

COLOUR and SPACE: An Investigation of Three-Dimensionality

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Abstract: *Monica Billger, in her doctoral dissertation, states 'The feasibility of working consciously with colours is limited by our knowledge about how the appearance of coloured materials varies with context, that is, how a coloured surface is affected by its spatial situation' (Billger, 1999, p. 5). In association, however, we can also seek to understand how the application of colour provides the spatial context and/or potentiates our experience of spatiality.*

Within this paper, I will discuss some of the issues involved in our understanding and interpretation of spatiality. These include firstly, space and its relationship to colour; secondly, colour education in relation to colour and space, and thirdly, the potential of paintings or photographs of artists' work in understanding colour and space. The two dimensional work of artists (such as Mark Rothko, Bridget Riley, Claude Monet, and Wassily Kandinsky) is a valuable source of information for emerging designers in the field of colour as a consequent of investigating and/or observing the work. Key relationships may be understood and applied to three dimensional spaces abstractly, and in practice, to environmental projects that are relevant to Interior Design and Architecture. Finally, I will explore the way I, in association with the tutors, have raised the students' awareness of colour as a tool to assist in the moulding of three dimensions or space. This will include the discussion of one student's work as an example of the process undertaken before summarising the link between three dimensional investigations and two dimensional observations and/or practices.

Keywords: *colour, space, design, three-dimensionality*

Introduction

Students of design often have difficulty in extrapolating theoretical or studio exercises in colour to the design of three dimensional space. This occurs because 'real' spaces are not able to be readily tested. Generally the principles can only be applied to representations of spaces. Although analyses of existing environments, drawing the designs for new environments or interiors, making working models, or developing presentation models can be incorporated into the coursework, the level of engagement with appropriately scaled or life size spaces is very limited for a student. Monica Billger, in her doctoral dissertation, stated that the 'feasibility of working consciously with colours is limited by our knowledge about how the appearance of coloured materials varies with context, that is, how a coloured surface is affected by its spatial situation' (Billger, 1999, p. 5). However, we can also seek to understand

how the application of colour contributes to the spatial context and/or potentiates our experience of spatiality. A number of differing procedures have been integrated into design programs by me (Smith, 1993; Smith, 1995) and by other educators to develop relevant skills and knowledge.

The work of the artist and academic Lois Swirnoff as reported in *Dimensional Color* (1992) acted as a source of inspiration for the studio work described in this paper. Swirnoff's investigations involved the construction of 'a unit' or installation consisting of several clear sheets to which colour patches were adhered. 'Students were challenged to think of the unit as a total field....Some students regarded each plane as an entity, making separate two-dimensional patterns against which each, when combined, formed a larger, complex unit' (pp.115–116). The purpose was to explore if 'the constellating effects of color, by their localizing, spacing, and dispersion can be visualised as surface patterns.'(p.114). Her concept of applying the two dimensional principles conceptually and pragmatically to a three dimensional setting was appealing. I posited that this would directly assist in the development of skills and knowledge applicable to students of the built environment.

Within this paper, I will discuss some of the issues involved in our understanding and interpretation of spatiality. These include firstly, space and its relationship to colour; secondly, colour education in relation to colour and space; and thirdly, the potential of paintings or photographs of artists' work in understanding colour and space. As a consequence of investigating and/or observing the work, the two dimensional work of artists (such as Mark Rothko, Bridget Riley, Claude Monet, and Wassily Kandinsky) is a valuable source of information for emerging designers in the field of colour. Key relationships may be understood and applied to three dimensional spaces abstractly, and in practice, to environmental projects that are relevant to Interior Design and Architecture. Finally, I will explore the way I, in association with the tutors, have raised the students' awareness of colour as a tool to assist in the moulding of three dimensions or space. This will include the discussion of one student's work as an example of the process undertaken before summarising the link between three dimensional investigations and two dimensional observations and/or practices.

Phenomena – perception of space

Space was traditionally understood as something that could be defined and measured. However, although space can be described mathematically, alternative understandings are evident. Space, as discussed by Arnheim (1975), is that which is not solid in an everyday

sense but is created due to the placement of objects – it has potency and is flexible as the defining elements move. Subsequently, interpretive definitions of space have arisen and with the notion of space as a temporarily bounded entity arises issues of permeability and fluidity.

