different senses perform differently at interpreting things like size and position. Because spatial properties relate to structure and scale many painters and architects also work within the design space covered by spatial metaphors. The eyes ability to detect and analyse spatial relationships is a critical factor in determining the effectiveness of visual displays. Therefore when designing either an information display or a picture it is the spatial metaphor and in particular structure that I focus on first.

When a picture emerges in my mind's eye it is only ever represented as an arrangement of spatial structures. The colours seen in my picture are always dreamed consciously. Colour is a good example of a direct metaphor. Direct metaphors are particular to each sense, and depend predominantly on the properties detected by each sense. With visual displays, colour is a commonly used property for displaying information. For example, some value of the data is simply mapped to the colour of an object. When looking at the display, the colour of an object then infers the underlying data value.

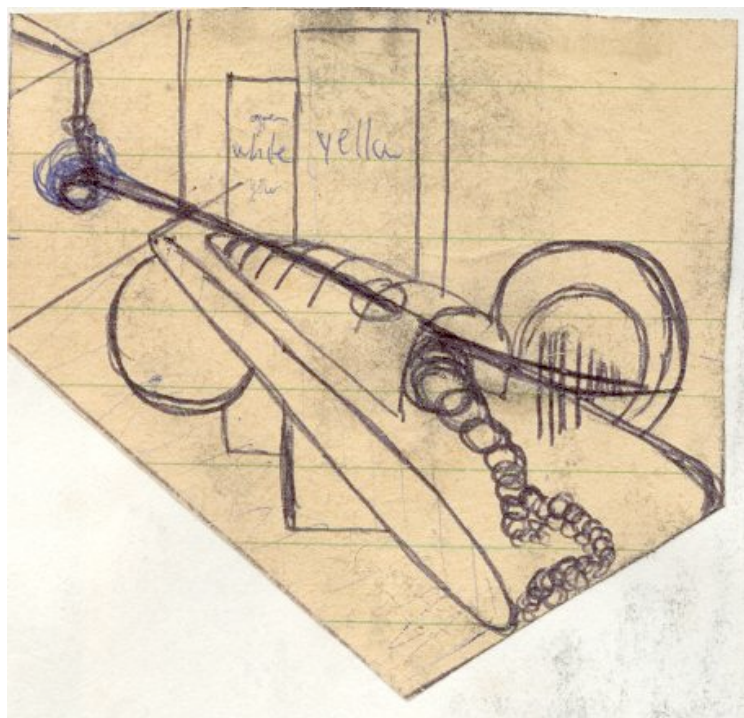
Temporal metaphors concern information that is inferred from the relationship between events occurring over time. For example, a noise that occurs at regular intervals, perhaps every two minutes, can suggest a simple temporal pattern. There are a number of ways that time is important for designers of information designers. Much abstract data that is collected is associated with the time that data was recorded. The time the data occurred is often critical in understanding how patterns in the data have evolved. One common approach is to map time to space (much like Picasso) and hence allow the eye, which is very good at detecting spatial patterns to interpret part of the static space as time. Another approach is to let the display evolve over time, like an animated series of events that allow the eye to interpret the changes. Concepts such as rhythm and meter are familiar to musicians and poets and cover the same design space described by temporal metaphors. Indeed the auditory sense is superior to the eye at detecting fine scale temporal changes.

While painters design with a mix of spatial structures and direct visual metaphors, musicians combine temporal structures with direct auditory metaphors (volume, pitch, timbre). Each of the paintings in the exhibit also has a song associated with it. When the initial picture emerges I am curious to understand its deeper "meaning". Some of the symbols by themselves are simple to interpret in relation to my conscious thoughts however the combined image is often very mysterious to me. To help in the interpretation I usually write a lyrical description of the work, try to capture more of its ghost in a slightly more conscious way. Sometimes the lyrics are almost as confusing as the picture itself. But I do get a sense that these words come from a different part of my mind compared to the pictures and hence create another viewpoint that I can use to decipher the meaning or if you like, to try and find a pattern in my ideas.

The song for the picture can be seen during the intermission part of the Underground movie. Apologies in advance if you don't like the retrospective 1970's style of the song. However that's when the picture was painted and the song was written. It somehow needed the psychedelic feel of Jimmy Hendrix and Aldous Huxley's, *Doors of Perception*. I interpret the work to be about the way new ideas emerge from the underground tunnel of our subconscious, that is, from behind the doors of perception.

This painting is somewhere between my abstract and figurative styles and was my first use of a shaped canvas. When I drew up this picture the space in the composition naturally suited the odd shape. The design of the overall display space of the picture, even with rectangular pictures, is important for context. It creates an interaction between the space in the picture and the space that surrounds it. These two aspects are emphasised when the canvas is shaped and the painting also becomes sculptural.

The work I'm most familiar with that also features shaped canvases is that of Ellsworth Kelly, although it was only much later that I discovered his work at the Guggenheim. At the time I started this work I was surprised that my non-artist friends never thought about the shape of a picture and how the space that surrounds it impacts on composition. It's as though they were all culturally conditioned to expect a rectangular window and to ignore any space outside the frame. Designing the display space gradually became more important in my work. At the very least I hope it forces the viewer to rethink the idea that pictures have a natural rectangular shape. On another level it is about the context of all our perceptions. That is, how all our thoughts live in a context of previously developed patterns, and how we frequently forget they exist when we express our views.



Original sketch for *Ride on Wave of Magic*

Ride on Wave of Magic

Been hidden forever in a shadow.
What lies inside that tunnel?
See it moving with the motion,
of water through a funnel.

Lying aimless in a red sun
How grows that strange new flower?
Standing still inside the gale,
planted in the tower.

Ride on wave of magic.
Ride on wave of time.
To close your eyes is tragic.
To close your eyes is blind.
You ride on a wave of magic.
You ride on a wave of time.

Flying arrows lead away of in.
What lies in each direction?
Some that point to danger,
some leading to protection.

Your eye must find the true course,
What lies in each new plane?
Following all the visions, meet like
corners on a frame.

Fire, Earth, Air and Water

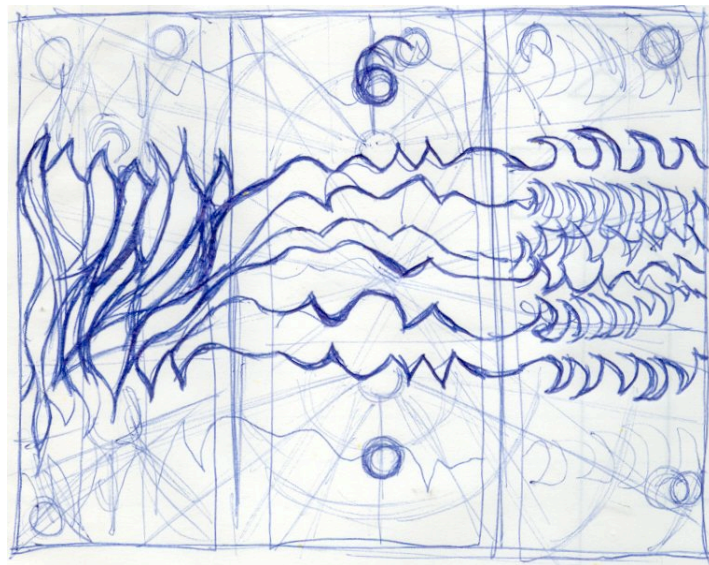


Fire, Earth, Air and Water (1997)

(Oil on canvas, triptych)

Fire, Earth, Air and Water was also painted just before my thesis officially began. However, at this time I was a research scientist at BHP Research and had already begun working in the area of multi-sensory displays. I was struggling with the many disparate and specialised fields of knowledge that this area encompassed. I was trying to build a simple model in my mind for understanding the many complex issues that had to be dealt with by the designer of such multi-sensory displays.

For me the key to this picture is about the process of abstracting knowledge. For example, taking the known world and generalising it into a very simple model. It is quite common in our modern world to have very complex models or metaphors to describe fields of knowledge. Indeed the complexity of human knowledge is today categorised by extreme specialisation, rather than generalisation. With this picture I wanted to return my mind to a simpler model of the world, one that had been common, quite generic and also very useful for classical Greece. If you wish, this was an abstraction back to an early metaphor or model of human thinking.



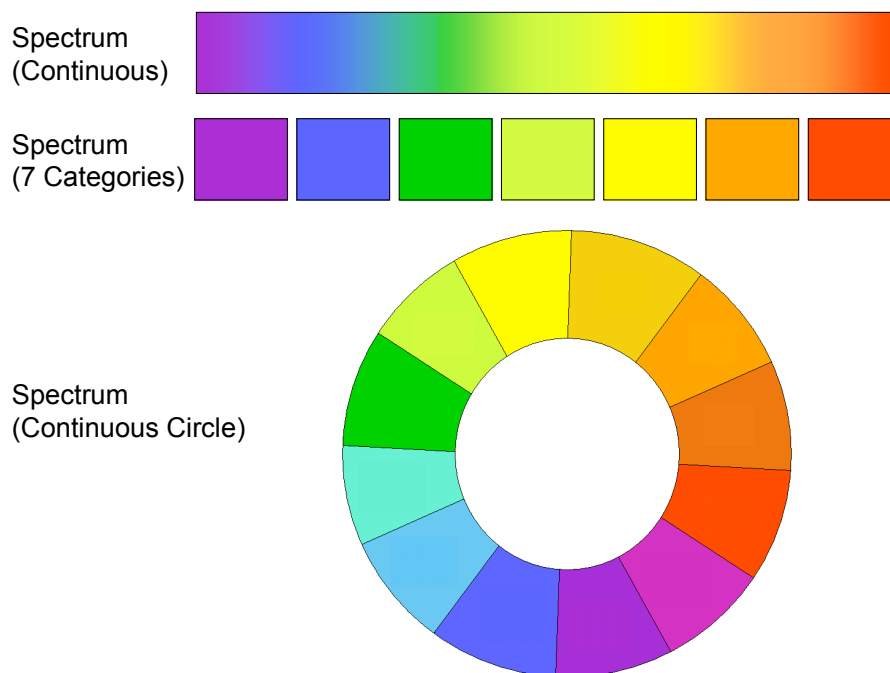
Original sketch for *Fire, Earth, Air and Water*.

