THE INFLUENCE OF PAINTING ON THE ARTIST'S VISUAL PERCEPTION

by

ANNETTE SOPHIA PRETORIUS

PRESENTED IN PARTIAL FULFILMENT OF THE DEGREE
D Phil (Fine Arts)

in

the Faculty of Arts

University of Pretoria
Pretoria

PROMOTOR: PROFESSOR N O ROOS

November 1998

BEDANKINGS

Die volgende persone het 'n bydrae gelewer tot die voltooiing van die tesis, en ek wil hulle graag bedank.

My promotor, professor N O Roos, het 'n groot aandeel aan my vorming. Met sy insig in my en kennis van die vakgebied kon ek die projek voltooi.

My familie se ondersteuning is baie belangrik. My ouers, my broer Johan en skoonsuster Julie het my altyd bygestaan.

Die tikster, mev Malan, was geduldig met veranderings en byvoegings wat gemaak is. Die proeflesers mej Eleonora Viljoen en me A Sales het noukeurig deur die teks en bibliografie gegaan.

Mev M van Niekerk se tegniese en strukturele kennis van tesisse was deurslaggewend.

My kollegas het my aangemoedig om my studies te voltooi. Pretoria Technikon het my finansieel ondersteun met die afronding van die tesis.

SAMEVATTING

Die doel van die tesis is om vas te stel of skilder die skilder se visuele waarneming beïnvloed. In die eerste plek om hierdie stelling te bewys, moet kousaliteit bewys word. Twee moontlikhede van kousaliteit bestaan. Die eerste moontlikheid wat oorweeg word is dat skilder die kunstenaar se visuele waarneming beïnvloed. As voorbeeld word Pablo Picasso se 'Guernica' bespreek. Hierdie skildery word deur die kunstenaar ervaar as 'n geldige visuele weergawe van die realiteit al is dit nie 'n realistiese weergawe van die gebeurtenis nie. Die tweede moontlikheid van kousaliteit wat oorweeg is, is dat die skilder visuele waarneming gebruik om die werklikheid te interpreteer. As voorbeeld word Hendrik Pierneef se werk bespreek.

In die tweede plek word die ooreenkomste tussen skilder en visuele waarneming ondersoek om te bepaal of analogiese gevolgtrekkings gemaak kan word ten opsigte van visuele waarneming deur middel van 'n studie van skilder. Ooreenkomste word gevind tussen die strukturele elemente van visuele waarneming en die formele eienskappe van skilder. Albei bestaan uit lig, kleur, diepte en vorm. Verskille tussen die strukturele elemente van visuele waarneming en die formele eienskappe van skilder, behels die moontlikede vir interpretasie wat uitgeoefen word of nie noodwendig uitgeoefen word nie. Dus: wanneer die kunstenaar 'n voorwerp waarneem en die formele eienskappe aanwend om 'n skildery te maak, ervaar hy dit as 'n geldige interprestasie van die werklikheid. In kotras is die reaksie op die strukturele eienskappe van visuele waarneming 'n

fisiologiese proses en die waarnemer is nie noodwendig bewus van 'n interpretatiewe proses nie.

'n Historiese oorsig van die ontwikkeling van skilder en die ontwikkeling van teorieë van visuele waarneming word gegee. Elke era maak 'n bydrae ten opsigte van die analogie wat getref word tussen die twee onderwerpe.

Die teorie van visuele waarneming wat waarneming beskryf as gefragmenteerd, is sentraal tot die skripsie. Aspekte van samevoeging ten opsigte van gefragmenteerde waarneming word analogies aan die skilderkuns se integrasie van die formele eienskappe, onthaal.

Die spekulatiewe sienings van Goldman-Rakic en Peterson ten opsigte van samevoeging in visuele waarneming word vergelyk met die eienskappe van samevoeging wat analogies uit die skilderkuns afgelei is.

Hierdie skripsie se gevolgtrekking is dat samevoeging in die skilder se visuele waarneming 'n aktiewe sentrale meganisme is wat nie-relevante detail uitskakel. Peterson se siening word dus ondersteun. Die bydrae van hierdie skripsie is dat eienskappe van binding in die skilder se visuele waarneming deur aspekte van die skilderkuns beskryf word. So is een aspek van die skilderkuns, naamlik die wisseling in die volgorde van die formele eienskappe, deurslaggewend in skilder en die konsep is analogies toegepas in visuele waarneming. Hiervolgens word fisiologiese visuele

waarneming beskryf as 'n visuele gebeurtelikheid of die gevolge van sekere omstandighede soos wat 'n skildery 'n gebeurlikheid is wat omstandighede weerspieël.

Vryetaal Sleutelterme Afrikaans

1. Visuele waarneming en skilderkuns.
2. Strukturele elemente in visuele waarneming en 'n analogie met die skilderkuns.
3. Formele eienskappe in skilderkuns en 'n analogie met visuele waarneming.
4. Die invloed van skilder op visuele waarneming.
5. Holistiese denkpatrone in die skilderkuns.
6. Afwisseling in die volgorde van die formele eienskappe in skilderkuns.
7. Die invloed van komposisie patrone in skilderkuns op visuele waarneming.
8. Gefragmenteerde waarneming en die skilderkuns.
9. Samevoeging/binding in visuele waarneming en skilderkuns.
10. Geskiedenis van die formele eienskappe in die skilderkuns.

INTRODUCTION

The aim of this thesis is to determine if painting can influence the painter's visual perception. The nature of the research is exploratory. The possibility of causality needs to be proven. Two possibilities of causality exist. The first possibility is that painting can influence the artist's visual perception. Pablo Picasso's 'Guernica', for example, is experienced as a valid visual representation of reality by the artist although it is not a realistic depiction of the event. The second possibility is that the painter uses visual perception to interpret reality.

The similarities between painting and visual perception are explored to determine if analogous inferences regarding visual perception can be made from a study of painting. Similarities are found between the structuring elements of visual perception and the formal properties of painting. Both the structuring elements and the formal properties consist of light, colour, depth and shape. Differences between the structuring elements of visual perception and the formal properties of painting are found in the interpretative possibilities that exist or does not necessarily exist. When the artist looks at a subject and applies the formal properties to make a painting he experiences this as being a valid interpretation of reality. In contrast the reaction to the structuring elements of visual perception is a physiological process and the viewer need not necessarily be aware of the interpretative process.

Historical overviews regarding the development of painting and the development of theories of visual perception are given. Each historical era added elements to the field of visual perception and painting that contribute to an analogy between the two subjects.

The similarities between visual perception and painting warrant an analogy between the two. Recent advances in the study of visual perception exposed the fractured nature of visual perception. This poses the problem of binding in the visual perceptual process. Analogous inferences drawn from painting regarding the binding mechanism in visual perception, favour one researcher's point of view rather than another's.

The viewpoint held in this thesis is that painting influences the visual perception of the artist. The artist seeks meaning through visual perception. Painting necessitates visual differentiation and choice. Imaginative value is added to visual perception through the choices made by the painter in his depiction. This viewpoint is not valid when visual perception does not seek meaning.

The particular contribution of this thesis as far as the artist is concerned lies in the analogy that can be drawn through physiological visual perception as a consequential perceptual happening and the consequential construction of paintings.

Keywords

1.   Visual perception and painting.

2.   Characteristics of the structuring elements in visual perception analogous to painting.

3.   Characteristics of the formal properties of painting analogous to visual perception.

4.   Influence of painting on visual perception.

5.   Holistic thinking in painting.

6.   Sequential employment of the formal properties in painting.

7.   The influence of patterns in painterly composition on visual perception.

8.   Fractured perception and painting.

9.   Binding mechanism in visual perception and painting.

10.   History of the formal properties in painting.

INDEX
CHAPTER 1

CHAPTER 2

CHARACTERISTICS OF PAINTING

CHAPTER 3

CHARACTERISTICS OF VISUAL PERCEPTION

CHAPTER 5

CHAPTER 1

1.1 DEFINITIONS OF CENTRAL CONCEPTS

1.1.1 What is a theory

A theory is, according to the "*Oxford English Dictionary*" (Simpson, 1989, p.902), "*A scheme or system of ideas or statements held as an explanation or account of a group of facts or phenomena; a hypothesis that has been confirmed or established by observation or experiment, and is propounded or accepted as accounting for the known facts; a statement of what are held to be the general laws, principles, or causes of something known or observed.*"

1.1.1 What is a hypothesis

A hypothesis is defined by Simpson (1989, p.581) as "*A subordinate particular thesis involved in a general thesis; a particular case of a general proposition.*"

It is also "*A proposition or principle put forth or stated (without any reference to its correspondence with fact) merely as a basis for reasoning or argument, or as a premiss from which to draw a conclusion; a supposition. In logic, the supposition or condition forming the antecedent or protasis of a conjunctive or conditional proposition*" (Simpson, 1989, p.582).

Furthermore, it is "*An actual or possible condition or state of things considered or dealt with as a basis for action; one of several such possible conditions, a case or alternative*" (Simpson, 1989, p.582).

Finally a hypotheses is also "*A supposition in general; something supposed or assumed to be true without proof or conclusive evidence; an assumption*" (Simpson, 1989, p.582).

The theory of visual perception expounded here is a theory because it fulfils the conditions set by the definition, namely that the

phenomena and facts contained in this theory of visual perception have been validated by observation and experiment.

The analogy drawn between certain characteristics of painting and of a theory of visual perception forms the basis for the hypothesis that painting can influence a theory of visual perception because the painter seeks meaning through visual perception. In this instance it is a hypothesis because it aims to expand the theory of visual perception through a study of the characteristics of painting and because the deductions have not been conclusively established through observation and experimentation, mainly because the analogy has not been considered to this extent before.

1.1.3   What is perception

According to Simpson (1989, p.522) the meaning of perception is derived "*From the secondary or metaphorical sense of (Latin) percipere, to be or become cognizant of. The taking cognizance or being aware of objects in general; sometimes practically (it is equivalent to) consciousness. In strict philosophical language ... the action of the mind by which it referees its sensations to an external object as their cause. Distinguished from sensation, conception or imagination, and judgement or inference*" (Simpson, 1989, p.523).

In a psychological sense its meaning is: "*the neurophysiological process, including memory, by which an organism becomes aware of and interprets external stimuli or sensations*" (Simpson, 1989, p.523).

In 'The Dictionary of Art' (Turner, 1996, p.375) perception is defined as the "*term for the way that humans see and understand what they see.*"

The definition in 'The Oxford English Dictionary' does not assume perception to be only visual but it can also be, for example, auditory.

In 'The Dictionary of Art' perception is assumed to be visual. Another concept important in relation to perception is 'seeing' or 'see'. According to Simpson (1989, p.864) to see is "*to perceive (light, colour, external objects and their movements) with the eyes, or by the sense of which the eye is the specific organ*" and seeing is "*the action (rarely an act) of the verb see*" (Simpson, 1989, p.875).

A definition for visual perception can then be derived from the definitions quoted above. Visual perception can be defined as an action of the mind, a neurophysiological process, which includes memory, and by which humans become aware of and interpret external visual stimuli.

See can be defined as becoming aware (perceive) with the eyes, or by the sense of which the eye is the specific organ.

The difference between seeing and perceiving is therefore slight. Perceiving is defined as "*a becoming aware, observing, cognizance, perception*" (Simpson, 1989, p.521).

In order to avoid confusion the definition of perception as given by Turner in 'The Dictionary of Art' is accepted for this thesis, because the point of reference remains the fine arts. Thus visual perception is defined as the "*term for the way that humans see and understand what they see*" (Turner, 1996, p.375).

1.1.4　What is an idea

In Platonic philosophy an idea is "*a supposed externally existing pattern or archetype of any class of things, of which the individual things in that class are imperfect copies, and from which they derive their existence*" (Simpson, 1989, p.613). In this sense, because the idea 'theory of visual perception' exists, there is a supposed externally existing archetypal theory of visual perception. But the individual or specific theory regarded here is imperfect and can be expanded to bring it nearer to the archetype.

1.1.5   What is a model

According to Simpson (1989, p.941) a model can mean to "*portray or describe (something) in detail*".

According to this definition the expansion of the existing theory of visual perception in this study leads to the realisation of a model of an expanded theory of visual perception.

1.1.6   What is a method

A method is "*a mode of investigation ... a special form of procedure adopted in any branch of mental activity, whether for the purpose of teaching and exposition, or for that of investigation and enquiry*" (Simpson, 1989, p.690).

The following method is used in this study: A specific theory of visual perception is put forward. This theory is compared to another theory of visual perception and shortcomings or areas not yet explored are exposed. Similarities between the characteristics of painting and the specific theory are expounded. In an analogy the other characteristics found in a painting and which are relevant to a theory of visual perception, but as yet not explored, are examined. The possibility that characteristics found in painting can lead to an expanded theory of visual perception. The possibility of adaptations of the characteristics of a painting to a theory of visual perception is thus explored.

1.1.7   What is an analogy

Simpson defines an analogy as a "*correspondence or adaptation of one thing to another*" and in logic as a "*resemblance of relations or attributes forming a ground of reasoning. The process of reasoning from parallel cases; presumptive reasoning based upon the assumption that if things have some similar attributes, their other attributes will be similar*" (1989, p.432).

In this thesis the analogy is drawn between the similar attributes of painting and the attributes of visual perception. The assumption is that the other attributes of the two subjects will show similarities. The analogy is used to enrich both subjects: it firstly shows the most basic characteristic of painting and secondly provides a point of reference (painting) for revealing issues about and proposing options to consider for key problems in theories of visual perception. In the search for an answer to what painting reveals about human perception, an analogy between painting and a theory of visual perception can also be of value; it can open up avenues for further research in both subjects. These are, however, not parallel cases because visual perception is a physiological process and painting is an interpretative process. But the eye that perceives without making a choice is the same as the eye that chooses.

1.1.8   What is a painting

A painting is defined as "*the result or product of applying paint or colour ... a representation of an object or scene on a surface by means of colours; a picture ... the representing of objects or figures by means of colours laid on a surface; the art of so depicting objects*" (Simpson, 1989, p.72).

To the definition of a painting the following characteristics of a painting can be added:

- a painting consists of different structuring elements, namely colour, line, form and space;
- in a painting the different elements are combined to form a composition; and
- the painting reveals preferences on the part of the painter.

The painter's preferences are revealed through a study of the mode of application of the elements and a study of the composition of the painting.

1.1.9   What is influence

Influence is defined as "the power to produce an effect ... to exert an influence on, to affect (Simpson, 1989, p.421). The influence on painting on the artist's visual perception implies a causality. The problem is to prove causality. This problem is referred to in paragraph 1.2.3.

1.2   AN EXPLORATION OF THE CONCEPT 'THEORY OF VISUAL PERCEPTION'

1.2.1   The meaning of 'theory' in the context of the visual arts

Different forms of writings are distinguished in the context of the visual arts for example manifestoes, treatise and also theories.

A manifesto is usually when artists write about their art. It usually attempts an explanation or a motive for their actions and work. For example, the Dadaist Tristan Tzara issued the 'Manifeste Dada' in 1918, which stated that Dada is "*the roar of contorted pains, the interweaving of contraries and of all contradictions, freaks and irrelevancies: life*" (Turner, 1996, p.434).

A treatise can contain theories formulated previously, but it is a writing on a specific subject. It contains "*a formal or methodical discussion or exposition of the principles of the subject*" (Simpson, 1989, p.464). For example, the early Renaissance painter Piero Della Francesca (1416 - 1492) wrote a treatise on perspective called 'De Prospectiva Pingendi.' His "*treatise is divided into three parts: perspective of flat figures, perspective of solid (columns, human head, etcetera), perspectives of the same bodies according to the practices of the studio. That is to say, it does not systematise theorizing, but with (drawing) exercises (for painters)*" (Murray, 1967, p.109).

A theory is produced after experimentation and observation of phenomena lead to an explanation of the phenomena. Perceptual

researchers, for example, produced theories on perception which are of interest to both artists and philosophers of art. Their concern was the question "*how the picture in two dimensions relates to the spatial arrangement in three (dimensions) ... and what this reveals about human perception*" (Turner, 1996, p.375). Their particular field of observation and experimentation was perception, particularly the perception of pictures. One of the explanations of this phenomenon was the theory of empiricism which states that "*all ideas and knowledge, including those of depth and distance, are learnt associations between elementary sense data, or sensations ... - and more narrowly, 'conventionalist' arguments that pictures, and all pictorial elements suggesting depth, are arbitrary socially determined signs*" (Turner, 1996, p.375).

1.2.2   The meaning of 'theory' in the context of this thesis

The theory of visual perception principally regarded in this thesis is derived from observations and experimentation, and is accounted for by known facts. This theory states that visual perception is fractured. The background, description and implication of this theory is described in chapter three. The research and formulation of this theory was done by scientists. Superficially seen, because this theory was formulated outside the parameters of the visual arts, it would not be of interest to artists and philosophers of art. However, perception is often a subject of research in relation to painting and the perception of paintings. A theory of perception, even if it was not formulated primarily in the context of the visual arts, could thus be of interest to artists and philosophers of art, because of the new point of view it can afford to both subjects.

For example, a theory that demonstrates the influence that a theory of visual perception can exert on painting was instigated by Johann Wolfgang von Goethe (1749 - 1832). His experimental work on colour and insight into the aesthetics of colour harmony, contained in the book 'Zur Farbenlehre', is thought to have indirectly influenced, among other painters of the nineteenth century, Eugène Delacroix (1798 - 1863) and through him the impressionists. Delacroix aimed to apply scientific principles to resolve technical

problems. Although it is difficult to ascertain, it is thought that Delacroix was aware of and influenced by the theory of colour perception derived from Goethe's studies and formulated by Michel-Eugène Chevreul (1786 - 1889) in 'De la Loi du Contraste simultané des Couleurs' of 1839. (The contact of Goethe and Chevreul was through a third person: Philipp Otto Runge. His thoughts and book, 'Die Farbenkugel', were influenced by and, in turn, influenced Goethe and was known to Chevreul.)

Chevreul's investigations had an impact on the development of new theories of colour at the end of the nineteenth century. "*For the practicing artist, the most significant of Chevreul's ideas was that a colour seen alone will appear to be surrounded by a faint ring of its complementary colour*" (Turner, 1996, p.645). Delacroix applied this idea through adding the complementary of a colour to achieve a half tone rather than to add black to get a halftone, for example, in preparatory studies for the painting 'The Entry of the Crusaders.'

Delacroix's increasing use of pure colour and the contrasts of hue rather than tone, under the influence of Chevreul's theory of colour perception, influenced the use of colour of the impressionists who studied Delacroix's work. For example, in the work of George Seurat (1859 - 1891), the notions of complementary colour and optical mixture were to remain central to his thinking and painting.

Goethe thus instigated the theory of colour perception that influenced the impressionists.