With the advent of Gestalt psychology, our understanding of the role of the viewer in deciphering the world around him or her within the visual field as an objective reality removed from the interpreter was challenged. The figure ground puzzles, which most of us are familiar with, exemplify how a dominant element can define the spatial characteristics of a situation at a particular point of time. As part of the visual encounter some aspects are the background while others become the foreground. The latter are therefore seen to be 'in front', more active, and/or instrumental in how a situation is understood spatially.

The experience of space as described by Berleant in his book *Art and Engagement*, gives reference to space in relation to paintings. He states that the usual treatment of space in painting is based on Newton's physics – that is, 'both space and time are objective and absolute. Space is a medium that is abstract, universal, and impersonal, a medium in which discrete objects are placed and in which they can be located clearly and irrefragably... We continue unwittingly to apply this repudiated spatial orientation to pictorial, as well as to ordinary, experience' (Berleant, 1991, p. 55).

With the development of relativity as a concept, alternative understandings of space have arisen. These are also captured within Berleant's discussion. A viewer's position is a locality from which other relationships arise resulting in the generation of the spatial relations of the situation (Berleant, 1991). As I have discussed elsewhere in regard to the person-environment relationships, people interact and experience the world – and in particular, the built environment – through a series of person-states. The viewer (the person looking at an environment) and the participant (the person entering the environment) are two of these states (Smith, 2000). Therefore, we can understand the environment is at times objectified and removed, while at other times the environment comes 'to meet you' or you are interdependent with it.

If we return to an analysis of paintings what can we observe? In regard to the portrayal of the landscape, Berleant (1991) defines panoramic and participatory relationships. The first focussed on distance and separation; the second requires that we look into the space, that we enter it, and that we become part of it. This he states is similar to our perception of our everyday surroundings. Therefore, I will now consider how colour is part of our spatial and worldly experience of our environments.

Colour and space

Our built environment is not experienced as a lifeless achromatic environment. Instead, it is moulded by shadows and light, brushed with varying hues, or saturated in intense colour such that, we are engaged, comforted, confronted and/or simply supported in what we are doing as the environment falls into the role of the *unconscious backdrop*.

The architect, Galen Minah (1996) in his discussion of high density cityscapes, notes diagramming techniques used in a formal analysis can reveal the ordering of buildings in terms of figure-ground relationships. These can be amplified by colour as demonstrated by investigations into the perception of spatial phenomena which is due (in part) to colour contrast, juxtaposition of colour surfaces, and to the effects of atmospheric conditions upon the colour palette and the level of contrast. Certain colour phenomenon fall into categories which are recognisable and generalisable. These categories, Minah states, are understood as 'the familiar' and 'general' world of colour interactions, and can also be represented through diagrammatic analysis of the environment. As with formal analysis of buildings, a colour field can be named using the same terminology as architectural forms: centre, perimeter, figure and ground. As an example of a colour field, an abstract painting 'can be analysed, diagrammed, and interpreted in much the same way as a work of architecture, although colour juxtapositions become only formal elements' (Minah, 1996, p. 13).

In association, what we perceive is affected by the inherent colour of the materials used and/or the colours applied to the surface. The outcome of the combination of the material and the colour is a spatial composition. As the educationalist Freisner (2000) points out, the building surface affects how the building is perceived. In addition she notes that contrast affects our perception of architecture. For example, the light and dark contrasts can create three dimensional effects on flat planes, with broken surface appearing smaller, and the smoother, flat surfaces appearing larger. Colour use can reverse these effects. For example, 'a building containing many (dark) windows embedded in white grid or surface will appear smaller than the same sized building with blue-tinted windows set in a steel wall' (Freisner, 2000, p. 143).