The whole universe is captured in three simple pictures based on the four elements of fire, earth, air and water. In ancient Greece this model was a powerful cognitive tool that could even be used to describe human nature. With only these four elements, Greek scientists were able to develop quite sophisticated principles of science and engineering. They could, for example, build coin-operated holy water dispensers for their temples. So in these simpler times, these four elements were enough to describe the known world in a single model. This metaphor seems somewhat primitive, even farcical today when we have fractals and chaos, thermodynamics and intricate mathematical models made of strings.

In my thesis I would also attempt to develop a new abstraction or model of the multi-sensory design space. I was hoping to develop a new and simpler model for understanding the complex design space that designers of information displays must contend with. This would eventually lead to a taxonomy made up of the units of human perception. The taxonomy is

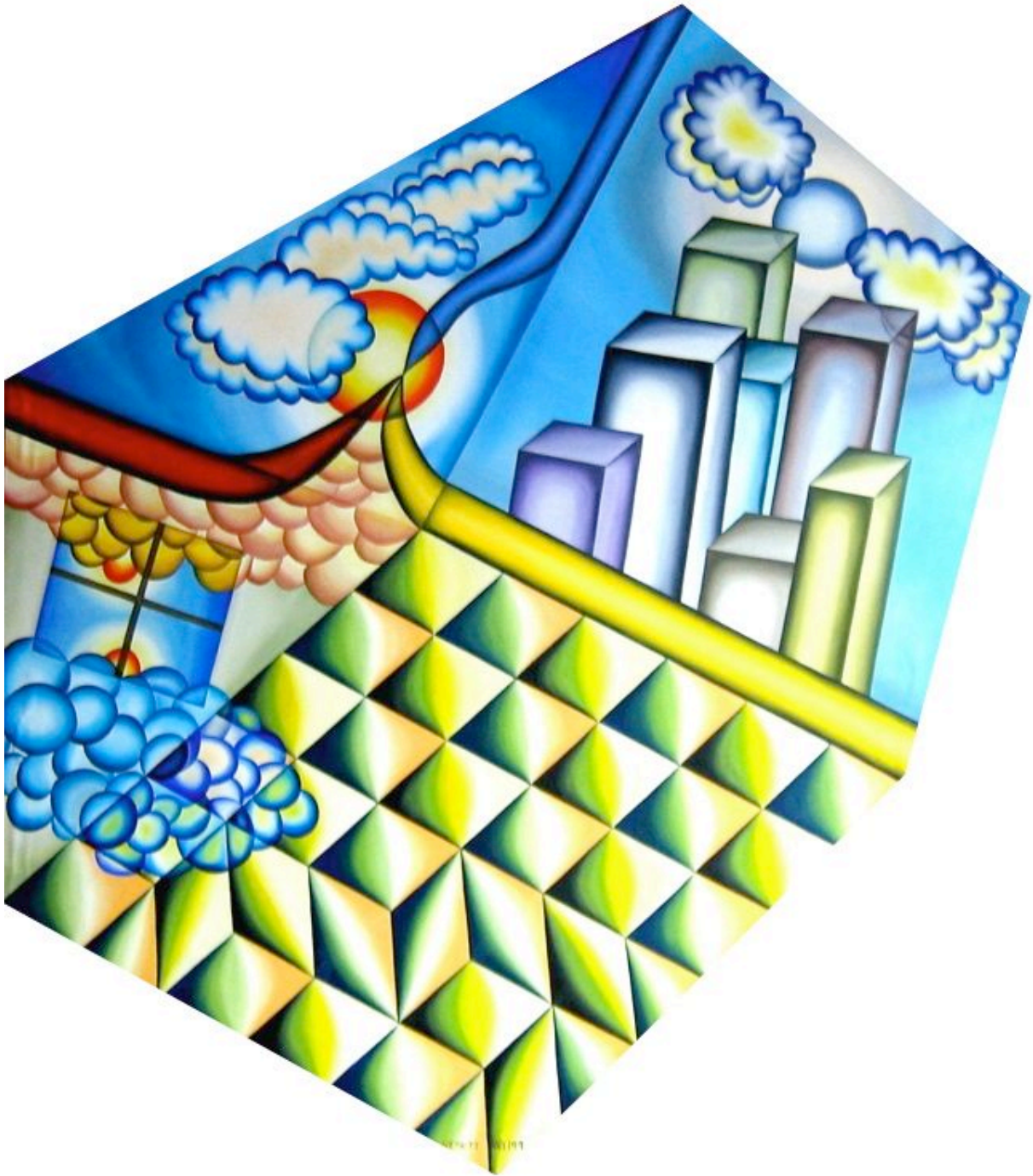
very simple at its highest most abstracted levels yet at the lowest level retains the detail and complexity you might expect when dealing with complex issues of perception and cognition.

The colour scheme of painting borrows from another simple and familiar metaphor, namely that of the rainbow. The rainbow is also a common direct visual metaphor that is used in information visualisation. Data can be mapped in an ordered way to a range of colours in the spectrum. For designers of an information display the spectrum provides a useful tool for designing displays. It can easily be adapted to represent both a continuous range of data values and also discrete unordered categories of data. There is a naturally ordering in the spectrum, although people don't generally perceive a linear ordering from red (low) to violet (high) but rather a circular continuum that is often described as a colour wheel.



Colour is a commonly used Direct Metaphor. The values of the data become like colours. There are many different mapping strategies. For example, data can be mapped to the continuous range of hues or perceptually distinct categories.

More Than One Way



More Than One Way (1999)

(Oil on shaped canvas)

This picture was painted at the beginning of my thesis. At the time I was considering alternative models of the multi-sensory design space. While in art it is quite normal to develop your own unique viewpoint, it is typical in science to build on previously proven ideas, perhaps extending slightly on these foundations. However, I felt the existing descriptions of the multi-sensory design space were too strongly divided between the different senses. Specialisation of experts in the field of visual, auditory and haptic (touch) displays meant that existing knowledge was difficult to relate across the sensory boundaries. This made it difficult to incorporate existing knowledge into the design process for multi-sensory displays. Therefore, my thesis began with my search for a new model to categorise the multi-sensory design space. That is, a new way of looking at things.

Having spent many years using the software engineering tools of specialisation-generalisation and aggregation it was natural for me to adopt these tools as a modelling language to describe the design space. The Universal Modelling Language (UML) is a tool commonly used by software engineers to model software. However, originally the ideas behind UML had been developed in the domain of Artificial Intelligence for modelling more general concepts of knowledge. UML is itself an information visualisation, relying on drawing pictures (diagrams) of the abstract concepts being modelled. While the final UML models act as a form of documentation and communication between software engineers, it is often the process of drawing the models that is more important as it is this process that leads to insight into the patterns and structure that will shape the final software.

The final model I developed is called the MS-Taxonomy as it is based on both metaphors (M) and senses (S). However, in my categorisation of the design space, the senses play a more secondary role than was typical in other descriptions of the design space. The most important high-level concepts in the MS-Taxonomy deal with the ideas of spatial metaphors, direct metaphors and temporal metaphors. These three categories of metaphors can be described for each of the three senses and it is the concepts of spatial visual metaphors and direct visual metaphors that are most typified in my paintings.

The most important spatial visual metaphor studied in this picture is the "display space". The display space is the space where the pictorial elements are drawn and provides the context by which the other structures in the picture are interpreted. In this picture the unusual shape of the canvas is a dominate part of the composition, forcing the viewer to consider the actual shape of the canvas when viewing the picture. Many people I meet seem looked into a viewpoint that paintings come in the shape of a rectangle. Some are even genuinely shocked to see "odd-shaped" pictures. I am equally shocked that a new way of looking at things also seems like an unusual activity for them to engage in. I guess unlike me they have outgrown their childhood. In this picture the viewer is forced to try a new view, and must consider an alternative definition of the 'normal' display space.