Another theory referred to in this thesis, and which influenced painting, is linear perspective, formulated mainly by Renaissance mathematicians. As in the example of the theory of colour perception of Goethe, these two perceptual theories influenced and can still influence painting, profoundly. Conversely in this thesis the stance is taken that painting can influence a theory of visual perception. Primarily this was suggested by the historical link created between perceptual theories and painting (for example in the case of the impressionists).

1.2.3 The concept 'visual perception' in the context of this thesis

This study does not purport to explain the phenomenon of visual perception. It reflects on one of the current theories regarding the interpretation of visual perception namely fractured perception from the perspective of painting. Many aspects of visual perception are not included in this study or indirectly addressed because they do not clarify a specific issue on the hypothetical influence of painting on a theory of visual perception. For instance, two aspects that are omitted: firstly "*the ability to fuse flickers of light into a continuous pattern,* [and secondly] *the ability to fuse the slightly different set of information from the two eyes into one image*" (Froman, 1969, p.5).

Aspects that are considered to make an important contribution to the understanding of visual perception include eye disease and abnormalities in perception.

For example, localized injury to a small area of the cortex was observed to lead to partial loss of perception. For example, only the perception of line will be lost or some perception of colour. The fact that only partial loss of perception occurred contributed to the better understanding of visual perception, which in turn lead to the formulation of the theory that perception is fractured.

The focus of the study is also not the visual perceptual concerns that have already been extensively and scientifically researched and that pertain to the interest of both artists and philosophers of art. The perception of pictures is such an instance which is of interest to artists, philosophers of art and theorists of perception, but has been extensively researched. For example, paintings are two dimensional "*but can represent three dimensional spatial arrangements of entirely different objects*" (Turner, 1996, p.375). The question that arises from this is: how a two dimensional picture can be perceived to represent the spatial arrangement that occurs in the three dimensional world and also what this says about visual perception.

© University of Pretoria

Digitised by the Open Scholarship & Digitisation Programme, University of Pretoria, 2016

The focus of this thesis is the fact that this question is posed and not the answer to the question. The reason is that although this question is asked in the context of the perception of pictures, it does create a link between visual perception and painting. It is necessary to point out the link between visual perception and painting because, although it may appear obvious that it should exist, it is difficult to circumscribe. Once a link is established it can have a wider application in the field of visual perception such as in a study of the influence of painting on visual perception which is the focus of this thesis.

It has to be established that a link between painting and the painter's visual perception can lead to causality, in other words that painting can influence the artist's visual perception.

Two possibilities of causality exist. The first possibility is that painting can influence the artist's visual perception. Pablo Picasso's 'Guernica' for example, is experienced as a valid visual representation of reality by the painter although it does not directly depict the event of the bombing of Guernica.

The second possibility is that the painter uses visual perception to interpret reality. The painter seeks meaning through visual perception. Painting necessitates visual differentiation and choice to establish meaning. Value is added to visual perception through the choices made by the painter through his depiction. An instance is Pierneef's rendering of a tree. Picasso's 'Guernica' illustrates that a link between painting and the painter's visual perception can lead to causality. It is a response to the bombing of the Spanish town Guernica on 26 April 1937, prior to the Second World War. The painting was therefore motivated by a historical event. Picasso did not experience the event but learned of it in Paris through contradictory and distorted news reports. The French newspapers that Picasso were known to read 'Le Figaro' and 'Ce Soir' however, published photographs of the shattered buildings of Guernica on 30 April and 1 May 1937. Another newspaper 'Humanité' published photographs of women and children killed in an earlier attack.

Therefore, Picasso had access to accurate visual information of Guernica after the bombing and of victims of a similar attack. But his sketches on 1 May 1937 did not include scenes of war.

Instead he commenced with the bullfight - a theme that occupied him since childhood. He turned inward and transformed the emotions of shock and outrage into images of violence and suffering based on those already present in his painting. The final painting was preceded by many sketches and the style of drawing in these sketches varied between detailed realism to spontaneous scribbles. The drawings and his personalized imagery changed his perception of the event.

Because the images were based on those already present in his work, it carried an emotional charge and contains a wide range of personal meanings such as reference to the ritual of the bullfight. He did not attempt to represent the event of the bombing (although there is the suggestion of flames behind one building to the viewer's right) but his final composition has many levels of meaning that represents the effect and emotion of the event. Picasso made a visual representation of chaos and suffering. Although he had some visual access through photographs of the aftermath of the bombing, he did not use this but painting influenced his perception of the event. However, 'Guernica' is experienced as a valid visual representation of reality by the painter.

As an instance of the second possibility of causality Pierneef's rendering of a tree was so characteristic that it influenced viewers to recognize Pierneef's trees in nature. Pierneef employed his visual perception with the intention to distill some qualities of the tree in order to capture this in his painting. It not only caused viewers to notice aspects of the trees that they would not necessarily have noticed without having seen the painting but they also recognize Pierneef's trees in nature. In this instance of causality, painting influences the viewer's visual perception of nature.

From these two examples it can be concluded that painting can influence visual perception. Thus a link between painting and the artist's visual perception can lead to causality.

1.2.4 What advantages do the formulation of a theory of visual perception offer

Theories of visual perception order the interpretation of impressions. They make an objective interpretation and representation of subjective visual information possible because subjective information is often confusing in its emotional and intellectual implications; reference to a theory clarifies and gives structure to the experience.

This structure also gives a greater possibility for the exploration of ideas not previously noticed. This can happen because the relationship and differences between any impression or idea, such as Neethling's brain profile, and the structure can be examined as in chapter five. However, this contemplation will inevitable lead to the adaptation of the theory.

Theories also allow looking at the world in terms of sets of integrated relations, the so-called systems view. Here different theories can be compared with one another and can be combined to enrich perception and representation. A theory of perception is also built into mechanical man-made imaging systems, such as cameras and photocopy machines. these systems can surpass and extend human vision in certain instances. For example, certain types of film can detect frequencies not visible to the human eye. When the eye seems to compare unfavourably with a mechanical system it is because of the terms of reference adopted. By studying man-made imaging systems the human visual system can be extended and spatial and perceptual information otherwise unnoticed can be made visible.

1.2.5   A theory as a restriction

It could be argued that each person has a theory of perception that enables him to see. This theory has been acquired by trial and error since birth and has stood the test of time. It thus seems to be the 'right' way of looking because it fits the individual's needs and expectations and it also fits the expectations of others. It is not essential to his immediate survival to question his perceptual skills. Even a threat to his survival would not immediately suggest an adjustment in his theory of perception; it would at the most cause a scanning of possibilities within the framework of this theory.

This argument points to the fact that because this theory seems to satisfy the individual's needs (he cannot experience its restriction because he does not know an alternative), it is very difficult to evaluate and change the theory. It would cause a great deal of anxiety to abandon the protection of this seemingly solid perceptual structure and to question the validity of this structure which has always met the individual's needs and ensure his survival in many situations.

This anxiety would explain the mind's natural resistance to new ideas and the actual opposition that exists in regard to, for example, scientific discoveries. It is natural to prefer to avoid this anxiety and rather not to face and question the restrictions imposed by an acquired perceptual theory.

The question arises why it would be necessary to try to expand perception. It could be explained as necessary because perception is the tool which enhances every experience. It makes possible the experience of things which would otherwise not have been noticed. The expansion of perception thus leads to greater awareness and sensitivity.

It is not only anxiety that inhibits the search to expand a theory of visual perception. According to Beveridge (writing about scientific discovery), the significance of a detail is not appreciated or understood if it does not comply with the beliefs of its time.

Beveridge makes the following remarks regarding scientific discovery. He states that the scientist only infrequently has the opportunity to make a worthwhile discovery. Novel procedures enhance the possibility of encountering a fortunate accident because chance can play a role in discovery. Beveridge stresses that acute "*powers of observation are often required to notice the clue and one needs the ability to remain sensitive and alert for the unexpected while watching for the expected. The most difficult phase would be to interpret the clue and to grasp its possible significance. This requires a prepared mind*" (Beveridge, 1979, p.34).

Although Beveridge wrote this to illustrate the process of scientific investigation, it would also be applicable to the investigation of a theory of perception and to the use of new information in the process of generating ideas.

An artist has to acquire a theory of perception to represent impressions. This is often not a very formal process but it is usually deeply considered and only arrived at after many experiments and creative insight, and it is constantly in revision and changing. The inherent restriction in a theory is not necessarily a disadvantage and indeed seems to be the only way in which to define and represent impressions.

When, for example, linear perspective was introduced by Brunelleschi in the Renaissance it excluded many other possibilities (such as the enlargement of important detail), but it was a breakthrough for the construction of pictures in a specific way. Its advantages were so many that it remained virtually unchallenged in Western art for nearly two centuries, until the advent of Cézanne. Gombrich states: "(Cézanne) *was not out to distort nature; but he did not mind very much if it became distorted ... provided this helped him to obtain the desired effect ... He threw it* (linear perspective) overboard when he found that it hampered him in his work" (1974, pp. 432-433).

A theory is thus a restriction when it inhibits the exploration of questions and the representation of impressions. However, a theory is an advantage when this system-making gives free reign to the imagination. This mostly happens when an intensely personal way of perceiving, interpreting and representing the world is present. The mind feeds upon itself without the intrusions of stereotyped points of view or the exigencies of practice or a representation that would not challenge the viewer. This personal view shakes up inherited habits and in this way is continuing the visual evolutionary process under the pressure of ongoing questioning that results from a desire for deeper knowledge.

I suggest that the purpose of theories of visual perception is not to have a realistic concept or representation of reality, but to go beyond the ordinary view of reality. Speculatively one could say that this is the case because a theory of perception overemphasises one aspect of a specific way of perceiving the world (a restricted view). In one way our ability to perceive the world in depth expands our perceptual ability in general and makes us more sensitive because this ability could be applied in other contexts as well as could lead to insight in other areas. Restriction and simplification can thus lead to greater depth in insight.

1.2.6   **Difficulties at establishing theories of visual perception and the diverse fields of application of visual studies**

The diverse fields of application of visual studies and a brief mention of two of these applications show the wide range of applications and the difficulty to establish a theory of visual perception. Theories of visual perception have an application in many fields, not only in the visual arts but also in, for example, science and psychology.

One theory of perception (which does not specify 'visual' perception but includes all the senses) is the empiricist theory of perception. This theory states that "*perception provides us with pure facts*"

(Brown, 1977, p.81). The empiricist holds the view that data can be perceived without reference to a theory. Brown questioned this theory and proposed instead that "*the knowledge, beliefs and theories we already hold play a fundamental role in determining what we perceive*" (1977, p.81).

A second study of perception is the study of two visual systems. This study states that in human infants smooth pursuit - "*the oculomotor mechanism that maintains the image of a moving target on the fovea*" (Fisher, 1981, p.32) - "*is mediated primarily by cortical structures, whereas developmentally immature saccadic movements are mediated primarily by subcortical structures (e.g. the superior colliculus)*" (Fisher, 1981, p.48). This study is questioned by Richard N. Aslin stating that "*the applicability to humans is obscured by the absence of animal data on the functional development of visual structures and pathways that mediate specific oculomotor responses. Moreover, the cortical-subcortical distinction is undoubtedly too simplistic since many cortical, thalamic, cerebellar, and brain stem areas are known to be capable of influencing oculomotor responding. It seems reasonable to delay speculations about the anatomical and physiological mechanisms underlying the development of smooth pursuit until more data on these issues of structure and function have been collected*" (Fisher, 1981, p.48).

Anslin's approach is to focus rather on general abilities deemed necessary for smooth pursuit in infants than to attempt "*detailed speculations about the specific physiological mechanisms underlying these abilities*" (Fisher, 1981, p.48).

In the first instance, the empiricist theory of perception, Brown's questioning of this theory centres on the ability to derive pure information from perception only, without reference to a set theory or a frame of reference. Brown's view is that "*in order to derive information from perception it is necessary that I be able to identify the objects that I encounter, and in order to identify them it is necessary that I already have available a relevant body of information*" (Brown, 1977, p.82).

The empiricist maintains that the objectively perceived data is not burdened by theory which would destroy objectivity. The empiricist's stance is that it would be impossible to objectively test data if it can only be tested from the data produced by this theory.

However, Brown states that his theory can be interpreted to imply that perception is formed from "*already structured but still malleable material. This perceptual material, whatever it may be, will serve to limit the class of possible constructs without dictating a unique percept*" (Brown, 1977, p.82).

Brown's stance includes some of the empiricists' view that pure data can be provided by perception, but he insists on the necessity of also having access to knowledge, beliefs and theories from which to derive information from perception.

(a) From the brief discussion on the empiricist's theory of visual perception and Brown's theory of perception several issues emerge concerning the application of theories of perception.

   (i) Brown is a scientist; this underlines the fact that theories of visual perception have a wide field of application. They do not only influence the visual arts.

   (ii) The empiricists formulated a theory of perception and this was questioned by Brown. Thus the conclusion can be drawn that perceptual theories are formulated to study man, as the empiricists formulated a theory, but eventually these theories are adapted and revised to form a more accurate and comprehensive theory or new facts emerge that invalidate the theory. It is thus to be expected that a new theory will emerge.

   (iii) Because different theories highlight different aspects they tend to be incomplete observations of the subject. However, even when a theory can be criticized it usually does illuminate one area of perception. Many details

(until that time unobserved) are then brought to light around this one area that the theory illuminates. The empiricists, for example, underlined the importance of avoiding theory-laden perception and proving theories by employing data produced by the theory under investigation. Thus theories are applied to illuminate specific areas of a subject, bringing to light new information on a subject.

(iv)   Theories can also lead to the grouping together of information previously thought to be incompatible or never previously regarded together. This leads to a new insight into the subject being studied. But the problem that Brown detects in the empiricist theory is the question of access to new information if there is no frame of reference or theory from which to proceed. His assertion that experience, which is formed by knowledge, beliefs and theories, is paramount to perception is convincing because the wider the individual's experience, the more information he will perceive from a given situation and the more likely he is to gain access to new information and to arrive at new solutions. However, in certain situations, such as teaching visual art students, it is desirable to teach skills that would enable a person to arrive at unique solutions to perceptual problems. Due to limited experience, the student often cannot arrive at a unique solution of his own accord. These skills usually consist of the grouping together of information previously thought to be incompatible, for example through brainstorming sessions.

(b)   From the description of the theory of the two visual systems and the objection to this theory by Aslin, the following issues come to the fore concerning the application of theories of perception.

(i)   Firstly, Aslin is a human engineering scientist interested in eye movements in infants and what this reveals about

perception. His interest would have an application in the field of human sciences rather than a direct influence on the visual arts.

(ii)   The formulation of a theory is very complicated. In this example Aslin described the difficulties encountered in the search for objective recording techniques regarding eye movement. He also refrained from formulating a theory because of insufficient information regarding the anatomical and physiological mechanisms underlying this phenomenon. Thus before a theory can be formulated and applied, extensive research is necessary.

1.2.7   Structured elements in theories of visual perception

In formulating a theory of visual perception, the following visual elements and their combinations and influence on one another have to be considered. (These are also structuring elements or formal properties in painting.) The elements are light, colour, depth and movement.

(a) **Light as a structuring element in theories of visual perception**

Although different theories of visual perception interpret visual perception in different ways, the elements involved in stimulating visual perception remain constant. Although perception does not exclusively depend on the quality of the information received and relayed by the retina, it does influence the perception decisively. If critical information about the object is omitted from the image formed on the retina, the information omitted cannot be regained later on in the perceptual process. The quality of the images formed on the retina is directly influenced by the light source and the presence or absence of light. Although light is a key element in perception, the study of the physics of light is not essential, in this context, to an understanding of theories of visual perception. However, a simplified description of an

distribution of light (and the image) is in sharp focus on the retina.

Light can also be reflected by an object and via this route the quanta will again travel in straight light paths to the eye and enter through the lens.

This is a summary of the nature of light and the changes on it as it forms an image on the retina (in a healthy eye).

(b) **Colour as a structuring element in theories of visual perception**

Colour is the second structuring element in a theory of visual perception, regarded. To understand the nature of light as an element in perception, the physics of colour should be considered. In the description of light, the electro-magnetic radiation was described as quanta travelling at the speed of light (in a vacuum). It was stated that the velocity of quanta was the same but no attention was paid to the wavelengths of the quanta. It is now important to note that, although the velocity of the quanta is the same, the wavelengths can vary. An experiment was conducted in 1676 by Isaac Newton, the English physicist, that showed that when a ray of white light passes through a prism, it is separated into a spectrum of colours, namely red, orange, yellow, green, blue, indigo and violet. The separated or refracted ray of light can be projected onto a screen to reveal the spectrum. (An addition of the colours of the spectrum, or prismatic colours, will once again yield white as an additive outcome.)

Each area of the spectrum reflects quanta of a different wavelength to the eye. For the eye "*each colour corresponds to a different wavelength*" ... for example when "*light of wavelength 578 nm strikes the retina, activity must result that is different in some respect from the activity resulting from light of other wavelengths, and we have learned ... to use the world 'yellow' to apply to that aspect of the activity. We*

have learned a variety of names to apply to the (physical) activities resulting from a variety of wavelengths and combinations of wavelengths" (Cornsweet, 1970, p.155-156). Instances occur, however, when the discrimination between different wavelengths are, to normal perception, possible, but the different wavelengths are called the same. For example, wavelengths of 490 micron and 530 micron are both called 'green' but differ when juxtaposed.

The interaction between the eye and the stimuli of quanta of different wavelengths is complex and not yet fully understood. In this thesis the physical sensation of the stimuli on the viewer is considered part of the process of perception and thus important to consider to some extend.

The area in the retina (in the eye) that is sensitive to different wavelengths, is thought to be composed of four different visual pigments called rod pigment (rhodopsin) and three cone pigments.

The three cone pigments each has a different wavelength absorption spectrum. The three are called the red-absorbing, green-absorbing and blue-absorbing pigments. The names refer *"to the colour of the wavelength at the maximum absorption"* (Cornsweet, 1970, p.216).

Cornsweet maintains that the *"normal human visual system is ... (not very sensitive to the) infinite number of physically different combinations of wavelengths and intensities"* (1970, p.192). Cornsweet continues that if this were not so, the effect of, for example, grass in sunlight would not appear to correspond to a mixture by a painter of the three primary colours that visually seem to correspond to grass. However, the wavelengths of the quanta radiated by grass differ vastly from those radiated by a seemingly corresponding combination of the three primary colours in a painting of grass. If the eye were very sensitive to different wavelengths it would only be possible to make a painting of a patch of grass that looked like grass if

the pigment had "*exactly the same spectral reflectivity as grass*" (Cornsweet, 1970, p.192). Human visual perception is not acute and cannot identify the specific wavelengths combined in the spectral radiation from grass. Thus the approximation obtained by a painter and which satisfies the viewer as artist as representing grass only emphasizes human visual perception as differing from the scientific analysis derived from the given object. Cornsweet notes that "*wavelength information is present as light passes through the media of the eye, but the media contain no machinery for detecting it, and, at the very first stage where quanta are detected, that is where the quanta isomerize (cone) pigment molecules, a large part of the wavelength information is lost. It can never be recovered by the remainder of the subject's system*" (1970, p.194).