There are multiple factors such as illumination, distance from the object, and the influence of surrounding colours, which affect the colour appearance of a material. Billger (1999) makes the important point in her doctoral research that the spatial effects of colour have been reported, however, these are only through discussions concerning figure-ground features in pictures or the like. In contrast, situations where we are surrounded by colours had not

been investigated to any great extent prior to her research (Billger, 1999). She observed some aspects which contradicted previously held beliefs. For example, the colour appearance due to simultaneous contrast 'was not discernable when surfaces were separated in space or met each other at an angle. On the contrary, the effects of reflections or overspreading were most striking during these observations. In other words, the colours became more alike instead of contrasting with each other' (Billger 1999, p. 23). Others' observations, such as the effect of distance, were also used to provide insights into spatial context and colour appearance.

COLOUR in 2D and/or 3D

By using the ordering principles that the Gestalt psychologists identified, we are able to explain the apparent existence of three dimensional spaces in two dimensional representations such as paintings or photographs. Principles such as figure-ground propose that we perceive some aspects of our visual world, which are located on the same plane, as being dominant objects or surfaces (the figure), and therefore, to be 'in front' of other components (the ground). As a consequence spatial order is transformed and/or challenged by the context and the way that a person perceives the relative relationships between the elements.

Colour can influence the ordering of such elements. For example, certain elements can be unified or differentiated by the selection of a particular hue, the amount of hue, the variety of hues, tints or shades, and/or the degree of contrast. The integration of colour can cluster elements together or divide the grouping, unify a composition or cause it to fracture. Depending on the level of contrast the ability of aspects of the visual field to appear to move forward, to recede, to expand or to contract is affected.

It is also appropriate to note that certain colours have spatial qualities that differ from others. The tendency for some to advance and for others to recede is readily observed. This can be linked to various properties such as value, hue, temperature, and/or contrast.

The seminal work of the psychologist Katz (1935) included a list of the characteristics of the filmic appearance of colours which included colour's indefinite location. For example, the colour 'extended into space...; it appeared to have a spongy texture; one perceived one could reach into it; it was localised in a bi-dimensional...plane; it maintained a frontal position to the viewer; it was relatively smooth... and positioned its definition opposite to that of a definition of colour as a property of a surface (Willard, 1995, p.157). Willard proposes two elements associated with colour juxtaposition to be involved. These are 'high contrast of hue or near assimilation of hue and repeating element of design' (p.161). 'Although we perceive

the surface design of the painting, duration in viewing and optical mixing of the colours quickly generates an illusion of non-surface localized colour...'. It is important to also note that he claims that photographs cannot duplicate the filmic effects evident when looking at a painting. Viewing distance, size of receptive field, and luminance all play a role in the perception of the 'filmic mode of appearance' (p.162).

Colour and design education

These observations are all important in the design of the built environment where the form, space and experience are interrelated. Colour as an active player influences how people interpret and experience space or place. Therefore, colour effects need to be understood in relation to space. As we are largely unable to test our schemes in-situ, it is important to endeavour to capture the proposed spatial and colour effects in the studio.

The psychologist, J.J. Gibson 'criticised studies of spatial perception that were two dimensional and focused on one point of the visual field', and more recently Dahlin, in Scandinavian Colour Institute Report, states that because colour education often concerns two-dimensional studies there is a deficiency in applying such knowledge in space (Bilinger, 1999). As Billger goes on to say, there are major differences between looking into a room or site and when we are located in a room.

Educators world wide have strived to address this issue. For example, Thomson (1995) states that experimentation with the contrast of temperature results in an illusionistic progression of space. Meanwhile the design educator, Linton (1995) outlines how research into an artist's composition can reveal the influence of cultural background and aesthetic beliefs on three dimensional interpretation. This is the basis of his studio projects titled 'A spatial interpretation of a 2-D composition'.

In regard to the work discussed in this paper, the studio project (as part of an undergraduate course in Interior Design) has evolved over a number of years in an attempt to deal with these and other concepts. It was recognised through the evolution of the project work that the integration of two dimensional artists' work is highly appropriate for design education for those students who need to think and engage with design spatially. It will now be described.