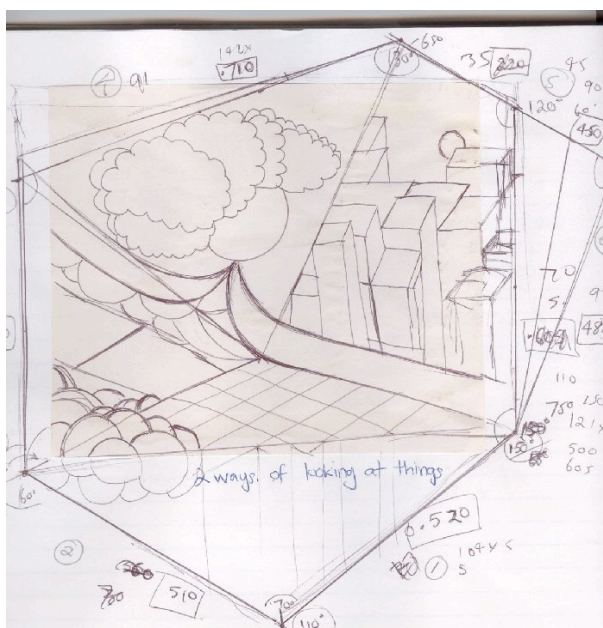
The well-known perceptual illusion created by the cubes in the foreground of the picture reinforces this idea. It was an illusion often used by Escher amongst others, and highlights the important part that perceptual illusions can play in interpreting sensory information. One moment the viewer sees the cubes coming out of the picture, and in very the next the interpretation completely changes so that the cubes seem to recede into the picture. In the design of perceptual displays for scientific purposes it is generally important to be wary of such perceptual illusions and make sure that such conflicting views are not generated.

The design space is also a very important consideration for the designer of an information visualisation. Although it is equally common for the designer to assume or adopt a traditional definition of the space there are a number of options the designer can decide on. All of these decisions about design space can have an impact on how the viewer will interpret the objects in the final display. The painting highlights some key aspects of this design space. The bottom part of the picture is divided into squares suggesting that the space is somehow discrete rather than continuous like the other parts of the pictures. Histograms typically use such a discrete division of space, while scatter plots and line plots typically employ a continuous space. The overall space of the picture is subdivided and this is a common ploy in information visualisation when the relationship between more than two abstract variables needs to be compared. For example, a series of three scatter plots, each showing two variables can be used to compare the relationship between three variables.

Another important consideration for the display designer is the dimension of the space itself. One and two dimensional design spaces have been used in information visualisation and more recently different three dimensional spaces have been tried. With the advent of such 3D spaces, similar issues have arisen for display designers as they often do with artists about how the viewer interprets depth in pictures. The traditional painter's algorithms for creating the illusion of depth, such as shadows, occlusion, atmospheric attenuation and linear perspective all contribute to the interpretation of an objects position in space. In Virtual Reality environments, these two dimensional cues for depth can also be augmented by stereoscopic cues, and if the visual models are interactive, motion cues can also impact on the viewer's perception of depth.

I see the space in my pictures creating an abstract, internal model and though it may mirror my perceptions of the real world, it is not intended to recreate it. Although it is not my primary aim, I often use different perspectives in my pictures that may create some conflict for the user in interpreting the space.

Just as space is a traditional concern of the painter so is way colours are used and interpreted. From the sun the in the top left of the picture emerges a ray of light that splits into the traditional primary colours. This was an intentional reference to the visual direct metaphor of colour which is so important to the designer of visual displays.



Original sketch for *More Than One Way*.

More Than One Way

There's more than one way,
of looking at things.

There is danger and yet relief
inside the wonders
nature's tempest brings.
There's beauty and deception
in the patterns
on a butterfly's wings.

There is reason and no purpose
in all the songs
every spring bird sings.
There is joy and maybe sorrow
in the people
when the chapel bell rings.

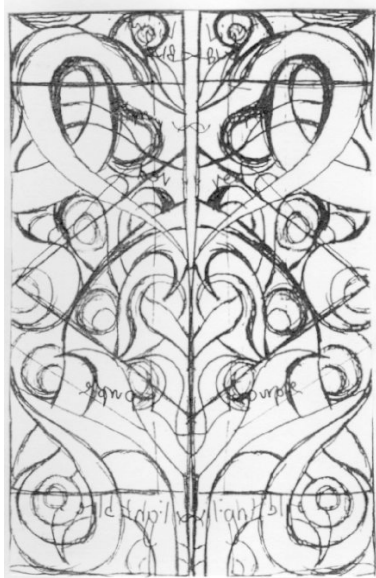
There's more than one way,
of looking at things.

Double Vision, Mirror Image



Double Vision, Mirror Image (1999)

(Oil on canvas)



Double Vision, Mirror Image

Double Vision, Mirror Image.

Picture, picture on the wall.

My eyes are making lines of thought
as coloured shadows fall.

Some of my pictures are composed of identifiable figurative elements. Although I see these more as metaphors or symbols rather than any attempt to capture real world spaces and structures.

In this abstract picture I explore the dynamics between both straight and curved lines. These two elements represent a duality that can be symbolically interpreted as other dualities such as, natural vs man-made, emotion vs logic, art vs science, female vs. male etc. To me it seems edges must be either straight or curved and that this is somehow a fundamental duality.

Edge detection is a well developed function of the visual cortex, with direct 'hardware' support for recognising lines of various orientations. As a painter I find the perception of both curves and straight lines to be bound by certain limits. They do not need to be executed perfectly and the eye is in fact quite forgiving in its interpretation of what is 'straight' and what is a 'natural curve'.

Small errors get overlooked, although there is always a certain point where the flow of the curve or the linearity of the edge becomes unconvincing and suddenly loses some pleasurable aesthetic quality. It is as if the point is reached where the mind can no longer interpret the edge in an automatic way and has to work too hard to convince itself that the edge is satisfying some natural order or principle of constancy.

The interpretation of curved and straight lines is also important in the interpretation of many information visualisations. For example, it is common to map the relationship between two abstract variables as a scatter plot and then look for a linear relation between them. The idea of perceptual constancy is also important for designers of displays. With all the units of perception, the mind attempts to maintain a constant interpretation. Once the pattern or interpretation is established, the stimulus causing the perception must exceed a greater threshold before the change is noticed. For example, if the loudness of a sound is suddenly changed it only requires a small change for the listener to identify the change. However, if the loudness of the sound is gradually changed, a much greater change is required before the listener will identify that a change has occurred. This principle is quite general in perception.

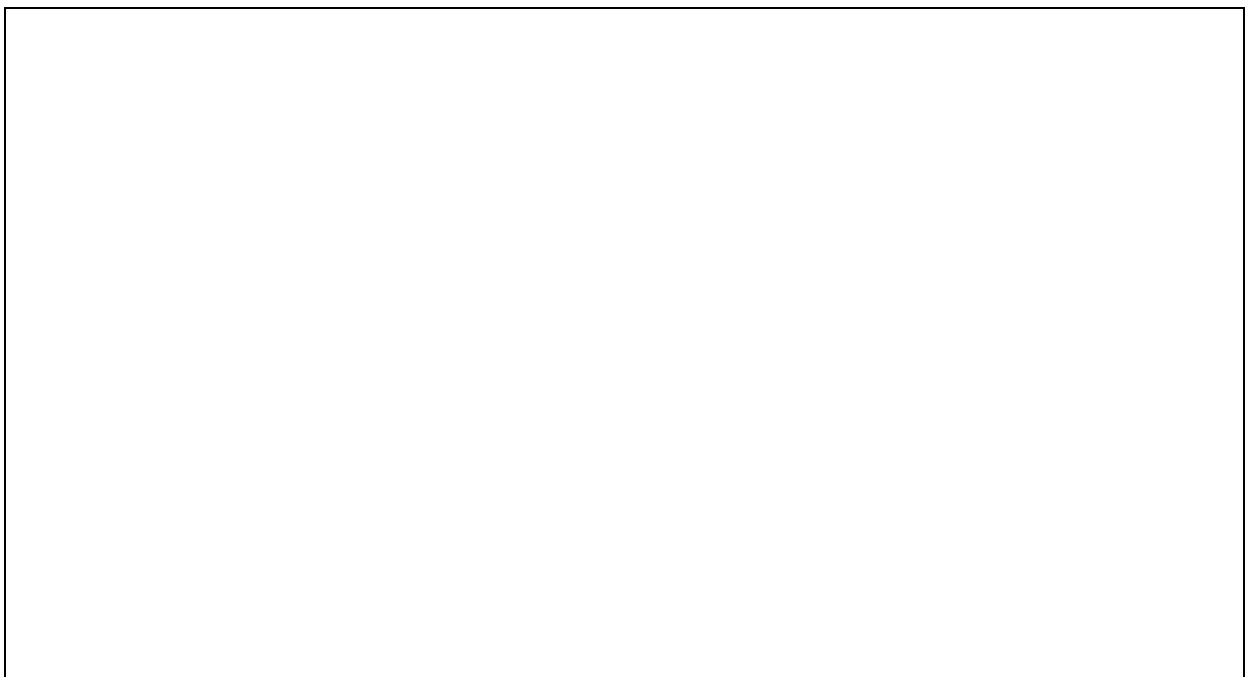
This discussion leads us to the Gestalt principles which apply as much to designers composing visual, auditory and haptic displays as they do to artists and musicians. In this picture the viewer can explore a number of Gestalt concepts, including symmetry and balance, figure and ground, the law of good continuation, the law of similarity, the law of connectedness and the law of familiarity. Gestalt principles describe how the perceptual system organizes or groups disjoint visual elements into coherent structures, forms or 'Gestalten'. Some of these principles and how they apply to graph drawing are described

below. Graph drawings are one of the more fundamental types of 'pictures' that are used in information visualisation.