The brief reference to the structure of the eye belies the enormous complexity of the physical interaction with stimuli before colour is perceived. In the context of this thesis, however, the fact that there is discrimination between stimuli is important, but also conversely, the fact that the eye is relatively insensitive to stimuli, is just as important. This 'insensitivity' can be explained by the fact that the eye chooses amongst a variety of stimuli. People do not see the same reality. Thus mental interpretation based on memory and intention play a decisive role in perception.

Following the argument above, the question can be posed whether painting in colour is possible because the normal eye is relatively colour blind. Some thoughts on this question will be expounded in chapter two.

Three further aspects that influence the perception of light are termed hue, saturation and brightness. Brightness is the aspect of light that varies as the number of quanta per second that reach the retina vary (it is equivalent to the concept of value in painting). The saturation varies as more white light is added to

a light of a single wavelength, in other words, monochromatic light. The hue varies as the wavelengths change.

These are simplified explanations for the existence of these aspects of light because, as Cornsweet notes, when the wavelength or the amount of white colour or the number of quanta per second that reach the retina change then the hue, the saturation and the brightness all change. It can only be approximated that, for example, the aspect that changes most when the number of quanta per second that reach the retina vary, is brightness.

Perception of light is also influenced by other factors such as the darkness or illumination of the background.

(c) **Depth as a structuring element in theories of visual perception**

Depth is the third structuring element of theories of visual perception to be regarded. As in light and colour, the quality of the images formed on the retina depends on the light source. In this instance the influence of the distance between the retina and the light source is studied. In the study of the element of depth, the important aspects are: focal length, the intensity of an image (which includes the effect of the pupil size and the effect of the distance of the object) and the depth of focus.

(i) The focal length is determined by the distance of the source of light from a lens. The focal length changes and will be closer to a lens if the source is moved away, and further from the lense if the source is nearer. Cornsweet notes that because the eye's lens is flexible and "*attached to the eyeball by muscles that can change the curvatures of its surfaces, thus changing the refractive power of the eye as a whole*" (1970, p.39), both images near to and far away from the eye can be seen in focus. The eye can thus focus on a light source near the lens and further away from the lens by changing the

curvature of the lens and thus also its refractive power, so that the image is sharply focused on the retina.

(ii)   The intensity of an image is effected by the pupil size and the object distance. If the source of light sends out a large number of quanta the intensity of the source would be high and the number of quanta falling on the retina would be large. Cornsweet maintains that "*if the pupil of the eye were to double in diameter, and thus quadruple in area, four times as many of the quanta radiated from the source would be able to pass through the retina, and the image would be four times as intense*" (1970, p.42).

The aspect of object distance, however, is not directly proportional to the intensity of the image. It does not follow that when the source of light (the object) is moved twice as far away from the lens, that each point of light will be four times less intense, because the image of the object is smaller. Thus, although the light from the source or object is less intense, the total number of quanta radiated from source would not be reduced fourfold.

(iii)   The aspect of depth of focus of the eye is directly influenced by the size of the pupil. If the size of the pupil decreases, the depth of focus would increase. If an image of an object appears to be out of focus, the image would be formed either in front of the retina or behind the retina. This means that the "*distribution of light that falls on the retina is blurred*" (Cornsweet, 1970, p.41). If the size of the pupil decreases, the blur would be reduced.

1.3   AN EXPLORATION OF PAINTING IN THIS CONTEXT

1.3.1   Painting is the frame of reference of this thesis

Painting and its formal properties provide the frame of reference from which the influence of painting on a theory of visual perception is explored.

1.3.2   An explanation of the term 'aesthetics' and its relation to painting and to perception

The concept of painting as the frame of reference should be constructed and elaborated upon. Although it will complicate the issue, it is necessary to begin with an explanation of the term 'aesthetics' and its relation to painting and to perception. In a philosophical sense aesthetics was and still is of a kind of theoretical nature. It was distinguished from an 'aesthetic mode of awareness' which is the focus of such an inquiry.

Aesthetics, in a philosophical sense, is not directly, only or mainly concerned with painting. The term 'aesthetics' has a general meaning in which it refers to the philosophy of art. In this sense, any theoretical writing about art falls within the realm of aesthetics. A particular type of theoretical enquiry developed gradually in the eighteenth century from the ethical concept of disinterestedness or impartiality when the 'faculty of taste' was invented. Before the eighteenth century an object or activity was appreciated for its *"functional efficiency or its craftsmanship, as morally uplifting or theoretically interesting, - serving some purpose"* (Redfern, 1986, p.15]. Now the idea emerged that an object or activity could be a *"source of intrinsic satisfaction, something to be prized for its own sake"* (Redfern, 1986, p.15].

Redfern comments that the interest in something regardless of function or purpose became a dominant characteristic of the western idea of art during the last two hundred years. The play of the elements of art became more important than any function that a work of art could fulfill, such as moral upliftment.

One of the roles of the concept of the aesthetic in relation to painting was then to instill the concept that something can be enjoyed for its own sake and can possess an intrinsic value.

Redfern notes that in the classical antiquity the Greek term 'tekhne' and the Latin 'ars' included not only the fine arts (such as painting) but also crafts (such as carpentry) and subjects such as the physical sciences and mathematics. All these activities were regarded as involving knowledge that could be formulated according to rules. Following the Greek concept, art could be achieved by studying and applying the rules.

Redfern shows, however, that the present concept of fine arts is that it is something that has an intrinsic value and no apparent usefulness; something that cannot be learnt or taught directly.

The change from the classical concept to the concept of the present day was further advanced by Alexander Gottlieb Baumgarten who adopted the Greek word 'aisthetikos' (meaning sensory perception) in his book 'Aesthetika' of 1735, to refer to a special area of philosophy. The Oxford English Dictionary describes the Greek word 'aisthetikos' as "*things perceptible by the senses, things material (as opposed to ... things thinkable or immaterial) also from the stem to feel, apprehend by the senses*" (Simpson, 1989, p.206).

Baumgarten applied the term in the sense of a criticism of taste, as a science rather than ordinary, sensory perception. In the book 'Aesthetika' he expounded a theory of art and beauty. This theory held that there are "*two spheres of cognition, that of thought or intellect and that of perception. Just as logic is the science of intellect, so Baumgarten proposed, there should be a science of sensory perception or aesthetic*" (Turner, 1996, p.179).

Furthermore, the theory proposed that "*beauty is a property of things when perceived as wholes, and that this perception yielded*

knowledge of a special kind, unlike that involved in ordinary perception" (Redfern, 1986, p.17).

Thus, through the adoption of the word 'aisthetikos' Baumgarten connected the concepts of beauty and perception (aesthetics). This was not applied only to contemplations of art but also to the contemplation of nature.

Baumgarten furthermore strove to produce a science of beauty which was based upon sensory perception. The shift of focus was from things or objects to the perception of things or objects. This equalled a shift from object to subject. Eaton states that the question changed from: How can we know when things are beautiful? to: What happens when people respond aesthetically?

Conversely, although the modern concept that a work of art has an intrinsic value, differs from classical antiquity's concept of functional efficiency, the concept of a science of beauty recalls the Greek concept of 'tekne' (which the Oxford Reference Dictionary describes as an organised body of knowledge available on a subject).

And since the stem of the word 'aisthetikos' includes the meaning of 'to feel' there is also an early connection between aesthetic valuation and emotional response.

Finally, the aesthetic valuation was coupled to the concept that fine art (such as painting) distilled what was beautiful in nature; an artwork such as a painting was thus an object of beauty and connected to aesthetic valuation. The ideas on the aesthetic have changed and developed over the years. In his book 'The Critique of pure reason' of 1781, Immanuel Kant (1724-1804) argued that properties such as beauty and ugliness cannot reside in objects but are products of the human mind. Kant maintained that aesthetic qualities *"are to be thought of as constituted in a way which contrasts with that of ordinary, everyday perception - one in which our power of imagination and feeling function differently"* (Redfern, 1986, p.18). This is a summation of Baumgarten's theory

that aesthetic perception "*yielded knowledge of a special kind, unlike that involved in ordinary perception*" (Redfern, 1986, p.17).

(Kant not only differentiated between ordinary perception and aesthetic perception; he also differentiated between sensing and understanding. Until the middle of the 1970sm this distinction seems to have influenced the view of how the brain functions. In this view seeing (sensing) and understanding what was seen were considered to be two separate processes. Sensing was a passive process and understanding an active process.)

But, unlike Baumgarten, Kant refrained from applying the term 'science' of aesthetics. According to Kant, humans construct the world by classifying the given material which they are aware of. Reality is a product of the mind and its nature cannot be proven scientifically.

Kant also states that there are "*no distinctively aesthetic features such as beauty or ugliness that are (physically) perceivable and recognisable as are loudness, hardness or angularity. Rather an object of ordinary perception is regarded from a special standpoint ... and this involves a certain freedom of judgement and discrimination, an active personal response that has a markedly effective, as well as intellectual, dimension*" (Redfern, 1986, p.19).

This view of Kant is at present widely accepted with some variations to detail.

Generally, the 'aesthetic mode of appraisal' thus acquired different attributes to that connected to visual perception, as defined in paragraph 1.1.1., although the original meaning of the term aesthetic (aisthetikos) and the term perception coincide.

The connection between aesthetic perception (to perceive in a special way) and the visual perceptual theories described in this thesis is thus tenuous and only indirectly connected through the original Greek concept of 'aisthetikos'.

To summarize: Although all sensory perception is subject to a measure of interpretation, the perception of aesthetic qualities differs from ordinary, everyday perception. Kant maintained that beauty or ugliness are not perceivable in the same way as measurable attributes such as loudness or angularity.

Instead, aesthetic perception and awareness are subject to how we perceive instead of what we perceive. It is not a verification process or, for example, the shape or size of an object.

Redfern maintains that the present concept of fine arts is that it is something that cannot be learnt or taught directly. A contradictory approach maintains that specially perceptive individuals can be trained to be sensitive and responsive to qualities that are present but not straight forwardly perceivable.

In this thesis the view is maintained that specially 'perceptive' individuals will already by definition show insight and understanding. Their intention is already to seek meaning through perception. The meaning of qualities that are present but not straightforwardly perceivable can be pointed out. Repeating the process will reinforce their perception of these qualities. Therefore, perceptive individuals can be taught to respond to aesthetic qualities and the imaginative perception of an object, such as a painting, will yield a certain satisfaction or dissatisfaction, thus an aesthetic response.

1.3.3 Different focuses of aesthetic theories (related to the fine arts) and the aesthetic frame of reference of this thesis

The visual perceptual theories examined in this thesis, are applicable to ordinary, everyday perception, whereas painting is regarded from the vantage point of aesthetic awareness. Visual perceptual theories can thus only be associated, through analogy, with painting.

In order to clarify the specific aesthetic stance (regarding the fine arts) of this thesis, the different focuses of aesthetic theories have to be outlined. Aesthetic theories often focus upon one of the following components or upon ways in which these components interact:

(1) the maker of the object or the artist;
(2) the viewer;
(3) the object; and
(4) the context in which the object is perceived.

If the aesthetic theory focuses on the artist, considerations such as a special purpose that the artist has, or the creativity or imagination that the artist possesses, or the artistic psychology is studied. Eaton proposes from this perspective "*that something is an aesthetic object if and only if the artist creates with the intention of producing an aesthetic response*" (1988, p.6).

If the aesthetic theory focuses on the viewer, the response of the viewer to the aesthetic experience is at the centre of the theory. Considerations such as a "*special kind of audience experience*" (Eaton, 1988, p.6), or various viewer reactions to a work of art, or a particular effective or mental process is the at the centre of visual theories.

If the aesthetic theory focuses on the object, the consideration is often the distinction between aesthetic objects and non-aesthetic objects. The qualities and reactions of the artist or the viewer are not taken as criteria, only the properties of the object or painting matter. Eaton says that some of these theories "*focus on what are called 'formal properties' (sound, colour, or shape, for instance) and try to show that in aesthetic situations these are the only aesthetically relevant objects of attention. According to such views, only properties of (the painting for example) matter ... some of the most important work in recent philosophic aesthetics has grown out of attempts to explain that a special kind of language is present in aesthetic objects. Works of art are*

considered symbols that only people familiar with the symbol can grasp" (1988, p.7).

The aesthetic theory can focus on the context in which the object is perceived such as an art museum. In this case the same object will not be awarded the same aesthetic value outside the context of the art museum.

In the context of this thesis, the theories which focus on the object and its properties are considered the most relevant as the thesis focuses, to a large degree, on the formal properties of painting - the visual compositional elements such as colour, line, value and shape. (Non-formal properties such as the city in which the artwork was created, or the owner of the painting are not important in the context of this thesis.) The formal properties can also be distinguished from technique and content. One aesthetic theory which emphasises the autonomy of the formal properties of art, is formalism.

The origin of formalism is found in ancient Greece where philosophical debates about form commenced. It was believed that the universe was ruled by "*numerical relationships, or in the notion of form as the intelligible quality of things, imposed upon or inherent in matter. Even in antiquity such ideas were applied to the arts: Aristotle understood art (tekhne) as a shaping process analogous to the processes of nature*" (Turner, 1996, p.315).

Just as the concept 'aesthetic' evolved slowly, the initial concepts which led to the formulation of a formalist theory gradually evolved and took shape over many years. During the Enlightenment (in the eighteenth century), the notion gained acceptance that experiencing a work of art was not only sensual or rational but that this experience was different from other kinds of experience. Thus, as described above, this notion gave impetus to the concept of aesthetic experience yielding knowledge of a special kind. Immanual Kant, in his 'Critique of Judgement', wrote of 'adherent' and 'pure' beauty, that beauty could be regarded as a "*symbol of*

the good, that aesthetic experience could thus have a resonance in the realm of morality" (Turner, 1996, p.315).

Formalism was also connected to "*the concept of the aesthetic (which) evolved during the eighteenth century from the ethical concept of disinterestedness - opposed ... to that of self-interest. The idea gradually emerged that some thing or activity could be appreciated not only for its functional efficiency or its craftsmanship, as morally uplifting or theoretically interteresting - that is, as serving some purpose - but as a possible source of intrinsic satisfaction, something to be prized for its own sake*" (Redfern, 1986, p.15).

This union of the concepts of formalism and the aesthetic contributed to the separation of form and content in the visual arts. However, while the aesthetic and formalism were closely allied, especially during the years 1860 to 1890, formalism applies to the practice of the arts, whereas aestheticism has far-reaching implications in life.

The modern concept of formalism arose during the late nineteenth century and early twentieth century. The German essayist and art critic Konrad Fiedler developed a formalist theory. The focus of this theory was that "*a painting must succeed as an arrangement of compositional elements before it could succeed as representation. This was also central to the art of the post-impressionists*" (Turner, 1996, p.315).

Formalism paved the way for abstraction and an artist such as Vasily Kandinsky. Much of the writings on art during the first half of the twentieth century, for example by Roger Fry and Clive Bell, shaped formalist concepts.

The American critic Clement Greenberg's formalist definition of modernism in painting was influential until the mid-1970's. The theory of formalism also influenced the subject of art history and the Viennese scholar Alois Riegl and the Swiss Heinrich Wölfflin "*each sought to develop a systematic approach to the history of*

art that would, among other things, define the historical evolution of style as an autonomous and necessary process. Riegl made use of the notion of 'artistic will' to establish the distinctive formal features of works of art as the products of something other than technique. Wölfflin believed that, ideally, the history of art could be written 'without names', that it could be reduced to purely impersonal and necessary processes. Although the conceptual foundation of these systems were soon disputed, they have continued to serve as points of reference for such scholars as ... Otto Pächt (1902 - 1988)" (Turner, 1996, p.315).

1.3.4 The contribution of formalism to the concept of painting

Formalism can be accepted as a constituent of art or as a complete theory or art. In this thesis formalism is engaged as a complete theory of art. The focus is then on the formal properties of art or also referred to as the visual elements (such as colour and line). The attraction of formalism in the context of this thesis is the dependence of formalism on essential and elementary principles, and a structural approach to painting which will allow for analogous references to the structure of a theory of visual perception.

As such formalism can be regarded as utilizing an analytical method. Scientists, for example, will use analytical methods to obtain information about substances - in such an instance the analysis will typically isolate elements to aid scientists to obtain information. In another example analytical method can combine, rather than isolate, elements or properties. Twitchell cites the structuralism of Claude Lévi-Strauss which combined linguistics and anthropology as an example. Analytical methods can thus rely on isolation and/or combination to obtain knowledge.

Twitchell says that *"analysis approaching the methods of science, when applied to the visual arts, is most often restricted to the appearances of the individual work of art; it entails studying the*

structural use of the visual elements as they function in composition, or formalism" (1983, p.1).

In this thesis the formal properties in painting will be isolated and studied, their function in a composition will be analysed and the knowledge obtained will be, analogously, combined to knowledge obtained from a theory of visual perception.

An advantage of formalism is that any work of art can be analysed by this means because the formal properties of art remain constant. Thus the origin, subject and content of a work of art do not prevent analysis. The use of colour in a painting by Rembrandt can be studied just as the colour in a pre-historic cave painting in Lascaux can be studied. The worth of a formalist approach is also recognised in the training of artists. The formal properties of art are inherent in the creative process and students have been subjected to formalist exercises in the western art tradition, for example in the Bauhaus.

Also of significance to this thesis is the fact that formalism has two applications. The first is that the formal properties of art make up an integral part of the creative process. The second application is that formalism is part of the process of analysis of the completed painting.

An example of a painter considered to have worked in the formalist tradition is Paul Cézanne (1839 - 1906). To a large degree the formalist movement took shape around his work. Cézanne's work was represented in an exhibition assembled by the English critics Roger Fry and Clive Bell in 1910. Fry endeavoured to find intrinsic concerns in art in order to allow for an impersonal and systematic study of art. In the work of Cézanne he could apply his concept that "*aesthetic experience has only form as its object: now I venture to say that no one who has a real understanding of the art of painting attaches any importance to what we call the subject of a picture - what is represented. To one who feels the language of pictorial form all depends upon how it is presented, nothing on what ... Cézanne expressed some of this grandest*

conceptions in pictures of fruit and crockery on a common kitchen table" (Eaton, 1988, p.81).

Fry also asserts that imitation is not the purpose of painting.

Fry then "*locates the value of art in the 'emotions of imaginative life' aroused by perception of purposeful order resulting from the arrangement of the rhythm of lines, mass, space, light and shade, and colour*" (Eaton, 1988, p.81).

Formalists therefore try to isolate the properties that permeate artworks and which make the aesthetic experience unique. For example, if the viewer thinks only about the mundane subject matter, he will not be able to analyse Cézanne's concept of space created by relations and combinations of lines and colours.