Three dimensionality in artwork

By referring to paintings (or more specifically a body of work by an artist) we are able to see how particular patterns or practices of colour use can potentiate the way that we experience three-dimensionality in the two dimensions. For example, the works of artists such as Rothko,

Kandinsky, Bridget Riley, Matisse, Monet, or Mondrian represent different ways that colour can be integrated into works to create differing spatial characteristics. Feisner (2000), in her book *Colour. How to use colour in art and design*, states that Paul Cezanne 'demonstrated that subtle changes in the surface of a form and its spatial relationship to others could be expressed primarily in facets of color, modulated by varying degrees of tone, intensity, and temperature and the by the introduction of complementary color accents.' (p.139). Each artist's work involves a number of principles that can give us insights into colour juxtaposition and interpretation within a situation. The contextualisation of colour usage – as opposed to isolated colour chips or mixing exercises – is important for those people interested in the design of three dimensional spaces.

In order to help students to visualise the outcome of proposals for colour application and integration with the built environment, the project has been incorporated into a first year unit in the Interior Design degree course at the Queensland University of Technology, Australia. For interior and architectural design students a process that included the study of a two dimensional artist's work provided a stimulating and interesting reference source to assist them negotiate the application of colour to a context which is already three dimensional. The process and its outcomes will be described below.

The activity

The activity titled *Colour Application 1: 2D and 3D Relationships* involves three discrete yet interwoven stages. These are (a) a research component carried out in small groups, (b) the design of a three dimensional spatial 'installation' completed with a buddy, and finally (c) each student designed a colour design for an enclosed three dimensional space – a cube. The objective is for the student to apply in an informed manner their research (including observation and analysis), and for the students to develop their communication skills, knowledge of colour relationships and the associated theories, an ability to adapt and apply 2D principles to three dimensional forms and spaces, and an ability to successfully work in teams toward resolving a design task.

The research task is to investigate the light and colour theories of one artist or designer selected from a list provided. The group is required to identify who the artist/designer is, the period during which he/she worked, any group to which he/she belonged, typical examples of his/her body of work, and the principles of light and colour that are being applied.

Having completed the research and presented a seminar, each student creates a suspended 'installation'. This requires the student to identify the key principle/s of the artist's work that

they wish to explore and demonstrate. They may extend this principle beyond the artist's interpretation by considering the principle in conjunction with their knowledge of colour juxtaposition and the perception of spatial relationships. As previously highlighted, the installation design is based on the work of Lois Swirloff and is demonstrated in Figure 1. The students are asked to propose what may happen visually, to experiment, and to test their ideas. They are also asked to reflect upon what they have learnt and to explain their observations and analysis in terms of the theory in a work book or journal. The installation assists the student in visualising the two dimensional principles in three dimensions without having to apply them to a built form in the traditional sense.

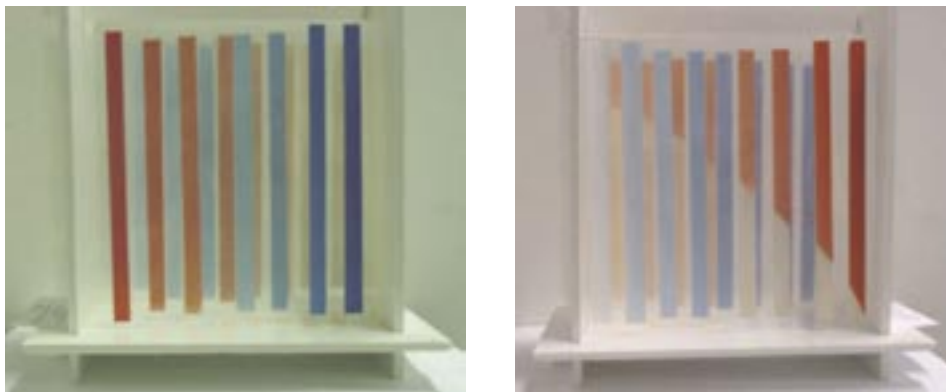


Figure 1: Spatial Installation (Student work: Krissy Collum, 2002).