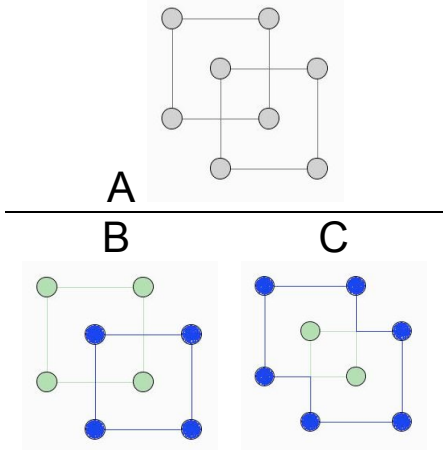
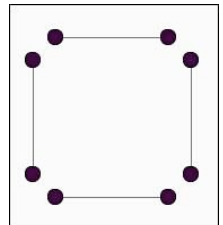
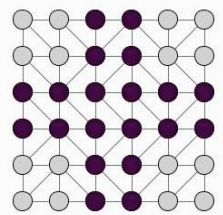
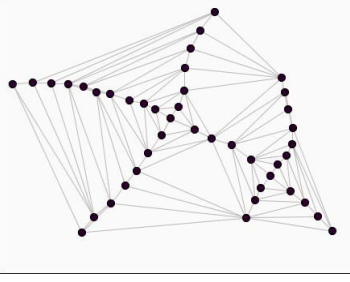
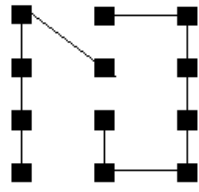
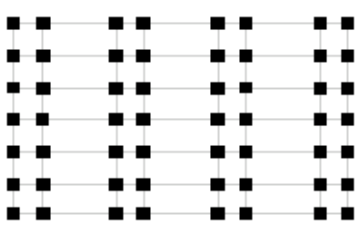
Gestalt is the German word for form. The Gestaltists proposed a theory of pattern perception that relies on the overall form and is not predictable by considering its components. Factors that impact on the perception of form and impact on how parts are grouped into structural forms are captured in what are called the "Gestalt Principles of Organization". The importance of these concepts to art and design were explored at the Bauhaus by such artists as Paul Klee, Wassily Kandinsky and Josef Albers. Gestalt Psychology itself developed in the 1900's to help counter the associationist view that stimuli are perceived as parts and then built into complete images. About 1910, German researchers Max Wertheimer, Wolfgang Köhler, and Kurt Koffka rejected the prevailing models of scientific analysis in psychology and used the principles of field theory to explain some cognitive processes which could not previously be explained without the holistic Gestalt viewpoint.

This picture started as a type of automatic drawing. I got the feeling for the picture on my mind and started to draw its ghost down, while trying not to think. I was familiar with the idea of automatic expression which had reached something of a climax with abstract expressionist painters like Pollock. I had recently read a scientific paper which had analysed Pollock's work and detected fractal patterns in the lines, thus suggesting that the expression process was driven by a chaotic system. At the time I was also considering symmetric architectures of the mind and how such 'hardware' might support thinking. The balance and conflict of straight and curved edges came to represent the same balance and conflict that exists between all the dualities in our mind and also the way these dualities exist as mirror images.

Although I thought this would be a purely abstract picture when I had finished I began to read figurative forms into the picture. Of course the human mind is good at finding such patterns (I am in fact constantly haunted by the one-legged, pacing chicken man in my bathroom tiles). This picture is subtitled, "Capricorn and Devil". These concepts happened to be connected to my personal life at the time and perhaps it is not surprising that I found their forms in the picture. Perhaps it was the law of familiarity working; perhaps it was coincidence or perhaps the more sinister Jungian principle of synchronicity.



Our perceptions frequently detect patterns where none exist. Here is the picture of the one-legged, pacing chicken man. Much to my constant dismay many hundreds of them live on my bathroom walls.

<p>The Law of Simplicity <i>"Every stimulus pattern is seen in such a way that the resulting structure is as simple as possible"</i></p>		<p>The law of simplicity states that we perceive an ambiguous structure [a] to be made up of simple shapes [b] and not the more complicated possibilities [c]. This is also related to the law of good continuation as the edges in [c] make sharp turns which violate this law, whereas the straight lines in [b] are a more natural interpretation.</p>
<p>The Law of Familiarity <i>"Things are more likely to form groups if the groups appear familiar or meaningful."</i></p>		<p>The law of familiarity states that we perceive structures that appear familiar. Therefore we might interpret the complex shape on the left as a square. We commonly interpret natural figures into abstract collections of lines.</p>
<p>The Law of Similarity <i>"Similar things appear to be grouped together"</i></p>		<p>The law of similarity states that similar things, such as the black nodes in this graph tend to be grouped together.</p>
<p>The Law of Good Continuation <i>"Points that, when connected, result in straight or smoothly curving lines, are seen as belonging together, and the lines tend to be seen in such a way as to follow the smoothest path"</i></p>		<p>The law of good continuation states that we perceive smoothly curving lines and straight lines in smooth paths. In this graph we perceive the nodes as part of smooth curves and straight lines even though they do not precisely describe such curves and lines.</p>
<p>The Law of Connectedness <i>"Things that are physically connected are perceived as a unit"</i></p>		<p>The law of connectedness states that we perceive connected objects as a single structure. Hence we interpret this structure as two parts based on the lines that connect the points.</p>
<p>The Law of Proximity <i>"Things that are near to each other appear to be grouped together"</i></p>		<p>The law of proximity states that we perceive objects that are close in space to be part of the same structure. Here the spatial arrangement means we normally perceive four groups of paired columns even though it is possible to devise other groupings, for example, by row.</p>

Piece of Mind



Piece of Mind (2000)

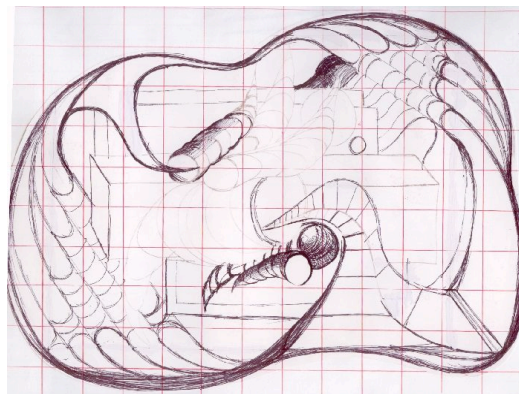
(Oil on shaped canvas)

Most of my shaped canvases extended straight lines of the picture into the straight lines of the canvas edges. This shaped picture extends the curved lines from the picture into the curved canvas edges. I'd been thinking for a while about this type of canvas but this was the first time I managed to devise a way to build a curved frame and stretch a canvas on it.

As the title suggests the picture is a lot about the inside of my head. Like most heads it is a little chaotic and unduly stressed at times and seems ever seeking some tranquil state. For me the ocean is always a place I associate with peace of mind so it is not surprising that the familiar waves and sand and sun appear. The waves are also a metaphor for my waves of thought. Sometimes the perfect rhyme and rhythm of some serene state of thinking and sometimes the restless abandon of the stormy seas.

My pictures are not trying to represent the real world outside my head but rather the world as it appears inside my head. This is illustrated by the clouds in the picture. They are not fluffy cloud shapes; they are logical straight-edged blocks. I'm thinking about how my mind might store the percept we call a cloud. The blocks of colour in the picture are more about the logical pieces of perception. They represent the basic colour building blocks from which we build a picture of the world. For the designer of visual displays, blocks or categories of colour are also integral to the design of direct visual metaphors.

Sea-shells in the picture introduce the familiar child-learnt myth that the sound of the sea can be heard by holding a sea-shell against your ear. Here is the law of familiarity applying to the auditory sense. In the picture the waves are like ideas generated from the shells. There is a deeper metaphor here, concerning the origin of creative thought. It's as if the waves arise from some darker deeper tunnel of the mind. You can think of this as the subconscious. To me this represents the same 'tunnels' that appear in *Abstract Train of Thought* and *Ride on Wave of Magic*.



Original sketch for *Piece of Mind*.

Piece of Mind

My random thoughts are chaos
or what meaning I can find
as I try to comprehend
my search for piece of mind

The creative process is essential to both scientists and artists, where the currency is new ideas and how they connect. Logical blocks of thought, along with intuitive leaps are important both for artistic discovery and scientific discovery. The study of patterns at many levels has also become the domain of software engineers and has long been a concern of architects. For the software engineer, reusable patterns and algorithms have become integral to most standard design processes. The 'piece of mind' the picture refers to is some fundamental pattern that we all use to create ideas. I call it the 'creator pattern'. That is, some fundamental template for knowledge formation. For more background on this fundamental pattern, you can skip to the final discussion in "Why 42?"