1.3.5 Structuring elements or the formal properties of painting

Actual materials are employed to create a painting. Cloth or wooden surfaces are prepared to accept pigment-bearing substances applied with various instruments, such as brushes or palette-knives.

The aesthetic interaction of the formal properties of painting depends upon the relationships and images created on a two-dimensional surface.

Rembrandt's painting of 1665, 'The Jewish Bride', consists of areas of coloured paint applied to a canvas surface. The colour was mixed and applied with a brush to create an image of a man and a woman which appears to be three-dimensional. The figures appear to be bathed in strong light and the background darkly shadowed. It is as if the viewer perceives living people involved in an activity. But the painter, while he painted the picture, knew that the figures were an illusion and the viewer knows that he is looking at an image, not real figures. The painter created this image by the "*colour, the size and shape of the colour areas, and their relative*

positions so that the three-dimensional illusion appeared" (Knobler, 1971, p.94). Knobler also says that the marks made by the painting materials are in a certain colour, they fill certain areas, there are distances between them and they form a texture or a surface quality. These denote the formal aspects or art regarded here: colour, form, space and texture. (Line is included in form and discussed thereunder.)

(a) **Colour as a structuring element or formal property of painting**

Earlier in this document, colour was explored as a structuring element in theories of visual perception. The physics of colour formed the most important aspect in that exploration. It was concluded that light waves are not in themselves coloured; colour originates in the human eye and brain. How this is achieved is not yet understood, but it is accepted that the colours arise from differences in sensitivity to light waves of differing length. The colours in Newton's prism (prismatic colours) were formed by the separation or refraction of white light. An addition of all the prismatic colours will result in white light again - called an additive outcome.

The colour of objects (and paint) remains to be considered as it differs somewhat from colour resulting from the refraction of light from a direct source; instead of an additive outcome, it has a subtractive outcome. Itten describes the formation of the colour of objects as follows. If two colour filters of complementary colours such as red and green are placed before an arc lamp, the two filters together will result in black. The red filter will absorb all the wavelengths in the spectrum except the red and the green filter absorbs all the wavelengths except the green. Thus no wavelengths or colour is left and the result is black.

The colours perceived as a result of the absorption of certain wavelengths, are called subtractive colours.

The colours of objects are mainly subtractive colours. For example, if a bag is red this means that the surface of the bag absorbs all other wavelengths of light and reflects only the wavelength for red. Itten states that the object *"does not have colour in itself; light generates the colour"* (1971, p.16).

The painter's colours are also absorptive, and thus subtractive colours result from colour mixtures. As in the example of the colour filters in complementary colours, when paints of complementary colours or paints in the three primary colours (red, yellow and blue) are mixed in the correct proportions, the subtractive outcome will be black. This is the opposite of the combination of prismatic colours which yield white - an additive outcome.

Hue, value (brightness) and saturation are terms employed in connection with colour physics, but these terms are analogously applied in painting. In the physics of colour *"the hue of a colour is a function of the wavelength of the light that is reflected from a surface to the retina of the eye"* (Knobler, 1971, p.100). The prismatic spectrum of wavelengths and the correlative hues, vary between waves of 800 - 650 micron which are perceived as red to those of 430 - 390 micron which are perceived as violet. The change of wavelength at certain points along the spectrum are perceived as a change in colour. The changes in wavelength perceived are called red, orange, yellow, green, blue, indigo and violet. Intermediate changes can also be perceived such as yellow-orange or blue-violet. Each discernable change in the prismatic spectrum of wavelengths is termed a hue.

Most of the colours in the spectrum can be obtained from three primary hues namely yellow, red and blue. Summarily a combination of two primary hues will produce a secondary hue. For example, red and yellow combined in the correct proportion will produce the secondary hue orange.

Although painters do refer to the theoretical combinations of hues when painting, to obtain a specific hue, the pigments and the medium in which the pigments are suspended have to be taken into account.

The hue of manufactured paints is a result of the pigment employed. The pigments are obtained from two basic groups of pigments namely natural pigments derived from earth, bark, berries or roots, and synthetic pigments derived from metals and petroleum. For example, the metal cadmium (a bluish white metallic element discovered in 1817) is employed to produce a range of yellows and reds. These are produced as the metal changes colour in this range, as it is heated.

Although "*some of the pigment hues closely approximate spectrum colours ... few are identical to them*" (Knobler, 1971, p.101). Furthermore, not all the colours can be mixed from primary hues because the reality often does not match the theory that all hues can be mixed from primary hues. This means that paints are manufactured in a great number of different hues to attempt to rectify this shortfall. Painters also have to mix different pigments to arrive at the hues they want.

The value of a hue is perceived along a scale graded from black lightening to white. The value of yellow, for example, is nearer to white whereas the value of violet is nearer to black. When painting, it is possible to raise the value of a hue by adding white (this is called a tint of a hue). It is also possible to lower the value of a hue by adding black (this is a shade of a hue). If the paints are opaque this can be achieved by the direct addition of white paint or in transparent paints by the addition of medium which will allow a white ground to show through the paint. Optically this will result in a lighter value. In the same way hues can be darkened by the addition of black paint or in transparent paint, overpainting on a dark ground.

The saturation of a colour of the same hue and value is described by its brightness or dullness. If the hue is very bright

it is described as saturated and if it is dull it is not saturated. Knobler states that "*in paint, each hue has a different ultimate degree of saturation, for the pigments available to produce the colour and the binding medium have limits in the brilliance of colour they can produce. All hues, however, can be reduced in brilliance until they reach the lowest levels of saturation. At that point they become neutralized and appear as greys*" (1971, p.102).

Again the question arises as to how these limited pigments employed by the painter can persuade the viewer to accept, for example, the approximation of the yellow paint to that of a yellow flower? For although the yellow obtained from cadmium is not in wavelengths identical to the array of wavelength reflected from yellow flowers growing in the field, the viewer will accept and identify with the painter's intention. Therefore is the eye not capable of making distinctions between different viewpoints? The answer would be that the eye can make the distinction but that the total representation dictates perception. Thus the total representation would indicate that this refers to a flower and the eye would perceive 'flower'.

(b) **Line, form and shape as structuring elements or formal properties of painting**

The consideration of line in painting, in the context of this thesis, is difficult because it plays a very important role in painting, but defining the concept of line as an element in a theory of visual perception is difficult.

Knobler defines line in the context of painting as "*a special aspect of form that is basic to many kinds of ... painting. We might say that a line is actually a form so long in proportion to its width that we tend to overlook the dimension of width and assume that the element has only the one dimension of length. It is also possible to consider line as the edge of a form. In either case - as the evidence of the gestural act of drawing or as the boundary of a form - line plays an*

important role in the two-dimensional arts, whether it is considered a separate plastic element or a particular component of the element of form" (1971, p.99).

In the context of this thesis the assumption of Knobler that line is form is maintained.

Shape is another term grouped together with form although its meaning is less definite. An example to illustrate this difference is to consider a group of people. All the people have "*the same general form. It is in their shapes that they differ: fatter, leaner, taller, shorter, more closely, the shape of a thigh can be altered by being pressed against a chair or by the tension and relaxation of different muscles, but its form will remain the same*" (Hale, 1980, p.57). This instance can be related to painting as follows: a dollop of paint has an accidental shape until the painter gives it a significant form.

Form can, in terms of painting, also be described as the "*area containing colour*" (Knobler, 1971, p.104). As in Piet Mondriaan's paintings the areas can be well defined, or the edges of the forms can be vague; it can be difficult to perceive where one form ends and the contiguous form begins, as in Claude Monet's painting from the 'Water-lily' series. Another possibility is that smaller forms are grouped together in a large encompassing form. Painters often begin by studying shape which is less demanding than form but which develops hand and eye coordination and a sense of proportion.

Form demands knowledge of the meaning and purpose of an object and not only knowledge of outer appearance and shape. The interpretation and application of form vary between artists. One artist will, for example, stress the strength of human figures as did Michelangelo Buonarrotti (1475 - 1564) in the Sistine ceiling, whereas another painter, such as Leonardo da Vinci (1451-1519), will emphasize chiaroscuro effects which suggest subtle changes in expression of human figures. Although both these painters had an excellent grasp of the

anatomy or shape of the human figure, their interpretation and application of the figures resulted in different forms.

A specific concept of form can also characterize a certain group of painters. Wölfflin researched the differences in the interpretation and expression of form between German and Italian art in the period 1490 to 1530. In Italy portrayal of the human figure and its proportions dominated. Wölfflin notes that the "*Italian sensibility differs from that in the north in that it is more precise, more form-directed. The north, however, has the capacity to enter into the spirit of that which lies both behind and beyond objective form, and to be transported from the well-defined to the undefined*" (1958, p.23-24). In the painting of the German Albrecht Dürer (1471-1528) the emphasis is not on man as the focus but man integrated into the environment. The movement in a figure will be echoed in the atmosphere, the trees and water. "*The Germans early manifested the tendency to gather all single objects together into one great current*" (Wölfflin, 1958, p.24).

(c) **Depth and space as structuring elements or formal properties of painting**

Depth is also an element in a theory of visual perception. As described earlier, the perception of depth is the result of the curvature of the lens of the eye refracting light paths onto the fovea. In describing depth as a structuring element in theories of visual perception, it was stated that an object further away from the eye will appear smaller than when the same object is closer to the eye. Again this can be attributed to the structure of the eye and the refraction of light paths. The painter, however, works on a two-dimensional surface. This surface is described as the space of the painter. It is the "*world in which he constructs the plastic order of his art. Limited by the size and proportions of the two-dimensional plane, the painter arranges his forms in this space to make them satisfy the aesthetic, representational and expressive needs of his concept*" (Knobler, 1971, p.105). The painter can then, for

---

pyramids (our cone of vision); and the pyramids are intercepted by the pane of glass" (Hale, 1980, p.231).

Alberti's perspective construction solved the problem of depicting the visual contradictions of objects appearing smaller if they are further away from the viewer; lines converging towards the horizon, and more objects and detail contained per square centimeter focusing on the distance than focusing on the foreground. These contradictions can be depicted on the space of the painting through linear perspective.

Linear perspective was invented in western art and greatly influenced the arrangement of forms in the painter's space from the Renaissance to the nineteenth century. However, other arrangements of forms in pictorial space are not invalidated by linear perspective.

In the context of this thesis all the possible arrangements of forms in the pictorial space are acceptable and one is not more important than the others. In this context the concept of space, or depth, as a formal property is the most important.

The specific example of linear perspective can be generalized to include other arrangements of forms in pictorial space. For example, if the space of the painting is partially covered with a paper or papers representing a form or forms, the forms are perceived as being arranged in the space. The forms must be considered both in relation to one another and in relation to the space. Also possible as an example is if the space is completely covered by interlocking forms. The first instance could represent the forms as more important to the composition than the space or, in the second instance, the importance of certain forms could be interpreted in different ways.

Some forms would seem to be more important from one point of view, but from another point of view other forms assume greater importance.

(d) Light and dark as structuring elements or formal properties of painting

The inclusion of light and dark in a painting is decisive to define the desired atmosphere.

In the discussion of the physics of light the fact that quanta moved in straight lines and could be refracted by lenses, such as the lens of the eye, was of primary importance. However, it soon became clear that the varying wavelengths at which the quanta travelled and which denote hue (hue is the result of the refraction of light from a direct source or absorption of light by the surface of an object) is an inseparable part of light. The wavelength of the quanta therefore cannot be ignored. Light is then, in reality, not a separate entity to consider; it is always coupled to hue.

In this thesis light and dark, as structuring elements or formal properties of painting, are grouped under the structuring element of colour and considered to be the value of a hue. A simplified diagram of hue, value and saturation was developed by Philipp Otto Runge during the early years of the nineteenth century to support his ideas on colour expounded in his book 'Die Farbenkugel'. This diagram shows, to some extent, the interaction between hue, value and saturation. (A deficiency is that it does not show the difference in value between pure hues: for example, yellow has a higher value than red.) Although light and dark are grouped under the structuring element of colour in this thesis, they are discussed separately to denote their influence in painting.

The painter often forms decisions on two issues surrounding the representation of light in a painting, namely the source and direction of the light, and the surfaces that are bathed in light. Light sources can be natural such as the sun and candlelight or artificial such as the incandescent light bulb. However, in most cases the source of light is not painted, only the radiation of light. However, in paintings that do depict the source of light,

the radiation of light or a surface that is lit by the radiation of light is often of a higher value (lighter) than the actual source of light, such as the sun. An example of this is the Englishman J.M.W. Turner's painting 'Hannibal Crossing the Alps' of 1812. The sun is almost orange whereas the bright glow of sunlight, the radiation of light, is yellow-white, a hue which has a higher value than orange. The snow, depicted as almost white, is of a still higher value.

The representation of the radiation of light in painting, without depicting the light source, is mostly restricted to the sky, as in landscape painting. However, other examples exist, for instance the Dutch painter Harmen Steenwyck painted a still-life 'The Vanities of Human Life' in 1645. A shaft of light enters the picture from the top left corner. This representation of the radiation of light has a high value, but some of the small highlights on the objects are of an even higher value.

A contradiction in the depiction of light resides in the fact that the painter has only an absorptive matter, namely paint which results in subtractive colour, available to represent retractive light or additive colour. However, as Cornsweet noted, the human eye is not very sensitive and will regard approximations by the painter as acceptable. Thus the painter can achieve the illusion of recreating from absorptive light or paint an image of refractive light, such as a source of light or the radiation of light.

The painterly depiction of light that occurs most frequently, however, is that of absorptive light (light falling on an object, a figure, plants, etcetera). The painter's goal is to depict subtractive colour, or to make an approximation of the hue resultant of the "*wavelength of the light that is reflected from a surface to the retina of the eye*" (Knobler, 1971, p.100).

Cornsweet maintains that the normal human visual system is blind to extreme differences in arrays of quanta delivered to the eye, because the human eye cannot "*identify the particular*

wavelength that are mixed together in (for example) *grass"* (Cornsweet, 1979, p.193). It can accept an approximation of the array of wavelengths in a painting depicting grass, though, of course, the painting will consist of physically different combinations of wavelengths and intensities.

The influence of quanta of light falling on an object can be very strong. A painting typically "*results from the interaction, from the interdependence of these means (the structuring elements of painting), rather than from their operation as independent parts of the whole*" (Knobler, 1971, p.117). But the influence of one element can be so strong that it all but overpowers the other elements. For example, in reality if "*a light source is very bright, the shadows cast by forms that are in the path of the light are very dark, when these cast shadows fall across other forms they often completely obscure (form)*" (Hale, 1980, p.253). A painter such as Rembrandt van Rijn (1606-1669) applied this phenomenon to obtain "*dramatic, impenetrable chiaroscuro*" (Kitson, 1969, p.89); for example in the late 1657 painting of 'David Playing the Harp Before Saul.' The chiaroscura heightens the tension between the larger figure of Saul to the left and the smaller figure of David to the right. Although the dark background isolates the figures, they also seem to recede into the shadows because only small areas of the figures catch the light and the outline of the figures is obscured in the shade.

1.4   CONCLUSION

In this chapter the central concepts regarding painting and visual perception were established. The structuring elements in theories of visual perception and the formal properties in painting were discussed. Both visual perception and painting share the same structuring properties but the two cannot simply be equated because the first is a physiological process and the second is an interpretative process. However, because causality was proven painting can influence the painter's visual perception.

CHAPTER 2

CHARACTERISTICS OF PAINTING

2.1 THE FORMAL PROPERTIES OF PAINTING FROM A TECHNICAL AND PHILOSOPHICAL VIEWPOINT

Hayes writes that "*a painting is not just a coloured surface. It is an extremely complex three dimensional object composed of a series of layers. A comparison may be drawn with a geological diagram of the earth's crust. In both there are strata of differing thickness and composition and in both these variations account for the ultimate appearance of the surface.*

In the simplest terms the structure of a painting consists of a support, such as wood or canvas; a ground which acts as an intermediary between the support and the paint layer; and the paint layer itself, which is composed of coloured pigment particles suspended in some sort of binding medium such as wax, oil or egg.

Historically an immense number of materials have been used as supports for paintings - copper, stone, paper, leather, plastics and so on - but the most common of all are wood and canvass." (1978, p.18).

In contrast to this technical paragraph on the structure of a painting, the philosopher Israel Knox describes a work of art, and thus also a painting, in the following manner: "*The field of the artist's vision is the totality of life, and the function of art is to project, to interpret, and to elucidate human experience. The salient point to note, however, is that the experience - social, moral, religious - is merely the material, the stuff, of art, and is transmuted in the work of art to issue as an integrated aesthetic structure of autonomous worth and significance ... the product and fruition of art is experience heightened, clarified, and coordinated*" (1936, p.3).

Both these approaches to painting reflect some aspect of the role of the formal properties of painting. The first approach perceives the painting as an object which is manufactured from certain materials. From this perspective the formal properties of colour, line, depth and light consist mainly of layers of paints and perhaps traces of charcoal. Paints can be applied with various brushes and palette-knives to achieve variations in thickness of the layers of paint and to restrict the paint to the desired areas of the surface.

The support and ground of the painting contribute in the following way to the quality that the formal properties of the painting will possess: for example, a wooden support prepared with a gesso ground which is highly polished will denote a different quality when paint is applied, contrary to a support of coarsely woven canvas which is thinly prepared with a gesso ground. A polished ground will reflect fine detail and nuances in the application of line and detail. Jan van Eyck (1390 - 1441) is an example of a painter who exploited a highly polished surface to its fullest potential. Conversely, the texture of a coarse canvas will show through thinly applied paint and will be more suited to denote light and dark patterns than fine detail. For example, Jan Vermeer (1632 - 1675) employed a coarse canvas in the painting 'The Lacemaker'. Although there are some fine detail in the painting, the main emphasis is on the play of light and dark.

The fact that a painting is layered is also significant. From this can be derived that the quality of the formal properties of the painting is built up over a period of time, that areas can be changed (overpainted) and that much is hidden from the viewer of the painting.

The demands of the formal properties of painting imbue the malleable paint with form. As a first example, fine linework demands a diluent for most paints, so that the paint can be invested with the correct qualities to be applied with a very fine, pointed brush to the surface of the painting. As a second example, broad patterns of light and shade are formed through the value of colours. A colour can be mixed with white to produce a colour of a higher

value to form areas of light. Colour can also be mixed with black to produce a colour of a lower value to form areas of shade.

Thus, although the support and ground of the painting and the type and consistency of the paint influence the final appearance of the painting, these factors are adaptable and can be invested with any of the formal properties of painting.

In the second approach the philosopher speaks of the human experience as the material of art. This experience is then to be "*transmuted in the work of art to issue as an integrated aesthetic structure ... the product and fruition of art is experience heightened, clarified and coordinated*" (Knox, 1936, p.3).