The third step expands on the above principles through the application of colour to an enclosed space. The student is asked to consider the concepts of containment, expansion, and emotion as part of their design in association with the colour theory which had been discussed to date. The enclosed space (or cube) represents the three dimensionality of the built environment. Squares or rectangles may be cut from any of the sides to allow light into 'the interior' which is to be divided into two equal spaces as depicted in Figure 2. One of the sides is to be fully openable. On the right hand side an appropriate spatial quality and atmosphere is nominated to be created, while on the left hand side, a scheme that portrays the opposite spatial effect and atmosphere is to be designed. Vertical and horizontal planes may be inserted into the cube on either side. Every plane is to be a solid block of colour (not a pattern) and the colours are mixed by the student so the exact colour is obtained. Students are also asked to experiment, explore and test ideas and to record their hypotheses and the results in practice in their workbooks or journals as in the previous steps.

There are a number of artists which collectively demonstrate a cross section of principles that are relevant to designers of the built environment such as interior designers and architects. By

extracting these principles students are able to clearly identify the relationship between form, space, colour and perception.

A key role of the educative process is to inform students that colour application is more than decoration applied as a response to personal taste or style. Instead colour design addresses and extends the design concept and as a result is an active element in the design's development and resolution.

Student work: a case study

The example chosen is the work of Carolyne Jackson (and her research group). Carolyne was selected as she demonstrated a willingness to engage in the process and to readily explore the artists' work, to reflect on the principles revealed in association with her existing knowledge, and to apply the principles to the finished project through experimentation and self-evaluation. The research group selected Mark Rothko as their artist. The work of Rothko was broken down into periods by the group and the main points in relation to colour space and form identified. As Rothko is said not to like to be called a colourist, it is interesting how the students extracted information from other sources and then attempted to make linkages between their knowledge, interior design, and the 'new information' that they are acquiring. To demonstrate this point, quotes from their presentation are listed as follows.

Colour is no longer a secondary element that supports shape, it is now form & the vessel for transcendental meaning; [The work] was an art of spatial illusion; [It] creates figure-ground relationships; The colour floats in shallow depth over the colour field; and, He achieves this through adjusting colour values and its extent (Powerpoint presentation, 2002).



Figure 2: Reflective journal (Carolyne Jackson).

Figure 2 shows Carlyne's process journal. The journal is a document in which the student records his or her observations as they are developing their strategy and schemes. Unfortunately, not all students are as methodical or open to experimentation. The following comments (with her permission) are taken from Carlyne's journal. They demonstrate her ability to extrapolate information and to hypothesise what may happen when the principles are adapted to her work.

REFLECTIONS: *Hypothesis*

My original layout proved most successful. Based on the theories lectured to date it was based on the premise that colours of lighter value are most potent in their illusionary quality to advance. This may be manipulated by adopting contrast of extension evidenced in Rothko's work, although not the premise of this section of experiments. So too, the one dimensionality being explored may be represented by adopting Goethe's mathematical approach. Time permitting I would love to explore both these theories and many others further From the observation made side I. I would hypothesise that ordering of side B will be as follows ... the interplay of light may be responsible for illusory quality. The RED on side 1 appears to be more intense-red (orange) yet when viewed without O/H the colour is less defined (Carolyne Jackson, 2002).



Figure 3: *The reflective journal and The BOX: Three dimensional enclosed space (Carolyne Jackson).*

While constructing the box or cube, Carlyne's journal entries again reflect the development of her understanding of colour and space through her observations of the work in progress. An example is included below to demonstrate.

OBSERVATIONS:

By limiting the amount of natural light permitted, the colour loses the intensity relative to distance from natural light. Therefore, colour is dependent on light. This could be altered by inserting penetrations into the box.

SIDE A appears to recede further than side B

Therefore, by providing an insertion into the ceiling plane this could be minimised and the chroma therefore intensified. Grey appears more static in side B than A...this is attributed to the presence of the complementary colour Insertion.

Side B appears similar in hue to that in Side A although different.

This too I believe may be attributed to the absence of light, and the juxtaposition and therefore, interplay of colour where two colours of different hues adjoin, lighter colour appears intensified this contrasts with the interplay of the junction of an achromatic and chromatic colour, where the visual mixing results in a shaded version of the chromatic colour (Carolyne Jackson, 2002).

Student learning

A selection of students who were still enrolled in the program the following semester were asked to provide feedback on the unit. This was sourced to gain insights into the benefit of the exercise relative to the objectives of the project. Carolyne's feedback was as follows.