Information Metaphor



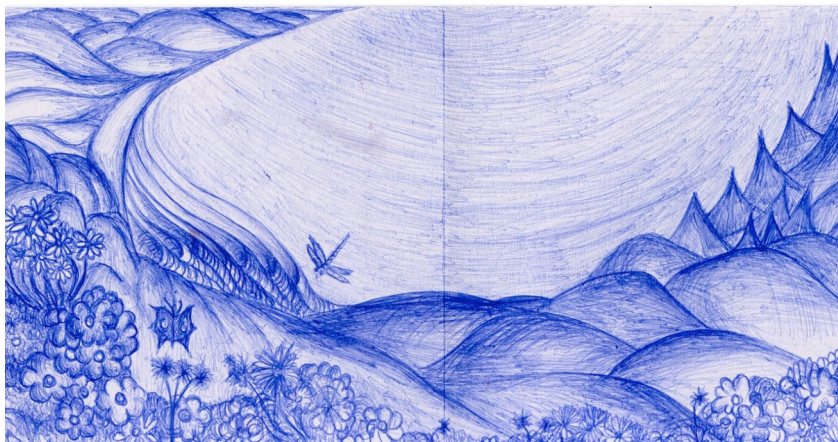
Information Metaphor (2001)

(Oil on canvas)

My doctoral thesis describes three main classes of metaphor – those to do with space, those to do with time and those to do with direct properties of our senses. Colour is a good example of a direct property associated with vision. The essential link between my science and art may or may not be apparent now; it revolves around how we perceive information and identify patterns.

During my Ph.D. I was developing a taxonomy to describe information metaphors. In the computer science field of “Information Visualisation” these metaphors describe mappings between abstract data such as stock market data to visual displays. A fairly well known example of this is to map data to the height and size and colour of buildings. The result is a cityscape that can be interpreted in terms of the underlying data. For example, perhaps the tallest building in the city is the stock with the highest price. Perhaps the blue chip stocks are represented as blue buildings.

A more rural metaphor might be to map data to hills and mountains, perhaps the shape and colour of flowers. Indeed each petal of each flower could represent some part of data. The waves might represent regular changing information, for example, a wave of trades on the stock market. The stock trader might watch a scene like the one in this painting to help them decide when to buy or sell. It would of course be an ever changing scene – as the stock market changed and waves of buyers and sellers entered the market.



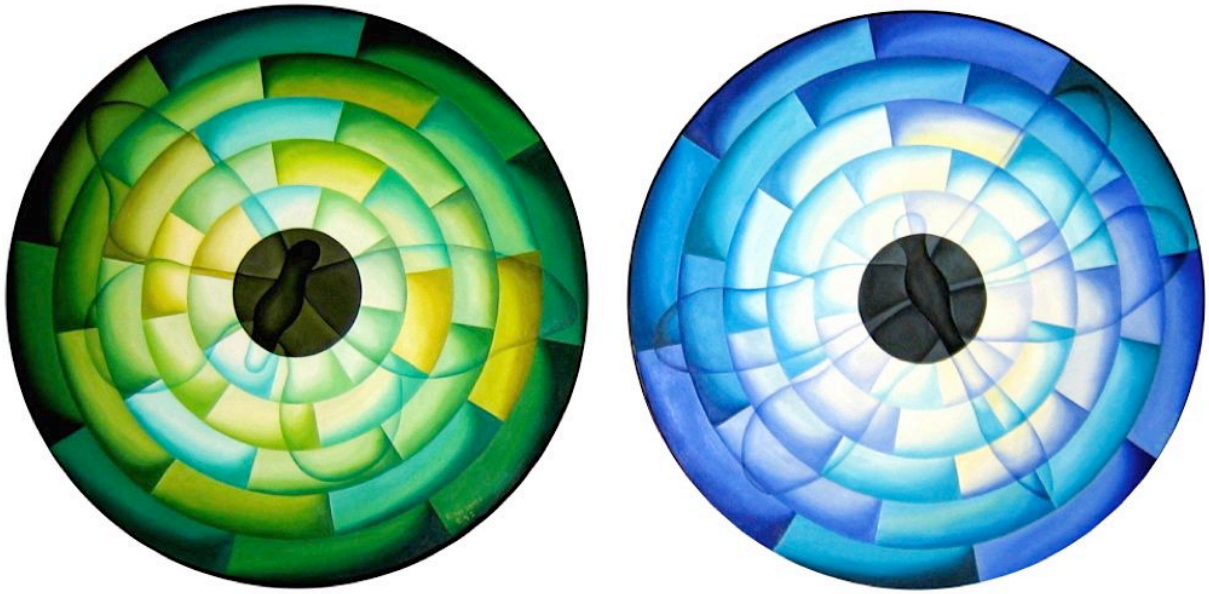
Information Metaphor

Information Metaphor.
Field of flowers
with butterfly navigation
and incidental dragonflies.

Original sketch for *Information Metaphor*.

One important aspect of Information Visualisation that differs from painting is that the images are frequently designed to either evolve over time or to allow the viewer to navigate through the information in the display. The butterfly and dragonfly had become important symbols in my art and are associated with many levels of meaning. However in this picture the reference is to styles of navigation. The dragonfly is symbolic of targeted hunting, where the hunt is driven by some primary purpose. Such navigation is rewarded when the goal is achieved. The butterfly symbolises a more chaotic gathering of information, driven by no reward but some simple pleasure in the gathering process itself. At the risk of starting a gender war, there are some obvious parallels to some gender stereotypes of male and female shopping. Although, if you leave the shoe shop and enter a hardware store or library you can identify both forms of navigation in either of the two halves of the gender duality.

Green-eyed Butterfly, Blue-eyed Dragonfly



Green-eyed Butterfly, Blue-eyed Dragonfly (2002)

(Oil on two shaped canvases)

There are three obvious connections with this picture and the science of Information Visualisation, namely, the design of the display space, the way colour has been used and the use of symbolism in the composition.

The design space is quite complex as it has been divided into two circular symmetric parts. The space of each circle has been further segmented in a geometric way to make the continuous space discrete. These discrete elements might represent categories if the pictures were part of an information visualisation. The colour scheme is based on slight alterations to hue (colour), saturation (amount of colour) and intensity (black-white). Hue, saturation and intensity are commonly used concepts in some descriptions of colour space. They are useful for the display designer because different data can be mapped to each of these parts of colour.

For the scientist designing data displays it is important to avoid symbolism. This is quite difficult, as the viewer typically brings many existing ideas and preconceptions into any task. So it is important that information is designed to be presented in a very neutral context. As much as possible patterns in the data should be considered in a dispassionate way. In truth this is probably impossible as artists such as Rothko have demonstrated colour itself can communicate subtle but strong emotional influences to the viewer.

Artists frequently employ some form of symbolism in their works and one could refer to the language of Miro or the strong Freudian symbolism in Dali's work. Apart from my more abstract pictures I commonly use a number of symbols, many of which have developed quite strong layers of meaning. I find the symbols emerge from and act on many levels of my subconscious. I might interpret them in a fashion that is similar to Jung's process of understanding dreams or sometimes even in a calculated, mathematical way.

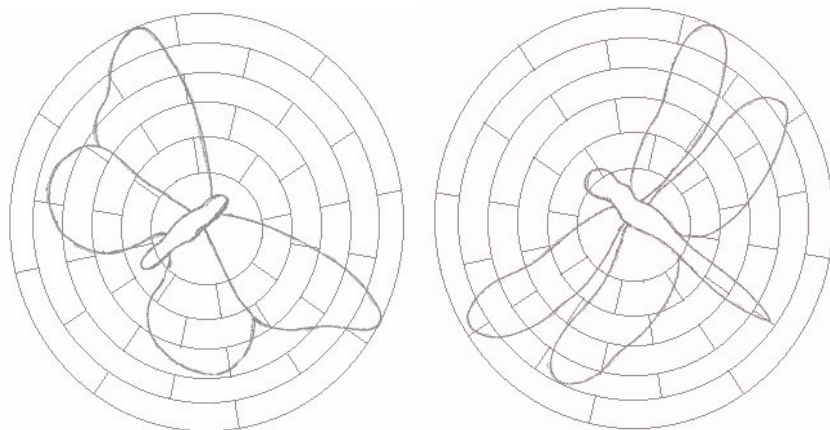
The butterfly and dragonfly are fundamental symbols for me and represent all dualities, such as day and night, particle and wave, male and female, black and white, emotion and logic, yin and yang etc. On a personal level the picture began as a kind of tribute to a green-eyed butterfly that had created a storm in my soul. This idea was based on the concepts of strange attractors (in love as in anything else) and the notion of chaotic systems and the butterfly effect. That is a butterfly flapping its wings in China could cause a storm on the other side of the world. Over time the poetry of this metaphor became more mathematical as I played with recursive algorithms running on symmetric networks composed of strange attractors. The eyes in the picture also carry some personal symbolism, as well as the traditional notion of the windows to the soul (our deepest patterns). I'm never sure if the picture is from the inside of my eyes looking out or the outside looking in. Because the blue and green eyes belong to different people both are true at once. From an information visualisation perspective the blue and green colours act to redundantly encode the two distinct categories of male and female.

The use of symbols is itself a fascinating area of study. For me the most interesting symbols are those that share similar meanings across cultures. For example, many geographical distant cultures share the myth that butterflies are somehow connected with the souls of the dead. The symbols of artists can seem quite strange to mathematicians, but I suspect no more strange than the symbols of mathematicians sometimes seem to artists. While the symbols of the artist seem to defy a single interpretation and often exist with multiple levels of meaning, the tradition of natural science is to carefully define all concepts so they share a single common interpretation.