Again, as the paint must be imbued with form, so too must experience be imbued with form. Again the formal properties of painting invest form into the formlessness of experience. As Knox says, the experience must be heightened, clarified and coordinated. Firstly, for example, an experience can be heightened when it is depicted through a painting by employing certain colours. The painting by El Greco (1541 - 1614) 'View of Toledo' portrays an identifiable viewpoint of the city despite some inaccuracies regarding the placement of the buildings. However, the colour employed changes the experience of simply looking af the view of a city, to the level of an unforgettable image. The riverbanks in the foreground are "*fertile and free; the distant landscape is barren and threatening. The sharp white light evokes both the eerie beauty of the place and the menace inherent in nature*" (De Montebello, 1993, p.195). Secondly, an experience can be clarified by the precise detail in the linework. The detail of the buildings , in this painting clarifies the scale of the landscape and shows the smallness (insignificance) of the man-made buildings against the immense drama of nature. Thirdly, an experience can be coordinated by the light and dark shadows or patterns which echo the 'sharp white light' throughout the composition.

From the description of the role of the formal properties of painting from a technical and philosophical viewpoint it can be deduced

that their role is central to every aspect of the structure of the image.

Thus, although the formal properties of painting can be regarded separately and from different approaches "*a work of art results from the interaction, from the interdependence of these (properties) rather than from their operation as independent parts of the whole*" (Knobler, 1971, p.117).

2.2   HISTORICAL INSTANCES OF THE ROLE OF THE FORMAL PROPERTIES IN PAINTING

2.2.1   The role of the formal properties in prehistoric painting

The term 'prehistoric' is generally applicable to the period before written history. European prehistory is classified into three eras: these are the Stone Age, Bronze Age, and Iron Age according to the materials of the tools used during these periods. However, no absolute dates can be set to these classifications and not all eras are represented in all parts of Europe. The term 'prehistoric art' is generally applied to the cave paintings of the Stone Age, for example at the Lascaux cave in South-west France which were painted about 15 000 years ago. These paintings were executed directly on the walls of caves. The wall paintings were mostly of animals - a valued source of food and clothing, vital to prehistoric man's survival. Because the animals were vital to man's survival and he thus had to know their characteristics well, the depictions of animals are precise and accurate. Every animal is recognisable, for example aurochs, horses, bears, bison and reindeer.

(a)   Colour as a formal property in prehistoric painting

Prior to ten thousand BC only very few pigments were employed. Pigments such as red, brown and yellow were obtained from ochres (earths). Black was obtained from charcoal. (Manganese oxide, extracted from pyrolusite ore, is

also listed as an early source of black pigment, but the technology for extraction was probably unknown to prehistoric man.) The pigment was mixed with fat which served as a binder. It was most probably applied to the wall with sticks that had chewed ends, pieces of fur or the fingers. The colours are not mixed to produce secondary colours. Some paintings indicate the patterns on the animal skins beautifully in the different colours, for example the cow painted approximately twenty thousand years ago in the cave of Lascaux: the head is black and the body, legs and tail are brownish-red. Some shading is indicated on the shoulder, stomach and hindquarters through a thicker layer of the brownish-red pigment.

(b) Form as a formal property in prehistoric painting

The accuracy of the portrayal of the different animals is manifest in the ease with which the animals can be identified. Some of the paintings were done only in outline. The form and description such as the mane, hoofs and horns are depicted in detail. The forms are depicted with confidence, in flowing lines, and the animals seem to be in motion or running.

The colour is contained in the form. Although the support, which is the cave wall, is uneven and not conducive to fine detail, it is easy to perceive the edges of the forms. One reason why it is easy to perceive is the definite outlines in either the same colour as the animal skin or a black outline. Other reasons why the forms stand out clearly are that some animals are partially painted over other paintings. However, although forms overlap, the integrity of each form is retained because of differences in either colour, size, the direction that the animals face, the definite outline of the forms or a combination of these factors. The clarity of the forms also reside in the persistence of a side view of the animals (in which can be included the most characteristic detail of the animal). Perhaps the most important reason is that although some animal forms overlap, most are painted as single animals against the untouched support or the cave wall and the form thus stands out as an entity.

(c) Depth as a formal property in prehistoric painting

The surface or space on or in which prehistoric man created his paintings, was cave walls. The uneven surface suggested some of the images created, for instance a natural protrusion of the cave wall echoes the form of the horse's head painted onto it.

The forms of the animals are arranged in the space. The animal forms are the positive, important forms set in position on a specific ground or space. The cave walls are usually covered in paintings of animals and it is difficult to know whether the whole is to be read as a composition. For example, at the cave of Lascaux in 'La Rotonde des Taureaux' the relative sizes of the animals vary. In one area four small antelope are painted between two large aurochs facing each other. One of the aurochs is also partially superimposed on two small aurochs. Higher up (between the two sets of horns of the aurochs) appears an incomplete horse larger in proportion to the four very small antelope below. In view of Leroi-Gourhan the size of the animals is not an indication of depth, but is intended to form a link between the two large aurochs; it is therefore a compositional consideration. The large forms in the space are thus linked by separate small forms.

Again the predominance of a side view of all the animals is an important factor and emphasizes a shallow space. The horizontal and vertical lines formed by the side view of the animals preclude the suggestion of depth that diagonal lines or frontal and fore-shortened views of the animals, would give.

(d) Light and dark as formal properties in prehistoric painting

Paging through a book of photographs taken in artificial light of the paintings in the cave of Lascaux, it is difficult to imagine the paintings lit only by torches or primitive lamps.

The effect of a flickering lamp on the uneven surface of the ceiling and walls of the cave will influence the perception of the paintings. The movement of the light could create dynamic and changing light and dark patterns on the painted walls and could reinforce the impression of animals in motion - movement already suggested by the running position of the legs.

Light and dark modelling is applied in some instances, for example, 'A Cow' at Lascaux. Some indication of shading is given on the shoulder, stomach and hindquarters through a denser application of the reddish-brown paint (used on the body) on these areas. However, although the roundness of the animals' bodies are delicately rendered in many instances, the main influence of light and dark as formal properties in prehistoric painting, would seem to arise from the torches and lamps used to light the caves.

(e) **Conclusion**

The formal properties in prehistoric art interact perfectly and from their interdependence the major concerns of the artist emerge.

The formal properties are employed to stress the defining characteristics of the different animals, facts that are important to the hunter. The accurate identification and depiction of the different forms of the animals, is pre-eminently possible through the insistence on the side-view of the different species as opposed to, for example, a front view. The formal properties of colour would further aid the identification of the animal and consist of the accurate representation of the colour pattern on the skin. This is also most easily identifiable from a side view of the animal.

Depth as a formal property is defeated by the side view of the animals. This side view stresses the shallowness of space and

perhaps mirrors the wish to bring the elusive animals nearer to the hunter and thus ensure the success of the hunt.

The composition of a group of animals, such as 'La Rotonde des Taureaux' at Lascaux, remains mysterious. The depiction of animals that are relatively smaller than others, are not an indication of depth but fulfil another function. Leroi-Gourhan's view is that the placement of the small animals between the two largest is a compositional consideration. The space, in which all the animal forms are depicted, is determined by the structure of the cave and this also contributes to the placement of the two largest animals and consequently visually the most important. The two large aurochs are placed where the wall is highest. They face each other and are linked by the smallest animals in the composition, the four antelope. The two large aurochs are only painted in outline whereas some of the smaller animals are represented in more detail. Thus, although most of the animals' forms are clearly silhouette against the light background of the wall, the black outlines of the two large aurochs also stand out clearly against the background and the more detailed depiction of the other animals. The aurochs were depicted as large and thus also featured as a large entity in the artist's preoccupations. Light and dark as formal properties are mainly represented in the form of primitive lamps and torches. The changing light and dark patterns projected by the flickering flamelight could have suggested the movement and elusiveness of the animals.

In prehistoric painting the formal properties are combined to express clearly the preoccupations of the era. However, line and form are of primary importance and are the definitive properties.

The use of outline, as in the two aurochs, and the more complete rendering of some of the other animals do not point to the painter's conscious predilection for line or colour, but rather to the constraints of the materials and the surface.

2.2.2 The role of the formal properties in classical Greek painting

Max Doerner in the book 'The Materials of the Artist' of 1949 does not perceive the incomplete inheritance of classical Greek painting as providing enough information to form conclusions regarding classical Greek painting. Following the subsequent discovery of two sets of disparate classical Greek murals at Kazanlak and Lefkadia, V.J. Bruno ventured to form opinions regarding classical Greek painting in the book 'Form and Colour in Greek Painting' of 1977, based on these murals.

Bruno writes that Greek painting of approximately 500 BC "*altered man's concept of the pictorial field, utterly transforming the art of painting. Starting from the archaic two-dimensional picture plane, these artists developed a new technology for the representation of a three-dimensional environment, something like a stage on which figures could move and turn in space in an atmosphere of light and air. For hundreds of years the Greeks, like the near eastern cultures before them, had followed a painting tradition as old as mankind, applying areas of opaque, solid colour to a picture plane that was conceived as a flat, unbreakable surface. Within a few generations, from about the period of the Persian wars* (Greek victories over Persia occurred in 490 BC at Marathon and 480 BC at Salamis and Plataea) *onward, there unfolded a process in which the two-dimensional picture plane was shattered, perspective and shading were invented, and human figures were for the first time rendered as objects moving in space*" (Bruno, 1977, p.11).

(a) Form as a formal property in Greek painting

Vincent Bruno describes Greek painting in terms of the formal properties of form and colour. He sees a dichotomy between form and colour already apparent in classical Greek art. Bruno and Otto Brendel describe two approaches to the property of form. Brendel, writing on Romano-Campanian painting (the painting of the Etruscans in the South of Italy), notices two

approaches in the representation of "*human figures as three-dimensional objects ... [he explains] that there are different ways of achieving this corporeal illusion. In the telephos painting, all the main forms are clearly designed and outlined, and modelling is supported by lineal hatching, as in a drawing. In the Zeus painting, on the other hand the forms are less definitely outlined; they emerge from an almost impressionistic technique of colour patches. The gradations from light to dark are not accompanied by regular parallel hatching. In other words, the method of representation in the one case is basically linear, akin to drawing; in the other case coloristic and painterly*" (Bruno, 1977, p.25). Brendel applies the terms 'abstract linear' and 'impressionistic-painterly' to the two different approaches by Campanian painters to show form. Bruno argues that classical Greek painting influenced Campanian painting and thus these terms can also be applied to Greek painting.

Bruno discusses the realisation of the figures in the Kazanlak tholos frieze (late fourth or early third century BC in present day Bulgaria) as an example of the abstract linear approach. The figure is first drawn in outline; afterwards the colour of the skin and clothes are added and lastly the shading is added. The outline is strengthened by the addition of the formal properties of colour and shading. This is attained because the colour is contained within the outline and the shading is often parallel to the outline, thus the repetition of the outline in a lower value of hue emphasises the outline. Furthermore, "*the darks and lights consist of darker or lighter tones of the same colour so that each area of colour, each garment or object, has a distinctly monochromatic quality*" (Bruno, 1977, p.25).

Conversely, but following the same train of thought, Bruno regards the Lefkadia paintings (second half of the fourth century BC in present day Bulgaria) as 'impressionistic - painterly. He sees the difference between the Kazanlak tholos frieze and the Lefkadia paintings as a difference in handling dark and light and in relation to the rendering of form in space.

He writes that "*the colouring is everywhere applied in shorter strokes and patches; there is no apparent methodological separation between indications of colour and indications of light and dark as at Kazanlak. A dark is not just an area of darker pink or brown flesh tones; it has blues and greens running through it and a complex system of overlapping tones in which every individual stroke is a slightly different colour. Colour accidents, produced by quick, overlapping brushstrokes, abound throughout the work and are accidents upon which the artist relied. The two elements - colour and the modelling of form in light and dark - which remain independent of each other in the Kazanlak painting, are here utterly interdependent. Accents of dark are not associated with a system of parallel hatching. They are at the same time accents of colour, representing interesting and sometimes unpredictable changes of hue of the kind that reveals a truly sophisticated colour sense. The aesthetic of contour, of continuous outline, is gone, and the forms turn easily into depth within an atmosphere or space*" (1977, p.25-26).

In Greek art a dichotomy became apparent between the 'abstract linear approach to render forms in space and the 'impressionistic-painterly' approach. In the first the outline of the form is emphasized. In the second a colouristic method is applied to suggest the three-dimensional form in space. The two approaches to rendering forms differ greatly because form (including line which is a particular component of the element of form) is a separate formal property to colour.

In the first the outline of the form is clearly defined and in the second the edges are less precise.

(b) **Colour as a formal property in Greek painting**

In classical Greek painting (mid-fifth century BC according to writers like Pliny) the painter was restricted to a basic four-colour palette in accord with the then reigning rule of

simplicity. The colours are listed as white, yellow, red, and black.

The restriction in colour recalls the modern primary colours, a set of basic colours which comprise of red, yellow and blue and from which most other hues can be mixed. However, the omission of blue from the basic palette of the Greeks, and the inclusion of white and black poses many questions. However, Bruno points out that the Greeks were acquainted with red, yellow and blue as primary colours and indeed mixed the secondary hues of orange, green and purple from the primary colours.

In connection with the inclusion of white and black in the set of basic colours, Bruno proposes that because the Greek painters had at that time only recently discovered shading or chiaroscuro, they would consider white as corresponding to light and black as corresponding to dark, and as necessary factors in producing the complete range of values and colours that occur in nature. The classical Greek artist also only recently discovered that a mixture of red, yellow, blue and white produced a flesh tone. This signified a break from the unmodulated red and white of pre-classical Greek art used to denote skin tone.

The inclusion of black as a basic colour and the apparent omission of blue pose the dilemma that the primary colour of blue and the range of hues obtained from a mixture of blue and yellow and from blue and red, are excluded from the palette. Furthermore, black cannot be a substitute for blue because of the muddy colours resultant from a mixture of yellow and black or red and black. Bruno also states that "*the ancients* (the artists of classical Greece) *themselves, in the writings that survive, create the clear impression that the four colour palette was expected to function as a palette of primaries in the modern sense of the term*" (1977, p.56).

The question of the apparent absence of blue from the basic palette is addressed by Bruno in recognising the role of a blue-black pigment that had to serve as a complementary colour to the warm flesh tones. The dark-blue pigment produced darker tones of the flesh tones and were employed in the modelling of tones.

Bruno concludes that the "*dark-blue pigment was capable of neutralizing reds and yellows (and) was universally adopted. This pigment could be mixed with the warm range of tones, preserving the nuance that only a blue can give yet achieving the role of a darkener. The blue-black pigment thus made possible the famous four-colour palette, a palette that omitted blue as an active colour in pictorial compositions yet included a darkening agent capable of producing a high degree of nuance in chiaroscuro and in the variety of reds and yellows, browns and ochres obtainable*" (1977, p.96).

The classical Greek painter thus already had access to the range of colours obtainable from the primary colours and white and black. He applied it to obtain subtle chiaroscuro effects as in the Kazanlak tholos frieze, or to obtain an almost impressionistic effect with individual but overlapping strokes of different colours which produced colour accidents upon which the painter relied as in the Lefkadia paintings. The classical Greek painter moved away from the symbolic and unmodulated tones, for example red as a skin tone, or archaic art. He introduced the full range of values and colours that occur in nature. However, Bruno sees a fundamental dichotomy between the chiaroscuro and impressionistic effects in the Kazanlak and Lefkadia paintings.

(c) **Depth as a formal property in Greek painting**

The two approaches to the rendering of figures as three-dimensional objects in space have been discussed in the paragraph on form as a formal property in Greek painting.

The use of shading in Greek painting was probably developed over a few generations of painters. From the early and mid-fifth century BC the eventual refinement and sophistication in the handling of light and dark in the painting of Apollodorus and the subsequent establishment of the rules of light and dark by his pupils, were the culmination of many years of attempts to show three dimensions on a two-dimensional surface.

Bruno proposes that Apollodorus perfected the simplest shading methods and this gave his paintings a convincing three-dimensional quality. Apollodorus was most probably able to "*synthesize earlier, less successful attempts, so that a systematic relationship between chiaroscuro and colour was established in some consistent manner*" (Bruno, 1977, p.29).

Bruno speculates that Zeuxis, the pupil of Apollodorus, most probably developed a light and dark system less dependant on the new defined contour line or outline which was a characteristic of archaic painting and which Apollodorus most probably perfected. Zeuxis was thus responsible for a more painterly method of rendering figures as three-dimensional objects in space. The brushwork and colouring became more subtle and complicated.

Bruno cites the Kazanlak tholos frieze as representative of the painting of Apollodorus, and the Lefkadia chamber tomb as representative of the painting of Zeuxis. Bruno poses the supposition that "*while the linear method or shading that I ascribe to Apollodorus undoubtedly began a tradition which was taken up again and again in later generations as a symbol of early classicism, Zeuxis provided an alternative method which allowed the artist to become more exclusively absorbed in the exploitation of light and dark and in the previously unexplored pictorial concept of a unified spatial atmosphere rendered in more naturalistic colouring. From that moment onward, a choice was possible, and a basis for controversy was introduced into both the practice and theory of the art of painting*" (1977, p.29).

At an early stage of the Persian wars, another example of the representation of space occurred, namely three-dimensional foreshortening. Several examples of foreshortening occurred at both Kazanlak and at Lefkadia. For example, the box carried by a processional figure at Kazanlak is seen in a three-quarters view: the bottom of the box and the one side is portrayed with shortening as in a visual perspective. The heads of the four horses in the procession are also seen from a three-quarter view and not from the side as in archaic painting. At Lefkadia the figure of Aeachos is seated and the torso is partly turned towards the viewer, thus the lower arm resting on his knee and the other arm and hand holding a staff is portrayed with foreshortening.

A further indication of the representation of space occurs when shapes overlap. For example, at Kazanlak the carriage drawn by the four horses is placed behind the horses and only a few details of the chariot are visible such as a railing, etcetera. The trunks of the horses also partially overlap as they are harnessed four abreast in front of the chariot. In the examples at Kazanlak and at Lefkadia no indication of a background is given. Thus although the figures, animals and objects are rendered as three-dimensional, their forms revolve in space due to foreshortening and they move behind and in front of others. In these instances the backgrounds are still devoid of activity. The figures are also placed on a "*line that represented the plane of gravity. This enabled the artist to make figures that could walk in two directions* (to the left and to the right) *and also confront the viewer ... this basic form of composition could express action, reaction, and time, but generally only one thing could happen within one picture. It was as though everything occurred in a narrow corridor*" (Hale, 1980, p.222).

The articulation of depth was thus still very restricted and concentrated on one plane.

(d) Light and dark as formal properties in Greek painting

Bruno describes two methods in Greek painting to denote light and dark. The first is "*a strongly 'linear' shading method of darkened contours ... (and the second) is a method that causes outlines to disappear in favour of a fall of light over the forms*" (1977, p.26).

In the first the outline is strengthened by shading along the contours. In the second, opaque white is used in the strong highlights of, for example, the face, arms and clothes.