COMMENTS:

Rothko successfully reduced his work as an abstract impressionist to simple blocks of colour, yet despite this minimalist approach his works are dynamic & evoke an emotive response. The way in which he layered his colour, the context & proportion greatly informed by own investigations. The illusions of colour which he explored informed my approach in blurring the three dimensional field and giving the illusion that planes transcend their actual location. I found the activities...interesting, stimulating, useful and the theories both complex and simplistic (C.J., 2003).

'I have always been interested in the illusionary properties of colour and had witness the dynamism of colour although did not necessarily understand all the underlying theories...the theories are not in themselves difficult to comprehend but governing factors influencing colour make the theories themselves dynamic and fluid...colour cannot be viewed in isolation of its context and it is often the context that is complex. Such

knowledge has certainly been useful, colour (or the absence of) is a great tool to evoke a more emotive/spiritual response in design projects (C. J., 2003).

Feedback from other students who studied alternative artists or photographs of designers' work also supports the value of this project's approach. For example, the following comments were recorded.

I learnt about the subtle effects light has on white surfaces... and how different times of the day, eg. dawn and dusk, influence the perception of whiteness. The presence of light therefore added a temporal quality to the overall experience of an otherwise simplistic, white building (K. C., 2003).

...interesting, stimulating, useful, complex ... project (K. C., 2003).

I found the final box installation to be a simple way on envisaging how colour would affect different surfaces of a building according to proximity and space. The ability to easily change the relationships of colour around and play with the shifting results was helpful in understanding the way colour, light and space work in 3D (K. C., 2003).

Studying Barragan's use of colour in the built environment highlighted the importance of the natural environment in the application and selection of colour. His emphasis on light quality and the contribution it makes to our perception of colour was of great interest to me. Whilst Barragan was primarily known for his use of vibrant colours I took great pleasure in studying his more subtle interior colour schemes whose complexity often lies in [the] interplay with natural lighting and earthy textures (C. P., 2003).

...interesting and useful ...I found parts of the subject (such as studying Barragan) very interesting and rewarding...I feel the most important thing I learnt from light and colour was how light, shade and texture influence our experience of colour, what's more I think that these are qualities that you can only truly appreciate by physically experiencing the space. Studying Barragan made me aware of these characteristics but I only truly appreciated them by going out and finding examples in the built environment (C. P., 2003).

Summary

The two major components which are the basis of this project are space and colour. I commenced this discussion by looking at space, describing the shift from Cartesian or defined and measurable space to understandings of relativity; space which is dynamic and experiential in nature. Berleant (1991) raises our awareness of how these concepts may be applied when looking at paintings (or photographs) of landscapes and drew our attention

to how understandings of space are embedded in these works. Our understanding of the resultant spatial phenomena is also due to colour – colour in context.

These effects and/or relationships can be analysed whether the subject of our analysis is an abstract painting or a building as the architect Minah suggests. There is a risk in schools of design to concentrate on the two dimensional aspects of colour because of the tradition of the exercises or practices that inform colour education. As a consequence, some interior design or architecture courses have sought projects which develop exploration and/or conceptualisation of colour relationships in the third dimension. In association, an investigation of interpretation and experience may also be incorporated into the project work.

In the current project through the use of well known artists, the students have a structure and/or strong basis to use as a launch pad to further experiments. Collectively, these aspects are the basis of the project introduced and described in this paper. Through the example given, the potential of the activities to foster positive attitudes toward observation, analysis, experimentation, discovery, as well the development of an understanding of colour theory and confidence in its application is also evident.

The need to examine the work from multiple viewpoints is important. Billger's warning that to look at a space is not the same as being surrounded by it should be noted. In this paper, three-dimensionality is identified as incorporating (a) inherent colour characteristics, (b) relationships, and (c) the particular context. Evidence of how these aspects are 'played out' can be understood by interrogating the work of artists and by exploring the effects in three dimensional sculptures or environments. This also serves to link colour effects with meaning and emotions, thereby, challenging us to move into the work, as well as, to analysis it from the outside in the viewer-state.

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