Of course much mathematics, like art is based on the ideas of geometry. Geometry in itself is almost about drawing mathematical pictures. Common symmetries based on natural numbers have emerged in the art work of many different cultures. Iconography and numerology are systems of thought that are generally considered in a derisive manner by logical scientists, however there is something in the basis of these systems that I find closely related to those of mathematics. (See Buckminster Fuller's discussion on Numerology in his Synergy book for a similar view of number systems.) This particular picture is based on the geometry and numerology of the number eight. While painting the picture I had found my thoughts to be strongly influenced (in an illogical way) by the symmetry of the number eight. While I was painting the picture I happened to visit Japan to present a paper at a conference. I guess it was not surprising that I discovered the strong Buddhist connection with the number eight. Painting is for me always a meditation sport and this picture especially acted like a geometric mandala for finding the idea generation room in my mind. If you like, finding the place where the white light comes from or in a reverse the dark tunnel from which my ideas emerge.

The paintings suddenly took on an unexpected connection to the more abstracted ideas of Japanese Buddhism. I find the way strong, seemingly unrelated ideas connect very curious. When these ideas are connected only by time, we might describe them as coincidence or in a Jungian way as synchronicity. Buddhism it seems is quite a multi-sensory religion as it actually describes eight senses.

Deep subconscious ideas that form from patterns in our perceptions can suddenly emerge and take on significance. In this way my paintings, even those painted in the past, can suddenly connect to a precise moment in future time. It's strangely metaphysical phenomenon (though you have to be there) and it's as if the picture was painted for that moment. It is a disturbing feeling and medication is fortunately available. This phenomenon is referred to as the eighth sense by Buddhists.



Original sketch for
Green-eyed Butterfly, Blue-eyed Dragonfly.

Green-eyed Butterfly,
Blue-eyed Dragonfly

Dancing on her wings
fleeting through my mind
skipping through the sky
my green-eyed butterfly

Balanced on the winds
hunting through my mind
skimming through the sky
the blue-eyed dragonfly

Modern Day Tragedy

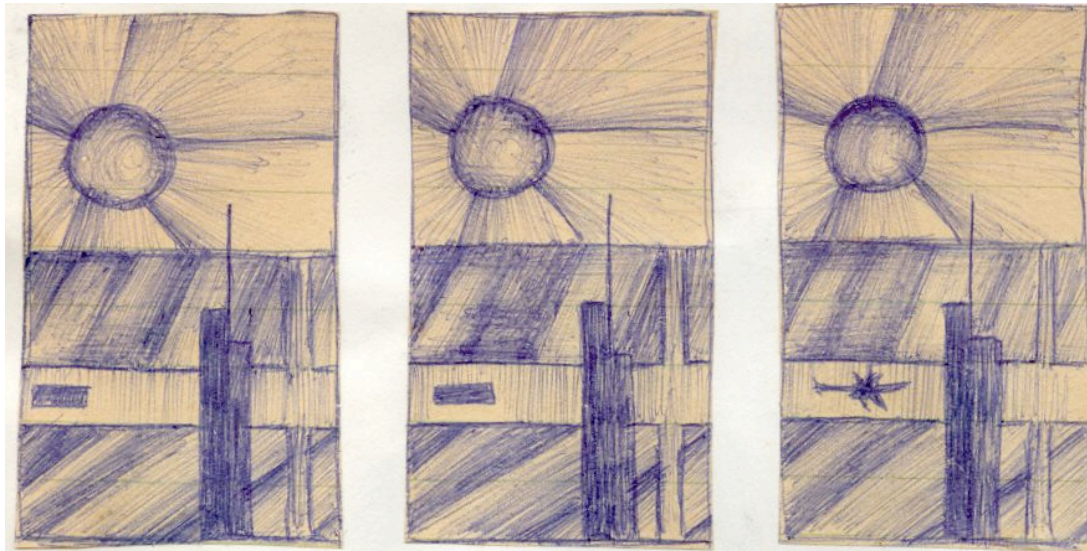


Modern Day Tragedy (1984)

(Oil on canvas, triptych)

Most of the pictures in the exhibit deal with spatial or direct metaphors. The spatial metaphor in this picture is interesting as it mixes two alternative perspectives, namely a plan and side view. However, the interpretation of the picture also deals with temporal metaphors. On a simple level the picture shows three frames of a short animation where the spatial position of the object (car) moves in each picture.

Modern Day Tragedy is based on the dramatical rules of Ancient Greek Tragedy. Namely that the action of the play should span only a small amount of time and occur in a limited space, encompassing a single dramatic event. The dramatic event suggested by the picture is a car crash, however, I also think of it as any event that brings about a major change in viewpoint, a moment of madness perhaps or epiphany. Some people also call it my 'Twin Towers' picture thus connecting the picture itself to an unexpected event that caused a major dramatic change in many people's viewpoints.



Original sketch for *Modern Day Tragedy*.

Time is frequently an important variable of abstract data. The order of events can often reveal patterns of cause and effect, although like our perception of everyday events this can sometimes be misleading. Things that occur simultaneously can appear connected, although in fact it may only be coincidence at work. It is important for the designer of information displays to allow the possibility of temporally connected patterns to be explored without unduly biasing people into forming improper inferences of cause and effect.

Abstract Train of Thought



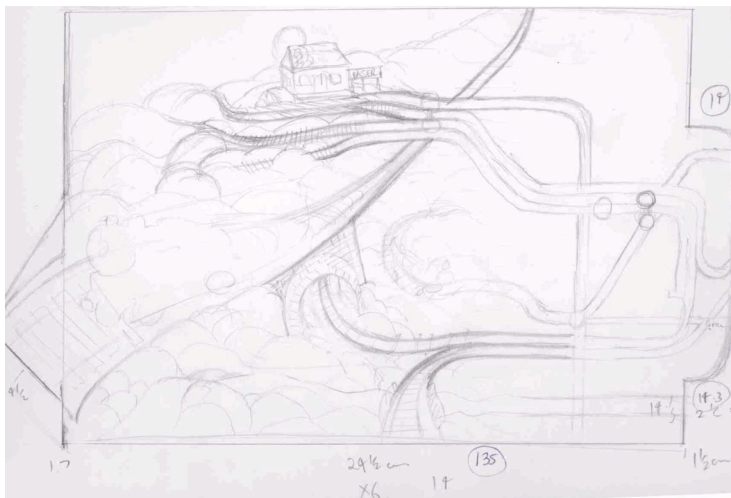
Abstract Train of Thought (2003)

(Oil on shaped canvas)

This picture marked the end of my Ph.D. work. Quite a few of the principles I had been exploring in my thesis are exemplified in this work. For example, the shape of the canvas is used to define the design space of the picture. The “design space” is a concept I was working with in my thesis and in this picture it is almost a parody that defies the viewer not to reconsider their perception that the design space must always be defined in some standard way.

The image is based on the familiar London Underground Map and also deals with the abstraction from a 3D reality to 2D abstract maps. The left side of the canvas contains three dimensional geometry and real-world imagery. The right-hand side of the canvas is the familiar, simple, stylised two dimensional metro map. In fact if you compare it with the London underground map you will find it maps fairly closely to an actual part of the map.

Apart from the abstraction which greatly simplifies the interpretation of the map, the main information visualisation principle employed by the metro map is to represent different categories (tracks) using different hues. Different colours are often mapped to different data categories to help the viewer differentiate each category and it is important that the colours are perceptually unique so that one track is not confused with another.



Original sketch for *Abstract Train Of Thought*.