The development of these two methods of denoting light and dark replaced the archaic flat planes of colour. Original Greek examples of the use of flat colour in paintings do not exist but Bruno refers to early Etruscan painting which was most probably influenced by Greek art. The tombs of Etruria were decorated with saturated reds, yellows, blues and greens. The strong colours are spread over large areas and if, for example, the main colours in the frieze are blues and greens, these are accentuated by narrow red stripes. Large areas of reds would be accentuated by smaller areas or stripes of blue and green. Colour relationships would be the painters' main concern. The introduction of the formal properties of light and dark would render obsolete the large areas or pure, bright colour found in archaic composition. The areas of colour would be broken by the play of light and dark. "*Strong colours spread over large areas would be replaced by modified and greatly softened tones, colours that would not disrupt the feeling of a three-dimensional atmosphere. Colours would, in a sense, become adulterated by shading as soon as three-dimensionality became the rule*" (Bruno, 1977, p.32).

The colours were modified and the tones softened by mixing colours and by adding white. Because it is not possible to obtain a chiaroscuro effect without white, Bruno speculates that white must have been equated with light in the mind of the classical Greek painter. Modelling a figure thus requires both

light and dark and if white was equated with light, then black was probably regarded as dark. This could explain the importance attached to white and black and their inclusion in the list of basic colours of classical Greek painting.

(e) **Conclusion**

The conclusions drawn by Bruno from the study of the two friezes at Kazanlak and at Lefkadia mainly centre upon two different approaches to represent figures. The first is termed 'abstract linear' and strengthens the outline of the form. The second is termed 'impressionistic-painterly' and relies on colour and colour accidents to suggest form.

The question must have arisen: "*How far should chiaroscuro be carried at the expense of outline and colour?*" (Bruno, 1977, p.40).

The relative importance attached to each of the formal properties (sequence of importance of the formal elements) of art as employed in a painting, was thus already an issue in classical Greek art. The change from archaic reliance on pure colour and outline was revolutionary and not accepted by, for example, Plato (429 - 347 BC) who regarded pure colours and forms which approached geometric shapes as complementary to his seeking of "*perfect entities outside the physical world, and of which the material things that we see and handle are ephemeral and imperfect copies*" (Hawkins, 1986, p.641). The disregard for outline, in other words the naturalism of the painter Zeuxis, would then seem to Plato to adulterate the pure and unmixed primary colours of archaic painting. For Plato outline or form and colour were the most important formal properties of painting. For Zeuxis light and dark were the most important formal properties of painting. Zeuxis' naturalism and his exploration of chiaroscuro to the point "*where its special laws could be recognized, systematized, and even varied*" (Bruno, 1977, p.40), thus his break with the archaic reliance on large areas of pure, bright colour is in essence a

redeployment of the formal properties of painting. There is no reason to believe that the world was perceived differently by the Greek people and Greek artists of 500 BC than by later people and artists. Thus a painter such as Zeuxis followed "*visual laws rather than formalized precepts*" (Bruno, 1977, p.40) and although light and dark (chiaroscuro) were not employed in archaic painting, they were available as a property of visual perception and of painting. The concentration of Plato on abstracts and ideas which are "*perfect entities outside the physical world, and of which the material things that we see and handle are ephemeral and imperfect copies*" (Hawkins, 1986, p.641) disregarded the possibilities of light and dark in painting, because they were considered to weaken the perfection of pure colour and outline. Zeuxis' predessors, and his own culminant effort in formalising the laws of chiaroscuro, thus introduced the formal properties of light and dark in classical Greek painting.

It is also important that two different approaches to light and dark are discernable, namely the 'abstract linear' and the 'impressionistic-painterly'. This implies that the painter had a predilection for a certain strategy and a choice between different pictorial representational strategies.

2.2.3   The role of the formal properties in sixteenth century Italian and German painting

Heinrich Wölfflin postulates in his book 'The Sense of Form in Art' that the modes of application of the formal properties of art were divided along national lines in sixteenth century European art. As examples he cites works from Italian and German art from between 1490 and 1530 to demonstrate the difference in approach.

The masters of German painting developed from Gothic painting of the fifteenth century just as Italian painting developed from the fifteenth century Italian primitive painting. Wölfflin remarks that both countries had the same problems but solved it in different ways because their concept of form differed. To illustrate the

difference, the 'Isenheim altarpiece' by Matthias Grünewald (1460 - 1528) is cited as contemporaneous to the 'Sistine ceiling' by Michelangelo Buonarroti (1475 - 1564).

In Italian painting of the sixteenth century, plastic clarity, as in for instance a figure of stable proportion, is generally the main focus. Italian painters thus concentrate on the visible. Wölfflin says "*once forms have attained completeness, they exist as wholly independent and self-sufficient entities*" (1958, p.21-22). The Italian painters applied "*Limited form, fixed proportions, and distinct shape*" (Wölfflin, 1958, p.22).

In contrast, in German painting of the sixteenth century "*the element of the undefined and the not-wholly-independent, which remains involved in an infinity of relationships (is a key characteristic) ..., the essence of German art is the impression of movement; and all movement refers to something outside itself*" (Wölfflin, 1958, p.22). Wölfflin further refers to Italian painting as 'plastic' and to German painting as 'painterly'.

(a) **Colour as a formal property in sixteenth century Italian and German painting**

The chromatic range, the brightness of the palette and the solvents and oils available to sixteenth century painters were the result of the increased availability of raw materials and the improvement in the manufacturing and purification processes. For example, the improved quality of linseed oil and the distillation of volatile thinners, such as turpentine, made it possible for these materials to be used in paints and varnishes. The first published recipes for varnishes containing linseed oil date from 1500 BC when linseed oil (used as a medium) and the pigments brought "*out the depth and tone of the pigment, and (gave) it a quality different from that which it possessed in the dry state*" (Mayer, 1991, p.169). New pigments introduced were lead-tin yellow, madder, vermillion and ultramarine. Mayer writes that the technical detail of Italian sixteenth century painting is well established through treatises and that the

painters were mostly restricted to a single mode of procedure by their guilds. In contrast, northern painters were less restricted and did more towards the introduction of the new materials. Thus the northern (Flemish) painter Jan van Eyck was credited with perfecting the oil painting technique. The oil painting technique creates, above all, the possibility of a variety of chromatic effects. Opaque colour, colour glazes, the saturation of colour and colour value can be denoted with oil paint.

The colour composition in sixteenth century Italian painting possesses "*a coherency of colour, but the colour remains bound to the object to a greater degree than in German art. In German painting - most of all in the works of the painterly painters - the colours have more contact with one another and, overpassing the objects, achieve a self-sufficient effect. The red in Altdorfer's 'Birth of the Virgin' constantly clings, it is true, to Joseph's robe; and we can always tell to whom it belongs when we see it repeated. But the over-all impression is still of free play of colour that has no counterpart in Italian art*" (Wölfflin, 1958, p.221-222).

(b) **Form as a formal property in sixteenth century Italian and German painting**

The division along national lines, as described by Wölfflin, specifically relates to form.

At the centre of this division lies the Italian mindset that demands that the painter must know the precise proportions of everything, but most importantly, of the human figure.

The German painter was not concerned with measurements, "*for them, the value of form lies more in its function than in its fixed proportions*" (Wölfflin, 1958, p.42).

Wölfflin maintains that the Italian style, concerned with the representation and the modelling of solid objects, in other

words a plastic style, tends to isolate objects. For example, a figure will be clearly separated from the background such as a landscape. Anything that still distract attention from the figure is discarded. "*Each form is then presented as a self-sufficient independent entity*" (Wölfflin, 1958, p.43).

The German style was a painterly style. The figure, per se, was not the focus of the composition. Wölfflin writes that "*the figure complex ... the interconnection of the form and its surroundings*" was the most important (1958, p.45). In an extreme example of a painterly style, movement is repeated and echoed throughout the picture plane which is crowded with bodies, draperies with sharp folds and landscape. In contrast, Italian painting favours harmonious, symmetrical organisation. A central axis is stressed and the sides are composed in a similar manner. Not only solemn images of, for example, saints are depicted according to this strict order but also dramatic narrative compositions, such as the slaughter of the innocents.

German painters mostly reserved symmetric organisation for compositions of dignified, ceremonious and unusual subject matter. To the German sensibility symmetry was a "*form that does not happen of its own accord in living things*" (Wölfflin, 1958, p.99).

This harmony in Italian painting does not only denote to symmetrical compositions, but also to the placement of the figure in relation to the shape of the picture. The horizontal and vertical lines mostly dominate in a rectangular panel. This is also reflected in the composition in a panel of circular shape or if the rectangle is crowned with a semi-circle.

In German painting, Wölfflin remarks that "*the Germans always long for a bit of freedom; for them, there must be something somewhere that does not submit to rule, and somewhere a window must be open to let in some fresh air.* (In Leonardo Da Vinci's 'Last supper') *no one would dare claim that in composing this picture, Leonardo was encumbered by*

schematic concepts - the feeling expressed is so powerful that the form must be fully accepted as personal necessity. But when detached from its national basis, the effect always degenerates into formalism" (1958, p.103).

Leonardo's painting the 'Last Supper' is an example of the repetition of the shape of the panel and of a symmetric organisation around a central axis. The long horizontal rectangle of the picture plane is repeated in the form of the table cloth and also in the coffered detail of the ceiling. The vertical lines of the picture lane and frame are repeated in the panels on the walls, in the windows at the back of the wall and in the figure of the Christ that is also the central axis of the picture. The figure of Christ is placed exactly on the central axis with the head in the middle of the picture plane. The figures of the apostles are grouped in four groups of three, two groups to the left of the Christ figure and two to the right.

In contrast to Leonardo's painting, in the 'Isenheim alterpiece' by the German painter Matthias Grünewald, the cross of the crucifixion is not placed in the centre of the picture but somewhat to the viewer's right. The figure of Christ is also not placed centrally on the upright post of the wooden cross, but to the viewer's right. The shape of the altarpiece is also irregular: two wings flank a raised centre. Wölfflin remarks that *"Grünewald did not recoil from the irregularity of the form; only by that irregularity was the compelling rhythm of the distribution of the figures rendered possible"* (1958, p.109-110).

(c) **Depth as a formal property in sixteenth century Italian and German painting**

Writing on the difference in approach between northern painters and Italian painters, Ernest Gombrich discusses the work of Jan van Eyck (of Bruges which today is Belgium) and Domenico Veneziano. Although Van Eyck is an undisputed master of the rendering of texture, such as a soft carpet or a

leaded glass window, Gombrich remarks that "*Van Eyck's rendering of forms in space is less secure. He is not in possession of the art of perspective construction, and so the floor seems slightly to slope and the spatial relationships between the figures and the building are not completely convincing*" (1993, p.20). On the other hand, the Italian Veneziano, a contemporary to Van Eyck, possessed knowledge of perspective. His "*figures stand clearly and firmly on the patterned floor which is constructed according to the rules of projective geometry. We feel that solidity of form which Berenson described as 'tactile values'*" (Gombrich, 1993, p.20). (Wölfflin would refer to a 'plastic style' instead of 'tactile values'.) However, the difference between German and Italian painting is more complex than northern ignorance of the rules of pictorial perspective. For example, the tilework on the floor in Grünewald's 'Annunciation' is not drawn according to the rules of perspective, but the result is more lively than could be obtained from correct perspective. Wölfflin maintains that in a group composition in an Italian painting, even when the figures are grouped together, they remain isolated. The figures also relate harmoniously to space "*but each pictorial component remains an entity in itself*" (Wölfflin, 1958, p.44).

In German painting "*figure and space form an indivisible complex ... here, everything depends on the experience of space and its contents as a unity, so that the elements appear inseparable even when each one is very clearly worked out. In such peculiarities of artistic imagination lie the reasons that 'St Jerome in his Cell' was possible for the Germans but not for the Italians. What oneness of figure and atmosphere! The saint is like a spider in a web of lines and lights that is as indispensable to his existence as he is to the web*" (Wölfflin, 1958, p.44).

There is also a different approach between the two nationalities in another aspect of showing depth on a two-dimensional plane. The Italian painter arranges his forms mostly parallel to the picture plane. As was remarked in the instance of depth in

prehistoric art, this arrangement of forms guarantees the ease of comprehension of the forms. However, Italian painting does attain a feeling of depth and does not lose its three-dimensional character through this arrangement, whereas prehistoric painting does not have depth as an objective. In Italian painting, the picture plane is taken into account as a norm. Wölfflin writes that "*all movement into depth is gauged with reference to it, and every foreshortening becomes truly effective only in contrast to markedly unforeshortened form*" (1958, p.192). This allegiance with the picture plane is the most obvious in the fifteenth century Italian painting but is still applicable to the sixteenth century. Thus Wölfflin compares a painting by Andrea Mantegna (1431-1506) to an engraving of the same theme by the German Martin Schongauer (active from approximately 1470 to 1500) to show the difference in approach between the Italian and the German.

Mantegna, in his depiction of the 'Death of the Virgin', placed "*the bier ... parallel to the picture plane and the figures are clearly distributed stepwise in space. In Schongauer's picture, the bed is foreshortened and the Apostles are entwined with it in such a way that the eye nowhere finds the possibility of building up connections in terms of the picture plane*" (Wölfflin, 1958, p.191).

The German therefore accentuated a feeling of depth through the insistence upon strategies such as the foreshortened view of the bed and the great variety of poses of the figures, foreshortened and leaning towards the figure of the virgin.

The sixteenth century Italian painters still had this influence in their painting, but achieve an impression of freedom in their compositions and not subjugation to the picture plane.

The figures of Leonardo da Vinci, for example the Saint Jerome, are painted in a pose that depends both on foreshortening and depth for effect, but still refer to the picture plane.

(d) Light and dark as formal properties in sixteenth century Italian and German painting

In Italian painting of the sixteenth century, light and dark as formal properties were considered together with the modelling of form in order to denote plastic clarity to form.

In German painting of the sixteenth century, the reality portrayed is bathed in a play of light and dark which Wölfflin describes as "*intangible and through which the interior has acquired its inner life*" (1958, p.221). The play of light and dark is thus not strictly rooted in reality. Wölfflin speaks of Dürer's woodcuts of the Small Passion as containing a "*complete irrational scattering of lights and darks*" (1958, p.81).

(e) Conclusion

The work of fifteenth century Italian painters such as Piero della Francesca (1415-1492) and Sandro Botticelli (1445-1510) show influences of neoplatonic philosophy. This philosophy was a synthesis of elements from the classical Greek philosophers such as Plato, Pythagoras, Aristotle and a school of philosophers, named 'Stoics.' Neoplatonism as a doctrine postulates that "*a hierarchy of being (exists), at the summit of which is the transcendent One, immaterial and indescribable. The human soul aspires to knowledge of this One through ascetic virtue and sustained contemplation, and in doing so rises above the imperfection and multiplicity of the material world*" (Hawkins, 1986, p.564).

In short, Pythagoras (approximately 550 BC) aimed to interpret the world through numbers and measurements. Plato's (429-347 BC) 'ideas' or 'forms' are "*abstracts, (or) perfect entities outside the physical world, and of which the material things that we see and handle are ephemeral and imperfect copies*" (Hawkins, 1986, p.641). Aristotle (384-322 BC) was a tireless

empirical scientific observer covering a wide variety of subjects such as biology and physical science. He introduced the inductive method of reasoning which states that a general law can be deducted from particular instances. The Greek Stoics (approximately 350 BC) believed that virtue or moral excellence is based on knowledge.

As was remarked in the discussion of the characteristics of Italian Renaissance painting, it was a restrained style of painting. The idealised forms of figures, such as Botticelli's Venus from the painting 'The Birth of Venus', is reminiscent of Plato's idea of perfection which cannot exist in the physical world. Botticelli represented Venus as an ideal of classical beauty.

Della Francesca was intensely concerned with mathematical theory and his paintings reflect this in the application of perspective and mathematical relationships. Hawkins writes that "*the world of his artistic imagination has clarity, dignity, and order, and the outlines of his figures tend towards the grace and regularity of curves in geometry ... He was capable of investing his art with hierarchic solemnity and power by using the severity of frontal or profile poses and formal presentation of the figure*" (1986, p.632). Della Francesca's pictorial interest in mathematical relationships and perspective reflects Pythagoras' aim to interpret the world through numbers and measurements.

The work of the sixteenth century Italian masters such as Leonardo da Vinci (1452-1519) also reflect an influence of neoplatonism. For example, 'La Gioconda' was presumably commenced as a portrait of Lisa, the wife of Francesco del Giocondo, but Da Vinci eventually transformed the image to reflect his ideal of classical beauty, therefore reminiscent of Plato's idea of a perfect entity. Da Vinci's wide range of interests reminds one of Aristotle who was also an empirical scientific observer. Because of Da Vinci's understanding of, for example, the movement of water and the shape of rocks and

mountains, he was able to combine empirical knowledge with imaginative power to create the background landscape of 'La Gioconda' which is suggestive of the forces of nature.

Bruno sums up the "*Renaissance interpretation of classical Greek form ... as characterized by what perhaps may be defined as a system of restraints in the depiction of chiaroscuro and in the use of colour to suggest the third dimension. The classical formula, as we have come to accept it, is one that maintains an enforced order and balance between inherently chaotic and contradictory elements: Line, in the sense of contour; chiaroscuro; and colour. In this interpretation, forms, while clearly modeled in terms of dark and light, continue to emphasize contour line and relatively flat local colour areas*" (1977, p.11).

There is an inherent contradiction in the Renaissance reference to neoplatonic philosophy, because Plato regarded the archaic adherence to pure colour and clarity of outline as superior to the work of painters, such as Apollodorus and Zeuxis who explored naturalistic rendering and whose work is closer in spirit to the Renaissance painting. Thus Plato visualised the perfect entities of his ideas in terms of the symbolic depiction of colour and the emphasis on outline. Contrarily, the painting of sixteenth century Italy visually has a closer resemblance to the painters concerned with naturalistic painting, but in the style of Apollodorus who still emphasises outline, rather than the painterly style of Zeuxis. Conceptually, however, classical Greek painting was ruled by simplicity as can be deducted from, for example, the limited palette employed. This simplicity is also found in sixteenth century Italian painting in the symmetrical, harmonious organisation, the employment of a central axis and the relation of the forms depicted to the form of the picture plane.

German painting is conceptually nearer to the painterly style ascribed to the classical Greek painter Zeuxis. This style reflects a sensitivity to the suggestive; the German sensibility is

not repulsed by the unclear. Wölfflin writes of German art: "*If light and shadow are introduced, the 'painterly' effect is even more easily achieved. These elements unite in a compelling over-all movement precisely when the shadows are not dependent on the figures and not restricted to an objective statement. What would Dürer's woodcuts of the Small Passion be ... without the completely irrational scattering of lights and darks*" [1958, p.81]. German painters also avoided a pronounced outline or contour of the forms because "*it was a threat to the essential merging of forms, that mysterious coherence of the whole that also had existed long before Schongauer*" (Wölfflin, 1958, p.79).

As described earlier, Zeuxis avoided a definite outline and the play of light and dark introduced "*the concept of a unified spatial atmosphere*" (Bruno, 1977, p.29).

Thus, the dichotomy between form and colour, introduced into painting by classical Greece and not evident in prehistoric painting, is evident in sixteenth century Italian and German painting. In the context of this thesis, Wölfflin's description of Italian painting as 'plastic' is equated with Brendel's term 'abstract linear' applied to classical Greek painting that stresses the outline of the form. In the same way, Wölfflin's description of German painting as 'painterley' is equated with Brendel's term 'impressionistic-painterly' applied to that strain of classical Greek painting which stresses the use of colour to suggest form. Thus, although two broad strategies have emerged by means of which to employ the formal properties in painting (reflecting an accent either on outline or on colour), the possibilities of employing the properties of painting are still endless for individual painters.

2.2.4 The role of the formal properties in twentieth century American formalist painting

This thesis is not a study of the formalist movement as instigated by Roger Fry and Clive Bell or the formalist tradition of the

American school of painting, but the focus is on the application of the formal properties of art. It is in this sense that the early years of the American formalist tradition are included as historical instance of the role of the formal properties in painting. The painter and teacher Joseph Albers was influential in laying the foundations of this tradition. At the Black Mountain College near Asheville, North Carolina, Josef Albers instigated a formalist tradition through his teaching and his own painting. He taught from the inception of the college in 1933 to 1949. Albers accepted a teaching position in America after Hitler closed the Bauhaus in Germany in 1933. At the Black Mountain college, Albers modeled the curriculum on the program of the Bauhaus. The basic design course included studies of materials, their applications and form characteristics. The approach to art was nonfigurative, highly disciplined and in contrast to abstract expressionism which emphasised emotional expression.

The paintings of the American abstract artists working in the formalist tradition reflected "*emotional restraint, clarity of form, precision of concept and execution, and commitment to nonfigurative painting, (and) this type of abstraction stood as the antithesis to the emotionality and painterliness of abstract expressionism*" (Buettner, 1981, p.127).

In his own painting Albers would, for example, develop a series of paintings based on a single motive in a rational and disciplined manner. Buettner notes that line and colour were afforded equal importance by Albers. The edges of the coloured forms are sharply defined. But Buettner says that "*the interest in colour which has occupied (Albers) for the last thirty years is a manifestation of his more overriding concern with perception. Colour fascinated him because of the problem it posed in the physiological phenomenon of sight. Colour was simply 'the most relative medium in art.' And it was relative because of this illusory nature. Owing to the phenomenon of the after-image, colour never was 'perceived as what it actually is'. Colour became to Albers a variable in the artistic equation which could not be trusted*" (1981, p.130). He also wrote a book 'The Interaction of Colour' in which he quotes

from Chevreuls book 'The Laws of Contrast of Colour'. Albers always emphasised "*articulation, control, mental discipline (in his painting), and precision of execution (which) led him to entertain little tolerance of the elements of chance and automatism which where crucial to a painter like Pollock ... automatism was the incarnation of all the excess of personal expression which Albers' stress on reason and clarity opposed*" (Buettner, 1981, p.131).

Another painter who worked in the American formalist tradition, was Ad(olph) Reinhardt (1913-1967). His later painting was nonobjective in the extreme. He regarded structure and the formal properties as the most important elements in painting. He favoured rectilinear, symmetrical composition. Reinhardt tolerated neither chance, nor accident or the spontaneous employment of the elements through brushwork.

Reinhardt also only accepted traditional tools and media and the arrangement of forms on the canvas was the only meaning of the painting.

(a) **Colour as a formal property in the early American formalist tradition**

Buettner's remarks on Albers' interest regarding the formal property of colour, show the formalist approach of Albers. Albers was mainly concerned with colour because of the possibility of creating an illusion. Whereas form is both visible and tangible in the physical world, colour is not tangible, and colour can thus be considered as illusionary. Albers also considered colour as "*the most relative medium in art*" (Buettner, 1981, p.130) because of the physiological characteristics of perception such as an after-image which influences the perception of colour. Colour, for Albers, was indeterminate and his late paintings depended on the careful arrangement of colours: "*the interaction of adjacent colours (produced) effects of modulation and tonal variation*" (Turner, 1996, p.549). The colours could be either harmonious or

disharmonious but control and precision of application and articulation were paramount.

In reaction to the emotionalism and individuality of abstract expressionism the painter Ad Reinhardt rejected the concept that painting could be "*a form of autobiography, he emphasised that the canvas was not the place for the artist to lay bare the human psyche. In so doing, he rejected expressionist brushwork, colour, texture, space, and movement*" (Buettner, 1981, p.140). In his late paintings Reinhardt adopted the term 'minimal' to describe the "*extent to which he had limited the formal elements found in his painting. He conceived his final works ... as absolute statements reduced to a single hue and 'purer and emptier and freer than any previous art'. It was Reinhardt's reduction of painting to limited, repeated formal values that became the first pure statement of 'minimalist' or 'formalist' art*" (Buettner, 1981, p.141).

The black paintings of Reinhardt date from 1960. Whereas Piet Mondriaan (1872-1944) limited his painting to primary colours, Reinhardt reduced the formal property of colour to black "*which he regarded as physically colourless*" (Buettner, 1981, p.143). Turner writes that he concentrated "*the viewer's attention on gradations of colour of such subtlety that they were nearly impossible to see*" (1996, p.127). The restriction of the formal properties was regarded as allowing greater freedom in perceptual response to the viewer. For example, if the viewer is confronted with a painting that conveys much, he is in fact more restricted in his response than with a painting that conveys little.

(b) **Form as a formal property in the early American formalist tradition**

The paintings of Albers consist of flat areas of colour or forms separated by precise clear edges created by changes in hue. For example, the painting 'Homage to the Square, Insert, 1959'

contains the simple form of the square placed centrally and parallel to the form but somewhat to the bottom of the picture plane. The form of the square is repeated by other squares seemingly larger and placed behind the central square. Subtle diagonal changes in hue also denote the corners of the two outermost squares. The employment of a form as simple as the square stresses Albers' "*emphasis on articulation, control, mental discipline, and precision of execution*" (Buettner, 1981, p.131). The choice of the squares and their position also indicate that nothing was left to chance.

Although the painting 'Homage to the Square, Insert, 1959' appears simple, the forms are restrictive and prescriptive to the viewer because of the forms parallel to the frame, the diagonal lines and the closely related colours. The forms can suggest a view of an interior - a square wall of a light hue with a square of a darker hue imposed on top. The outer squares with their corners accentuated by changes in hue suggest a recession, and this could be interpreted as walls, a ceiling and a floor. In another interpretation, the play of forms is the only important consideration. In this instance the incomplete perception of three of the squares and the further break in continuation by the change in hue in the corners of the two outer squares give prominence to the dark square perceived as an entity. The possible interpretations of Albers' work as described above still direct the viewer's "*retinal response*" (Buettner, 1981, p.141). This illustrates Reinhardt's conviction that the more a painting contained, the less it conveyed. Reinhardt's black paintings, for example 'Abstract Painting 1960-61', consist of a square painted colour field. The form of the painting is thus reduced to the simple square, and anything that detracts from its basic structure is taken away. Reinhardt, in stripping the painting to its most simple form, wished to lift any restriction placed on the viewer. He concluded that "*the less a painting conveyed (the more rigorously its formal components were restricted), the greater latitude in retinal response it allowed the viewer. The less a painting contained, the more it conveyed*" (Buettner, 1981, p.141).

Thus Albers' painting, though also taking the square as its subject, still restricts and directs the viewer's response by the repetition of form and the various smaller forms that result from this repetition. The result is that not everything is conveyed to the viewer and the viewer is left unsure. Less is conveyed in Albers' painting than in Reinhardt's painting, although Reinhardt's painting contains less. Here everything is clearly articulated and thus conveys more to the viewer than Albers' painting does.

(c) **Depth as a formal property in the early American formalist tradition**

Albers' painting 'Homage to the Square, Insert, 1959,' could be interpreted to contain a one-point perspective. The change in hue in the corners of the two outer squares forms diagonal lines. If these lines are extended, they will meet at a single point, centrally but one third from the bottom of the dark square that is perceived as an entity. The one-point perspective gives depth to the picture plane. Also, because the central square is lower in value than the other hues it tends to recede. Albers' play of values and of forms result in a pronounced perception of depth. But, as in sixteenth century Italian painting, the forms are parallel to the picture plane, a strategy which does not emphasise depth.

Reinhardt' painting is also framed by a black box frame which casts a shallow shadow on the black surface of the painting. Therefore, although black absorbs all colour or light, and reflects no colour or light, the shadow that is cast causes the surface of the painting to recede. Also, the lower the value of a hue the more it recedes. The black painted field is stripped of all superfluous meaning. *"Reinhardt rejected anything in painting that made reference beyond the purely visual"* (Buettner, 1981, p.141). The black recedes from the viewer and thus alludes to depth. However, the central, frontal, symmetrical organisation would suggest a picture plane less

conducive to the impression of depth. Because colour and light are absent, the form is reduced to the square of the picture plane. The picture plane is thus empty and in a low value that recedes; the depth is unlimited and allows great "*latitude in retinal response*" (Buettner, 1981, p.141).

(d) Light and dark as formal properties in the early American formalist tradition

Albers' painting 'Homage to the Square, Insert, 1959' a subtle play of higher and lower values around the edge of the picture plane and a sharper contrast between the darkest hue in the central square, and the lightest hue placed directly next to the dark hue, introduce a play of light and dark. The painting reminds one of conditions experienced before: that of an interior and the play of light and dark on the walls. However, the light and dark patterns are not consistent with illumination from a light source, thus the viewer is left unsure because of the ambiguous elements in the painting. The more subtle changes in hue around the outer edges of the picture plane allow for the attention to be drawn to the darkest hue of the square, set off against the lightest hue. The formal properties of light and dark thus accentuate the square - the subject of the picture - although there is ambiguity.

In Reinhardt's painting the absence of light is almost complete; the fact that black absorbs light and reflects no light results in only the black shadow of the box frame falling on the painted black field to modulate the field.

Reinhardt called the painting '*purer and emptier and freer than any previous art*' (Buettner, 1981, p.141). He described black as 'physically colourless', but it is also lightless because it reflects no light. The dark or shade in a painting is mostly represented by colour and not by black because of indirect illumination from other surfaces that reflect colour and light. For example, in impressionist painting the complementary colour to the colour employed in the area that is illuminated,

denotes shade. An object that is yellow will then be shaded by purple. In the impressionist example an obstacle intercepts the rays of light. However, through the reflection of (coloured) light from other surfaces, the shade is also indirectly illuminated (mostly not by the full spectrum of white light) and thus reflects colour of a lower value than the illuminated areas.

No indirect illumination is indicated in the black in Reinhardt's painting. No light is emitted and it could thus be argued that the black does not represent dark or shade, but emptiness.

(e) **Conclusion**

The early American formalist tradition embraces the "*accepted classical tenets of order, clarity and logic*" (Buettner, 1981, p.145). The compositions favoured symmetry and the methodical and controlled arrangement of the formal properties. The critic Clement Greenberg considered the formalist paintings as affirming the "*limitedness of pictorial space as such, with all its rectangularity and flatness and opacity*" (Buettner, 1981, p.146). Formalist painting aimed to relieve painting of "*all moral, ethical and intellectual values that had accrued to it since the beginning of western culture. In Frank Stella's words, it sought to divest art of 'the old values ... the humanistic values', in favour of art that could be appreciated in purely visual terms. In this sense, following the spirit of both Cage and Albers, perception became the absolute criterion of formalist painting*" (Buettner, 1981, p.148).

The role of chance was not taken into account in the early formalist tradition. However, in the work of the abstract expressionists, such as the paintings of Jackson Pollock, chance played a major part. The mark made by the paint could not be altered once it fell onto the canvas. The term 'automatism' was also applied to Pollock's painting action. This would imply an involuntary action or an unthinking routine according to the definition of the 'Oxford Reference

Dictionary'. However, Pollock did calculate his action beforehand but could not alter the line or form made by the paint once it was thrown onto the canvas. The painting of the abstract expressionists again refer to the dichotomy between painters who favour a painterly approach, such as the classical Greek painter Zeuxis and the sixteenth century German painters, and painters who favour a clearly delineated form. The early American formalist tradition refers to the strain of painters who favour form that is clearly delineated such as the classical Greek painter Apollodorus and the sixteenth century Italian painters.

2.3 THREE STRATEGIES IN THE DEPLOYMENT OF THE FORMAL PROPERTIES IN PAINTING

The painter can follow certain strategies in the deployment of the formal properties in painting. These strategies are employed to defeat the unwelcome intrusion of habit and "*create new patterns of perception*" (Watts, 1980, p.1) or they are a preferred representational or abstract orientation.

2.3.1 Chance as a strategy in the deployment of the formal properties in painting

Chance has always been an influential factor in painting. Harriett Watts makes a distinction "*between chance, or accident, as subject matter, and chance as compositional principle*" (Watts, 1980, p.1). The following are examples of chance as subject matter.

(a) **Chance as subject matter**

Chance was already a factor in prehistoric cave painting. Some of the forms of the animals painted are suggested by forms projecting from the cave wall. The painting is thus an elaboration of the chance form already present in the cave wall. The painting of 'A Horse' at Pech-Merle is an example.

In classical Greek painting the example of the Lefkadia paintings was cited. Here individual but overlapping strokes of different colours produced the colour accidents on which the painter relied. The colour accidents or chance formation of hues enlivened the rendering of shade.

The Italian painter Leonardo da Vinci saw that in "*the play of cracks and fissure on the wall ... warriors and clouds take on outlines*" (Focillon, 1989, p.16). In other words, Da Vinci saw forms and compositions of forms produced by chance in the cracked wall, ravaged and stained by wind and rain. Furthermore, Rudolph Arnheim studied chance as subject matter in realism. Realism is enhanced and enlivened by chance relationships between the formal properties. Arnheim gives the examples of a stylised Byzantine rendering of a figure which is controlled in its form and colour. In contrast, upon close examination a painting by Rembrandt of a figure is less controlled and is built up by and "*shows the intrusion of extraneous, individual encounters ...* (Arnheim says that) *with increased realism, the solution offered by the artist becomes a less probable one*" (Watts, 1980, pp.1-2). Arnheim thus says that chance plays a greater part in the apparent realistic rendering of the figure in the painting by Rembrandt than in the Byzantine painting. In the painting by Rembrandt, the apparent realistic rendering of the face is built up by coloured marks which, viewed in isolation, are not necessarily composed of skin tone, and which are built up by forms which have no clear, descriptive edges. The rendering is thus not realistic but the end result, or face, is.

To explain chance as subject matter, Arnheim cites the examples of crowd scenes. These scenes illustrate the role of chance relationships in painting. (Although the examples of crowd scenes do not as such illustrate chance as a strategy in the deployment of the formal properties in painting, these examples influence the employment of chance as compositional principle in twentieth century painting and hence the role of chance in the deployment of the formal properties.)

Firstly, the teeming crowd and its seemingly chance movement in the 'Last Supper' by the Venetian painter Jacopo Tintoretto (1518-1594) still has a focus point, namely the figure of Christ.

With the paintings of the romantics, chance begins to be employed to "*defy the rigid order of rationalism; and the same device points up the imperfection of everyday life in the harsh statements of social critics and naturalists, from Hogarth to George Gross*" (Watts, 1980, p.2). In other words, the crowd has no focus point.

In nineteenth century art the individual figures do not relate to one another; they exist in isolation and have no focus point. Arnheim uses Edgar Degas' 'Cotton Market in New Orleans' as an example of the chance grouping of figures. Arnheim reaches the conclusion that "*Degas and some other painters of his generation used the theme of accidental encounter as a subject matter to portray indifference, isolation, unawareness*" (Watts, 1980, p.2).

Arnheim concludes that in the twentieth century, cubism took "*the last step possible in depicting accidental relationships as subject matter* (they took the principle of indifference) *further and made it express the conflict of everything with everything. In the best works of this school, great skill is applied to defining with visual precision the oblique relationships among the single cubic units. These units constantly interfere with each other, breaking into each other's contours. They tend to destroy the remnants of over-all compositional groupings and instead evenly fill the entire surface with-in the picture frame. This is a logical development because when structure is reduced to a one-to-one interaction between individual elements no larger shape can build up. The pattern can extend forever. In its pure and extreme form, this style represents a level of order that, although intricate, is quite low - because it lacks hierarchy and diversity. But a definite form of order it still is: it is classically described in Plato's*

'Timaeus' as 'Anake', which is put in opposition to the lawful cosmos. In the realm of Anake, necessity is reduced to the causal action of any one object upon any other, and all of these actions add up to nothing more organized than an over-all balance" (Watts, 1980, p.2). Cubism thus concluded the use of chance as subject matter.

(b) Chance as compositional principle in painting

In this development, chance relationships are not merely represented, but chance is a determining factor in the deployment of the formal properties and in their composition in the final painting.

Although cubism represents the culmination of the use of chance as subject matter and although Dada initiates chance as primary compositional principle in twentieth century western painting, eastern painting has anticipated this development. The eighteenth century Japanese artist worked in a tradition where chance was accepted as a factor to be welcomed and not concealed. For example, in an effort to paint without using his hands, the painter Hokusai, poured a pot of blue paint over a paper placed on the floor and then "*dipping the claws of a rooster in a pot of red paint, he made the bird run across the scroll and leave its tracks on it. Everyone present recognized in them the waters of the stream called Tatsouta carrying along maple leaves reddened by autumn ... the spreading blue colour flows into divided streams like a real wave, and the bird's claw, with its separate and united elements, is like the structure of a leaf. Its nearly weightless trace marks accents unequalled in force and purity; and its path respects, but with the nuances of life, the intervals setting apart the delicate flotsam that the rapid water sweeps along*" (Focillon, 1989, pp.177-178). The form of the river and the leaves, and the light and dark and the value of the colour, and also the composition of the formal properties, are therefore determined by chance in this painting. Chance is thus the compositional principle in this eighteenth century Japanese painting.

Watts describes the environment which allowed chance to assume importance in twentieth century western painting. For example, at this time chance was at the basis of the quantum theory in physics. The 'uncertainty principle' of Werner Heisenbert (1901-1976) proposed in 1927, stated that the position and the momentum of the particles at atomic level cannot be ascertained simultaneously. This opened up the possibility that there could be spontaneity or chance in this structure because not all eventualities can be predicted from previous events. A world view in which chance played a major part thus permeated through all the disciplines. In this environment Dada (1915-20) embraced chance as a primary compositional principle, although Dada anticipated the development of quantum physics in which precision becomes possible only in a context of indeterminacy (Watts, 1980, p.35).