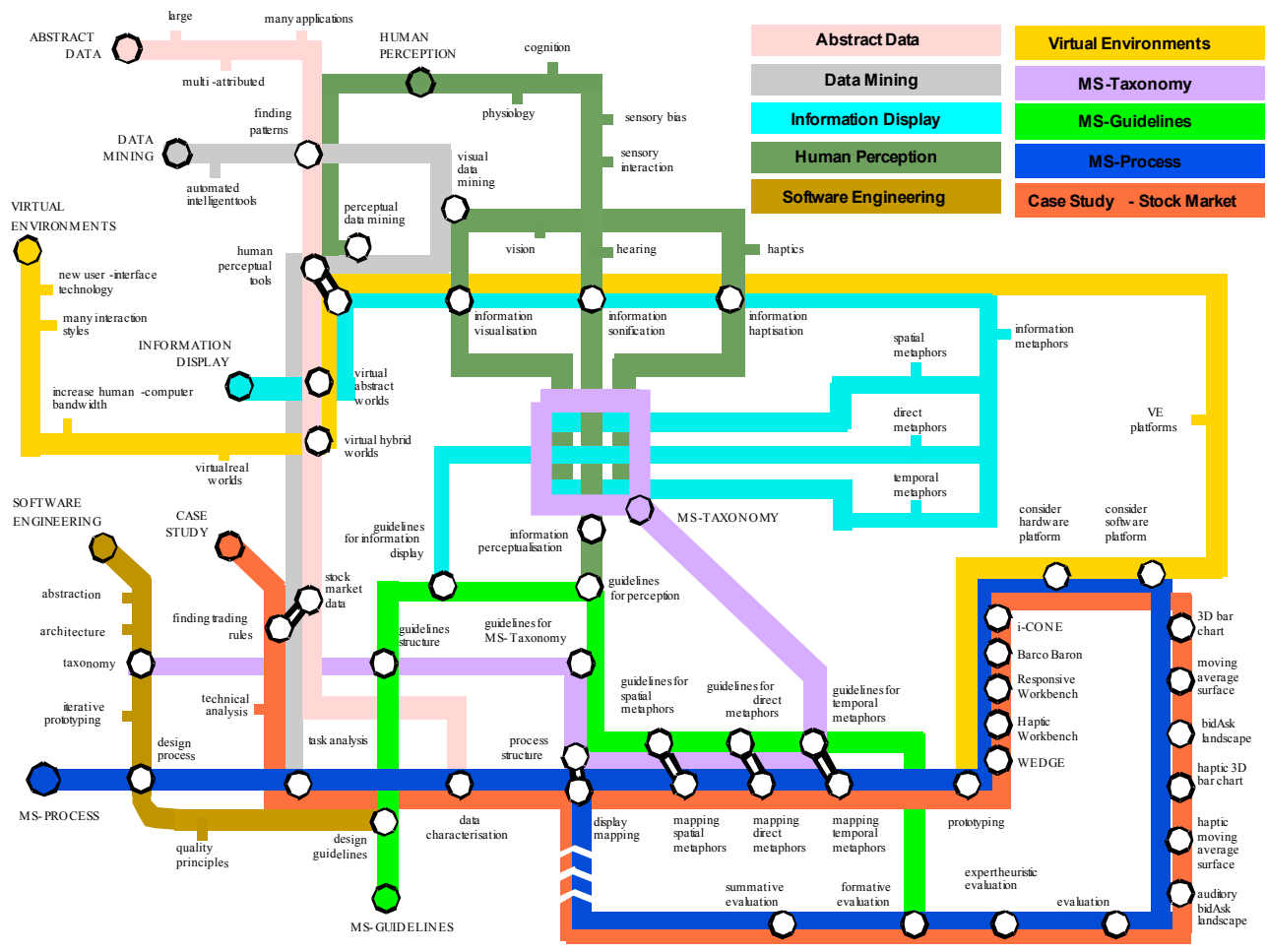
Abstract Train of Thought

Detail fades to simple line
strange abstracted
thoughts of mine.

Space and volume all decline
becoming planes and simple line.
Every shape becomes a sign
quite distracted, very strange
mad abstracted
thoughts of mine.

Ironically in my real life trains were having a significant impact on my day to day affairs. I was making a number of trips from Newcastle to Sydney University so I could see my supervisor and finalise my thesis. I also had some crazy train journeys through Europe in the previous couple of years. So during my thesis I spent a lot of time on trains thinking. At the end of my thesis I was struggling with an appropriate mean of communicating the many complex, interconnected ideas in the thesis. The London Underground map is one my supervisor's favourite visualisations and I had just returned from London so it seemed like a natural subject to paint. When the tunnel appeared in the picture, I was only consciously thinking about train things. It actually took me a while to get the connection with the way our tracks of thinking disappear and reappear in our subconscious. It was if this idea itself emerged from its own tunnel. I was surprised one day when someone suggested the green hills seemed like the surface of the brain.

Metro Map Metaphor



Metro Map Metaphor (2003)

My Ph. D. dealt with many complex and interconnected ideas. To try and make it easier for people to follow the tracks of my thinking (especially first-time readers) I developed an abstract visualisation based on the look and feel of the metro map. Each coloured track is associated with a distinct line of thought. Often more than one track of thinking converges on a single concept. You might think of each station as an appropriate place for changing stations or an intersection of more than one viewpoint.

In the last few years this style of map has become almost ubiquitous. Indeed the London Metro Map is very much a part of modern folklore and it has been used by many artists. Simon Patterson used the London underground map in his image, "the Great Bear", where the names of great "stars", such as, celebrated actors and politicians are substituted for the names of stations. It was also used by David Booth in an advertising poster called *The Tate Gallery* by 'Tube'. The familiarity of the metaphor makes it appealing for the designers of information displays. Most people have learnt the principles of using the map, and thus navigating the information seems to be simple and engaging.

This map of my thesis map shows ten interconnecting tracks of thought. These include the six fundamental areas on which the thesis is based, the three major contributions of the thesis and one track representing a validating case study. The fundamental tracks include *abstract data*, *data mining*, *information display*, *human perception*, *virtual environments* and *software engineering*. The three major contributions of the thesis are; the *MS-Taxonomy*, the *MS-Guidelines* and the *MS-Process*. These three "tracks of thought" emerged from the cross over of ideas covered by the six fundamental areas. A final track is the case study used to evaluate the contributions. The stations are sub-topic areas within the main tracks. For example, the *software engineering* track has stations called, abstraction, architecture, taxonomy, iterative prototyping, design process and quality principles.

The colour coding of the tracks are based directly on the colours used in the London Underground Map. For the designer of information displays, colour is an excellent way to display nominal categories and it has been shown that in visual search and recognition tasks, colours can improve speed, accuracy and memorability.

With this map there is no underlying geography to guide the layout. The placement of the tracks is at the discretion of the designer although there is a desire to minimise clutter by spreading the tracks across as much space as possible and minimising unnecessary crossings. There is also an unintentional cultural bias that was introduced in the way stations (concepts) are ordered from left to right and top to bottom. These simple aesthetic heuristics drove the design, but there was much "trial and error" before the overall placement of tracks was determined.

The automated drawing of such graphs or networks is itself an interesting area of study in Information Visualisation. Designing algorithms for such graph layouts is quite difficult, especially where the number of nodes (stations) and links (tracks) is large. During the process of designing the map I was also considering possible algorithms that could be used for automating the process of drawing such maps. I did not have too many insights in this regard but a number of interesting application domains suggested themselves including the layout of knowledge in help systems designed for computer software and the documentation of computer software itself. Of course pedagogy deals generally with navigation of knowledge and it may be that this familiar metaphor is a useful way to structure knowledge for learning.

Hills of Chaos, River of Time



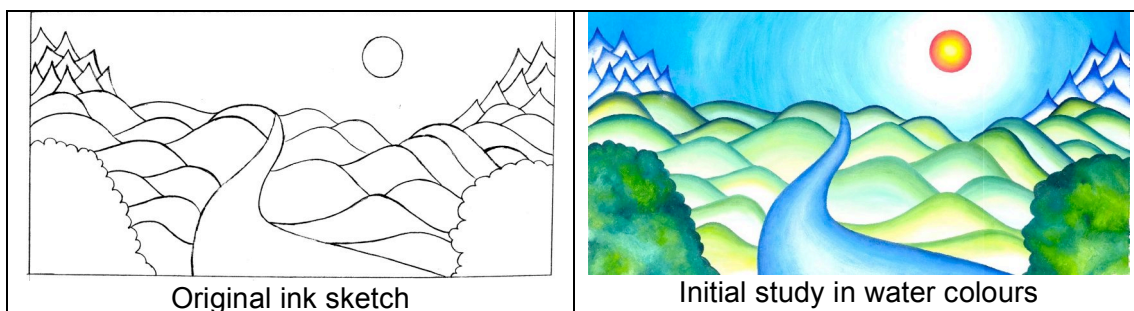
Hills of Chaos, River of Time (2005)

Although one outcome of my Ph.D. was a landscape for predicting stock market prices, I always considered that the display was more generic and that it could be adapted to display any data that could be interpreted as forces in balance that evolved over time. Indeed the primary reason I had chosen the stock market data was the idea that conflicting human emotions are responsible for the chaotic patterns occurring in the market data. As some fundamental level it may be that the display allows us to study the complex temporal patterns of human emotions; the rising and falling landscape of our feelings. Perhaps the same fundamental patterns that occur in stock market also occur in other complex system such as human thought.

Of course another good reason for using stock market data is that it sounds very scientific and practical and so it is easier to attract funding opportunities for such work. This is a traditional concern for artists but also a practical concern for scientists, especially where value is hard to quantify and research outcomes are not always predictable.

The original idea for this work was driven by collaboration with another researcher working on the concept of ambient displays. Ambient displays are computer driven displays that occupy an environment. They can appear as some normal artefact of an environment, such as a lamp, a door or even a picture on the wall. The display changes in subtle ways as the underlying data changes. Ambient displays are not meant to be studied closely but rather to impact at some subconscious perceptual level of the person in the environment. The person should not be aware of any changes until patterns in the ambient display emerge into the viewer's consciousness. This landscape picture was designed to be a painting on the office wall, which would gradually change to reflect changes in the stock market forces (bull vs bear, buyers vs sellers).

Of course evaluating such displays and determining their 'real' dollar value is quite difficult as by design they are meant to operate in a subliminal way. So one day the person in the environment just decides it is time to sell their stocks. Not surprisingly it is difficult to justify funding in this research domain as success is hard to define and the risk of failure is quite high.



The picture is very simple but you may also read into it the following underlying meaning. The river represents the flow of time. The left (yellow) and right (green) side of the river represents two strange attractors of some underlying chaotic system. The forces are in balance and competing. The shape of the landscape might reveal temporal patterns in a chaotic system. On one level the river might show the twist and turn of our feelings over time and the hills might reveal familiar patterns in the flux of our good and bad feelings. You can find out more about the aspects of information visualisation of this picture by watching the "Underground" movie.

Underground (the movie)



Underground (2005)

(Running Time ~42 minutes)



1. Introduction - Underground

Song by Strange Things with vocals and guitar by Dougie Rowe
Animation by K. Nesbitt

2. Perceptual Data Mining in Science

3. Perceptual Data Mining in Art

4. Virtual Reality - the Tool

5. The Multi-sensory Design Space

Intermission - Ride on wave of magic

Song by M. Cotterill and K. Nesbitt with guitar by Dougie Rowe
Animation by K. Nesbitt

6. Designing Stock Market Landscapes

7. The Moving Average Surface

8. The Bid-Ask Landscape

9. Finding Patterns in Complexity

10. Conclusion - Landscape

Song by Strange Things with guitar by Dougie Rowe,
Animation by K. Nesbitt



Strange Things is R. Newell, K. Nesbitt
www.strangethings.com.au

42

Why 42?

Why 42?

I'm surprised I still meet people who don't know about 42. So with apologies to those familiar with Douglas Adams and the Hitchhikers Guide to the Galaxy here is a brief explanation....

According to Douglas Adams well known radio program and later series of books The number '42' is 'the answer' to the 'Meaning of Life, the Universe and Everything'. This answer was calculated by the computer called 'Deep Thought'. 'Deep Thought' was in fact the second greatest computer of all time and space. Even so it took 'Deep Thought' seven and half million years to come up with 'the answer'. Researchers, who had programmed the computer to calculate 'the answer', were a bit disappointed (after seven and half million years) with 'the answer'. However, as Deep Thought points out, the problem is not so much 'the answer' but that no one really has any idea of what 'the question' really is.

Unfortunately for the group of researchers involved, 'Deep Thought' is not nearly clever enough to work out what 'the question' is. All seems lost, but fortunately for these researchers, 'Deep Thought' has designed an even cleverer computer (the greatest computer of all space and time) and this computer, once built, will be able to calculate 'the question' (although it will take a while).

As it happens, the greatest computer of all time and space is in fact 'Earth'. This 'somputer' It incorporates living beings as part of its computational matrix. (To some computer scientists this now starts to sound a little bit like a parody on complex systems, intelligent agents, evolutionary computing, biological computing etc). Unfortunately after billions of years, and only 5 minutes before 'the question' is about to emerge, the earth is demolished by Vogons to make way for a hyperspace bypass. (Although there is also some suggestion that a conspiracy is involved and that philosophers and psychiatrists have employed the Vogons for fear that they might lose their jobs if the 'meaning of life' becomes common knowledge.)

So, although we know that '42' is 'the answer' to 'the meaning of life, the universe and everything', we still do not know the fundamental 'question' that gives 'the answer'. Although the researchers in the book do think for a while about fudging the outcomes and making up a question. They even consider a line from a Bob Dylan song, such as, "How many roads must a man walk down?". The last earthling left alive after the Earth's untimely demolition (Arthur Dent) supposedly has 'the question' encoded in his brainwaves. He tries to find 'the question' by randomly selecting scrabble letters from a sack. What emerges is the question, "What do you get if you multiply six by nine?" Of course six times nine is 54 and not 42, but the universe is sometimes illogical. Some mathematicians have pointed out that six times nine is in fact 42 if you work in base 13. However, Douglas Adams has reportedly said that no one makes jokes in base 13. The final word, also from Douglas Adams, is that he just picked the number 42 because it was the funniest two digit number he could think of.

Anyway it's the same with me and the paintings. I just paint the ideas I think of. Although it's sometimes kind of spooky when the pictures just suddenly appear in my head. It's a bit like unexpected email arriving with a picture attachment. I open up the picture and save it by sketching it down. I'm as amazed as anyone at the weird things I get in my 'head-mail'. Eventually I might get around to painting 'the idea', although it can be many years before the sketch finally becomes a 'real' painting.

I wonder a lot about where the ideas emerge from and the mysteries of the 'underground' or subconscious of my mind. There's nothing in my consciousness and suddenly this complex picture is there inside my head. It's like the idea simply emerges out of a tunnel into the light. I can sort of see it but it's vague and sometimes it's more like I feel it rather than see it. Through the painting process the idea evolves although the main change is that colours get

added. Anyway, for me, the most fundamental question I can think of is, "Where do ideas come from?" Understanding how my ideas are created is the eternal puzzle for me and the essence of my art.

Indeed everything we think of is just 'an idea' and so if we can uncover the algorithm for thinking we may know how all meaning and all knowledge is created? There doesn't need to be any great motivation for this quest, it seems like we are all born natural philosophers seeking 'the answer' or 'the question'. But is there a single algorithm or pattern that we all follow to create meaning? Such a pattern must be a simple and abstract thing and yet it must be very powerful to enable the creation of the entire complex body of human knowledge.

This single pattern has many mystical names in fiction, such as, the 'philosopher's stone', the 'holy grail' or the 'one ring'. I'm a computer scientist by trade and so I like to call it the 'creator pattern'. This pattern is also the cornerstone of consilience (see Edward Wilson), that is the notion that we can find a framework for unifying all existing knowledge.

Finding the pattern that creates all ideas sounds difficult but fortunately we already know the answer is 42. Unfortunately it's also very difficult to study how ideas are created as most ethics committees reject research proposals that involve decapitation of subjects to remove their brains for dissection. My own methodology is to try and track the origin and emergence of my own ideas as best I can. Scientists will be alarmed at the subjective nature of this observation technique as well as the small sample size of one. Although it is possible to gather more data by using equally alarming qualitative interview techniques. That is I sometimes ask people to tell me what meanings they see in my pictures.

So where do ideas come from? Perhaps we all start with a blank canvas, which is our infant mind and then we grow ideas. The philosophers might want to raise Plato here and suggest that our perceptions are responsible for the way our ideas grow our own reality. I don't know much about philosophy so I don't want to get involved here. Likewise if we go much past Piaget I certainly won't want to discuss the various pedagogical interpretations of the how we learn ideas. I'm happier with the artists here. Those artists familiar with the Suprematist, called Malevich will remember the end of abstraction typified by his white canvas. Some say that modern art stopped here. Malevich argued that a white canvas had the most meaning because it has the most possible interpretations. I'm with Malevich, I think our ideas about the meaning of life have just as many interpretations. Indeed everyone looking at the abstract notion of life will end up thinking it means something different.

Although we might begin with a blank canvas in our minds, we do seem to share common patterns of thinking. Some are cultural, some social, some historical and some learnt. Others seem more universal, fundamental and indeed seem to have a biological or physiological basis. If you are interested in how we think in patterns, how we make them, and how we break them, then you can certainly do worse than read De Bono's very logical book, "I am right and you are wrong". De Bono talks a lot about patterns of thinking and describes them as hills which gather thoughts. The hills are like the catchment zone of our raining ideas. Although our thoughts rain at many different parts on the hills, the ideas all tend to gather into the same familiar pools. If you don't like this metaphor you might like to think of the patterns you use to think as well-laid tracks along which our various trains of thought run.

What I find curious is that we share so many common patterns and that we often think so much alike. What is equally curious is that the opposite is also true. That is, we all start at the same place, we all think the same and yet we all arrive at different places.

Anyway I like to assume that everybody has arrived at a different 'question' about 'the meaning of life, the universe and everything'. Scientists would now like a research question

to motivate my work. If you like my research question is, "How do we all start with different questions (about the meaning of things) and yet get to the same answer (42)".

Basically, I accept Malevich's premise that there are as many interpretations of 'the question' as there are people who question things. I also like to assume that for all our different questions we all have the same answer (which is 42). Taking up from Malevich, I'd like to explore the thought processes that take us all from the same abstract concepts, such as a white canvas, to so many different interpretations. From my qualitative studies I can report that when subjects look at my less abstract pictures they tend to reach a greater consensus about the meaning hidden in the pictures. Working backwards from Malevich, the more I remove abstraction the more constrained the interpretations become. What this does is reveal common patterns of thinking or interpretations in my 'subjects'. Furthermore the different levels of abstraction in the pictures become a way to study the different levels of subconscious patterns within the viewers of the paintings. By the time you get to my very abstract pictures, you find people often have difficulty explaining the more subconscious effect these pictures create. It's as those these more abstract pictures have an influence on unconscious patterns of thinking which are difficult to express in a conscious way. It is these underground patterns or thought tracks that I find most interesting as I like to see if they are thinking like me.

But in the end it is all about me. The deepest levels of interpretation, and usually the most reliable interpretation of the meaning in the works are those that I form. After all the final form of the painting has been modified since creation, sometimes by accident through my unconscious and sometimes intentionally through my consciousness to create the final images. I also carry the context of creation and no outsider who views the pictures has access to the hidden information that has shaped the idea. Of course occasionally someone sees something in a picture that I hadn't thought of before and it provides a new viewpoint for me to consider.

The art part of this exhibit explores the way ideas are created. I like to think of it as data-mining the soul. Searching my soul or the deepest hidden parts of my mind for recurring patterns of thought is what it's all about for me. While the art part of this exhibit explores the search for patterns of thinking, the scientific component discusses the search for patterns in abstract data. Both parts rely on our human perceptual capabilities to find patterns and order and so there is much in common. The designer of perceptual data mining displays must work with the 'units' of perception, mapping data to these units in a way that helps the user to explore the data perhaps find useful patterns. Art can get quite weird, so if you are a logical scientist you might wish to skip the art parts and stay with the science parts of the exhibit. If you believe that things are exactly the way you already know they are then you certainly don't want to entertain a new way of looking at things and you would be advised to skip both the art and science parts. Of course, you might just want to find your own meaning in the pictures. Anyway if you can think of a funnier two digit number than 42 then let me know.

Oh and what about the creator pattern. Do I know what it is? Would you like to know it? Well if you could just give me another 5 minutes!