Two approaches to chance can be discerned from Dadaist experiments; "*first, the attempt to assure indeterminacy regardless of the level of the new, a- logical order that emerges, and second, the interpretation of chance as an access to unknown, universal correspondences, to a universal order beyond any construct posited by western causal and logical thought ... on one side, one might find Picabia, Duchamp and Tzara, and on the other, the mystically inclined Arp, Ball, Richter, and to some degree, Ernst*" (Watts, 1980, p.4).

Marcel Duchamp regarded chance as an instrument to defeat logic. He regarded logic as "*a perceptual habit that must be broken*" (Watts, 1980, p.34). He thus aimed to defeat logic. In order to achieve his objective he employed mechanical means of production, among other methods, because this negated pictorial convention. Duchamp's "*total aesthetic indifference in creation*" (Watts, 1980, p.4) also included a very systematic application in which he meticulously recorded experiments, and followed recognised scientific procedures. For example, in the work 'Three standard stoppages', Duchamp released a rope

of a specific length at a certain height and recorded the chance figuration the rope adopted. This was repeated three times. Duchamp "*maintained that the 'distorted' meter lengths were indeed as valid as the extended, straight line meter and what was a standard unit of measure, in form as well as in length, now assumes an infinite variety of shapes, three of which already suffice to invalidate the concept of 'standard'. The three string profiles were transferred onto wood and cut out to form undulating rulers. After they had been used as the units of measurement for the capillary wires to the bachelor mallic moulds in the 'Grand Verre', each separate meter reproduced three times to trace the paths of the conductors, the rulers were retired in honour to an elegant croquet case, where they remained preserved as 'canned chance'* " (Watts, 1980, p.36). In this work the chance figurations of the dropped rope determined the form of the rulers, and mechanical production determined the formal properties of the croquet case. This example illustrates Duchamp's "*total aesthetic indifference in creation*" (Watts, 1980, p.4).

In contrast to Duchamp, Hans Arp interpreted "*his own Dada experiments as those of the 'holy fool' gambolling at the shores of mystical revelation, which at the time he had not recognised*" (Watts, 1980, p.4). Arp 'discovered' chance in 1916. In frustration, he tore up a drawing that did not satisfy him. The torn pieces fell upon the ground and "*he recognised in the accidental pattern that resulted the exact formal arrangement that he had been trying to achieve. He began to apply this procedure to other drawings and to his papiers collés of the Dada period*" (Watts, 1980, p.52). The chance arrangements in the work of Arp thus influence the forms and compose the formal elements according to aleatory influences. But Arp never experimented with chance as systematically as did Duchamp.

The predilection for compositions relying on chance developed from the use of chance in Dadaism to "*more or less controlled splashes and sprays of paint*" (Watts, 1980, p.72) in the

painting of, for example, the abstract expressionist Jackson Pollock. Pollock's drip painting was in fact technical experiments and liberated the formal property of form and line from the accepted concept of painting technique. The mark of the paint, once it touched the canvas, cannot be changed. Pollock is not able to control the specific mark of the paint on the canvas; he accepts that "*the experience of painting became the subject matter of the canvas. Painting was conceived as an event, a record of the artist's feelings and the physical movement to which they gave rise*" (Buettner, 1981, p.87). Pollock stated that he entered 'into' his paintings and did not know what he was doing. He did not aim to control his painting and worked in a trance-like state.

Chance can thus be accepted as a strategy in the deployment of the formal properties that continue to be employed.

2.3.2 Control as a strategy in the deployment of the formal properties in painting

Control has (as chance has) always been an influential factor in painting. Control and chance have also existed side by side or have been separated to a greater or lesser degree.

In prehistoric painting the outline and form of the animals, for example, are well defined and controlled. Although some of the animals' forms are suggested by the chance form of the rock formations in the cave wall, the prehistoric painter controlled the painted line, form and colour.

In classical Greek painting, the paintings at Kazanlak are more controlled than those at Lefkadia. Colour accident is not employed at Kazanlak as it is at Lefkadia, and the forms are clearly outlined and premeditated at Kazanlak. Although the linework at Kazanlak is fluent and reminds one of calligraphy, the forms and lines are not produced by chance but by control. Thus the strategy in the deployment of the formal properties in classical Greek painting at Kazanlak, is control.

In sixteenth century Italian painting, influenced by neoplatonic philosophy, beauty was thought to be attained through order, symmetry and definiteness. It was thus a restrained and controlled style of painting. Bruno remarks that "*the classical formula, as we have come to accept it, is one that maintains an enforced order and balance between inherently chaotic and contradictory elements: line, in the sense of contour; chiaroscuro; and colour, in this interpretation, forms, while clearly modeled in terms of dark and light, continue to emphasise contour line and relatively flat local colour areas*" (1977, p.11). Although there is an enforced balance between contradictory elements, the aim of sixteenth century Italian painting was to control the deployment of the formal properties through, for example, linear perspective, symmetrical compositions and outline. Measurement became an important mechanism to implement the strategy of control over the deployment of the formal properties in sixteenth century Italian painting.

In the early American formalist tradition, measurement was even more important in the controlled deployment of the formal properties. For example, Josef Albers' painting 'Homage to the Square, Insert, 1959' referred to earlier, the central square is placed exactly in the middle of the picture plane from left to right and a third from the bottom. The three squares, each larger than the previous and framing the central square, each forms the same margin, clockwise from the top in the proportion eighteen, twelve, six, twelve, around the central square. Another concern which occupied Albers is perception. Because colour exhibited the difficulty inherent in the accurate or controlled rendering and perception of the formal properties the best, Albers endeavoured to master the elusive properties of colour. For example, a physiological perceptual phenomenon such as after-image, which influences the accurate perception of colour cannot be controlled completely but can be harnassed to pose problems for the viewer. The study of perception, in the case of Albers but also more widely, contributed to efforts to control the deployment of the formal properties in painting. Buettner states that Albers believed "*that

the highest purpose of the artist was 'to end ... chaos and establish new fundamentals of living' " (1981, p.133).

The black paintings of Ad Reinhardt were definitive *"rectilinear, symmetrical compositions, a sense of order in the face of chaos and subjectivity"* (Buettner, 1981, p.140). Reinhardt aimed to eliminate *"everything which had a meaning greater than the compositional arrangement of forms on the canvas ... all the faculties of rational mind, mediation, control, and carefully calculated execution were the primary means which the painter had to utilize in developing the work rather than ignoring them in an effort to achieve mysterious and uncalculated effects"* (Buettner, 1981, pp.140-141). The black paintings were thus complete statements, they were controlled in their execution and in that which the viewer perceived.

In conclusion, control, as a strategy in the deployment of the formal properties in painting, depends on the mechanisms of premeditation, measurement and perceptual studies.

2.3.3 Representational orientation as a strategy in the deployment of the formal properties in painting

Henri Focillon discusses the apparent contradiction that form in painting can allude to something else. But he stresses that a specific form alludes to another specific form. This reference of one form to another form was the subject of disputation and investigation into two types of form, namely living forms and abstract forms.

As example Focillon refers to Romanesque sculpture in which *"ornamental figures and human beings can be superimposed: the contours of the body are at the same time arcs, capitals and bases constructed according to a complex play of circles, curves and triangles. Such fusion and ambiguity are rarely as complete as in early Romanesque art, but the same interplay between geometric and mimetic figures is to be found everywhere"* (1989, p.22). Figures in paintings, such as those in Raphael's 'School of Athens',

are "*the successive interlaces of a formal thought composed of and supported by the human body, and by means of which are contrived symmetries, contrappostos and alternating rhythms*" (Focillon, 1989, p.22).

The representational and geometric orientations thus coexist (as do the orientations of chance and control discussed previously). The coexistence of the representational and geometric orientation is already apparent in prehistoric art in which specific recognisable animals, such as horses, are represented together with geometric symbols, such as dots and rectangles. These two orientations coexist but can also allude to the other as in Focillon's description of Romanesque painting.

Furthermore, representational and geometric orientations can be understood as the iconography of forms. Focillon defines 'iconography' as "*either the variation of forms on the same meaning, or variation of meanings on the same form. Either method sheds equal light on the respective independence of these two terms*" (1989, p.23). Focillon asserts that iconography only identifies a form but does not fully clarify the significance of the form; in other words, the meaning and references that underlay them in the given culture and "*whose relation to form is largely arbitrary*" Focillon, 1989, p.25). Leonardo da Vinci regarded as essential for a painter "*a universal ability to represent all aspects of forms produced in nature (he said) you would not know how to do it without seeing them and taking them into your mind*" (Focillon, 1989, p.25).

Focillon states that painting and perception "*are based on the existence, the creation and the recreation of visible forms. There are then, really, two significations that adhere to form: A specifically formal signification that is allusion to other forms, and a nonformal signification, without a doubt always present, but whose relation to form is largely arbitrary*" (1989, p.25).

The 'David' of Michelangelo Buonarroti (1475-1564) is regarded as an example of these two significations that Focillon alludes to. The

form of the figure of David is based on a sculpture of Hercules of 1494 and other more ancient sculptures of Hercules. Focillon asserts that this is an *"allusion from one form to another form"* (1989, p.24). However, the nonformal, arbitrary relationship between David and Hercules is established at the same time.

2.4   SUMMARY

In the second chapter the employment of the formal properties of painting are traced through historical instances namely through prehistoric, classical Greek, sixteenth century Italian and German and twentieth century American formalist painting. Strategies in the deployment of the formal properties are also explored.

A continually more sophisticated employment and deployment can be traced. For example, Plato's archaic ideal of pure colour and outline, and little suggestion of depth, was replaced in classical Greek painting by two more sophisticated approaches to represent figures and depth. These are termed 'abstract linear' and 'impressionistic-painterly' and depth specifically, is suggested through foreshortening and shapes that overlap. Although depth is still restricted and concentrated on one plane, it is more developed than in archaic Greek painting. Plato's rejection of the two new approaches to painting, shows that he and the two painters (Apollodorus and Zeuxis) belonged to different worlds conceptually. Plato could not conceive of the altered concepts of depth in the pictorial field as encountered through Appollodorus and Zeuxis. In general the rejection which is later on followed by the acceptance (or later viewers) that their work is a valid representation of an aspect of the visual world, point to the artist's role in the development of visual perceptional concepts.

CHAPTER 3

3. CHARACTERISTICS OF VISUAL PERCEPTION

3.1 REFERENCES TO VISUAL PERCEPTION

In the first chapter an aesthetic mode of appraisal is differentiated from ordinary everyday visual perception, although the original meaning of the term aesthetic (aisthetikos) and the term perception coincide. Visual perception is also deemed subject to a measure of interpretation.

As stated earlier, Kant maintains that we interpret and construct the visual world according to material that we are aware of. Therefore reality is a product of the mind and the nature of reality cannot be proven scientifically. In addition, Redfern states that *"one's own powers of perception are limited: that for which we have no adequate terminology is likely to be missed"* (1986, p.91). This points to the subjective, incomplete perception of the world.

In this thesis, where it is not possible to refer back to clearly stated thoughts on visual perception throughout history, references to visual perception are mainly derived from the study of paintings. If records are available, for instance in the form of the writings of painters or philosophers, these are also referred to. Although ordinary visual perception and an aesthetic mode of appraisal are differentiated, the painter's product of his visual perceptual experience is used, especially in early history where no written records exist to form some thought on visual perception in the context of that era. This is done in order to form a historical background to visual perception.

3.2 ART HISTORICAL REFERENCES TO VISUAL PERCEPTION

3.2.1 Visual perception in prehistoric painting

Of this period no written records exist which could clarify prehistoric man's efforts to explain visual perception. However, a visual legacy in the form of paintings, reliefs and three-dimensional objects exist. Of these, painting would constitute the most tangible proof of visual perception because the painter and the viewer would primarily visually perceive the painting (whereas sculpture can also be perceived by the sense of touch). The object depicted, or "*the object of ordinary perception is regarded from a special standpoint ... and this involves a certain freedom of judgement and discrimination, an active personal response that has a markedly effective, as well as intellectual, dimension*" (Redfern, 1986, p.19). This statement is echoed by Henri Focillon when he says that "*painting is an intellectual activity because perception is an intellectual activity, as is imagination; but both are based on the existence, the creation and the recreation of visible forms*" (1989, p.25).

From these quotations it follows that the fact that paintings exist in prehistory, gives us access to the visual perceptual consciousness of prehistoric man. In his perceptual ability he thus already has a "*freedom of judgement and discrimination* (and) *an active personal response*" (Redfern, 1986, p.19) to his environment.

Simple materials are used in prehistoric paintings and the colours are restricted to earths and charcoal. The correlation between earth colours and the skin colours of animals shows a sophisticated perceptual interpretation of the visual world: equating two unequal entities and thus overcoming the apparent contradiction that earth can represent something disparate, an animal. The omission of the colour blue from the palette either points to the pigment being unavailable, or the colour not described by adequate terminology.

The detail included in the paintings, such as the patterns on the animal skins and the accurate representation of the different forms of the animals, reminds one of Leonardo da Vinci who said that "*in order to be excellent you* [Da Vinci addresses the painter] *must have a universal ability to represent all aspects of forms produced in nature, you would not know how to do it without seeing them and taking them into your mind*" (Focillon, 1989, p.25). From the accuracy and detail of the depiction in prehistoric painting, the conclusion can be drawn that the painter 'saw the forms and took them into his mind'. In other words, he accurately perceived the detail. In a society of hunters, accurate perception is at a premium to survive in the dangerous and, to a large extent, unpredictable environment.

Prehistoric man's main perceptual contribution would then be in the fact that he articulated his main concerns in pictorial form. He realized that "*large three-dimensional objects could be recognizably portrayed in miniature, or in two dimensions ... once men had accepted this idea, the artist could capture for all time and for all the tribe his idea of an animal, a scene which had occurred in the past, or one of his fantasies. And what he created could be used for play, for teaching the young, for worship, or simply for looking at with pleasure. In effect man could 'freeze' part of his environment long enough for his powerful intelligence to think about it, to manipulate it, to understand it fully. Soon he developed also symbols which were 'shorthand' representations of the real object. So were born not only art but also the diagram, the teaching aid, the scale model, the toy and the idol*" (Atmore, 1973, p.22).

The fact that prehistoric man could recognise the visual perceptual analogy between earth colours and the skin colours of animals thus opened many new visual perceptual possibilities. As Atmore states, the manipulation of the visual information through painting widened prehistoric man's interpretative skills and also, by implication, his perceptual skills (because interpretation is part of perception). Painting was thus an activity which exercised the important skill of perception both for the prehistoric painter and

viewer. Prehistoric man also allowed suggestion to stimulate his perception. In the dark recesses of the cave, lit by the flickering light of torches, the paintings of animals are perceptually elusive and seem to appear and disappear from the play of light and dark. This suggested movement and created the illusion that the elusive animals are in motion. It mimicked the reality of animals that are difficult to perceive and probably stimulated prehistoric man's ability to perceive these animals in the wild.

The representations of the real object, for example through scale models, made possible the simulation of as yet unrecognised possibilities, such as more effective hunting strategies. In other words, prehistoric man could develop adequate terminology to extend his powers of perception before encountering the possibility in reality, so that he would be prepared, recognise the possibility and not miss an opportunity in, for example, hunting.

(a) **Conclusion**

Interpretations of visual perception in prehistory are mainly derived from prehistoric painting. In this instance, perception is therefore approached from an art historical perspective. Although no written records exist concerning visual perception in prehistory, certain deductions are possible.

Visual perception was an essential survival skill in a society of hunters. As such it was most probably already highly developed and exercised by hunting before pictorial form came into existence. The intellectual breakthrough of pictorial depiction opened more perceptual possibilities. Because of this breakthrough, perception became even more effective at developing strategies for survival.

3.2.2 Visual perception in classical Greek painting

The philosopher Plato provides us with a written record that could allude to one perspective on visual perception in classical Greece. It is a criticism against the employment of optical illusion in

painting in the book 'The Republic'. Bruno refers to Plato who stated that "*any kind of optical illusion, according to Plato, whether in painting or elsewhere, plays us false in the sense that it takes advantage of a human failing, namely the inherent weakness of our sensory organs, upon which we must rely for knowledge. The sense of sight is already unequal to the task of informing the mind of what is actual and true in the world around us. The weakness of our senses should not be exploited by artists. On the contrary, they should create designs pure enough and abstract enough to appeal directly to the best parts of our mentality. In nature, illusions cannot be avoided. Among the examples given by Plato are the way objects appear bent when looked at in water, and the way in which the concave sometimes appear convex, 'owing to the illusion about colours to which we are liable.' In other words we are in enough danger of being deceived by our senses without adding to those dangers by surrounding ourselves with overly deceptive man-made illusions. Painting was better when artists were without the technical means to create optical illusions and could concentrate on 'ethos' and on pure aesthetic pleasure as it may be derived from geometric shapes and pure, unadulterated colour. In the course of this discussion, Plato refers specifically to 'deceiving by light and shade, and other ingenuous devices', which have an effect upon us 'like magic'. Thus, illusionism in painting of the kind that had made Zeuxis famous was, we may imagine, to be condemned in Plato's ideal state, and it seems very likely that in this regard Plato reflected the opinion of a much wider group of reactionary and no doubt outspoken critics*" (Bruno, 1977, p.35).

According to this quotation Plato had studied '*the sense of sight*' and had drawn the conclusion that '*the sense of sight*' does not inform the mind accurately and is easy to deceive. He refers to '*deceiving by light and shade*' and '*the illusion about colours*'. On the contrary, he refers to the moral values which may be derived from '*geometric shapes*' and '*pure unadulterated colour*'.

Plato thus considered the sensory organs as weak and in need of protection against man-made illusions. Certain shapes and colours

are more acceptable than others. In chapter one the Greek term 'aisthetikos' is described as "*things perceptible by the senses, things material (as opposed to ... things thinkable or immaterial) also from the stem to feel, apprehend by the senses*" (Simpson, 1989, p.206). Although Plato does not refer to the term 'perception' or 'aisthetikos' in Bruno's quotation, the implication of his customary words is that '*the sense of sight*' is easy to deceive and should be subjected to interpretation.

Plato believed that "*the objects of the sensible universe and the images of them that we create or perceive are illusionary, mutable distortions of the real 'forms' and belong to the realm of 'opinion' (doxa), 'faith' (pistis), and 'supposition' (eikasia). The purpose of education should be to help men overcome the deceptive function of the senses and attain an undistorted knowledge of reality. Anything that inclines the mind to immerse itself uncritically in the changing forms of the sensible world stands in the way of this aim. Artists, lacking this insight into the true nature of things, can produce only imitations of things in the world of 'opinion', a world which is itself already one stage removed from reality*" (Pollitt, 1974, p.43).

As an example Plato cites an object, a couch. He states that God created the category or 'form'. A particular example of a couch is produced by a carpenter which refers at least partially to the "*real forms*" (Pollitt, 1974, p.43). However, a painting of this couch is an "*imitation of an imitation. The painter, having no real knowledge of the objects that he reproduces, bases his judgement of them only on 'colours and shape ... and thus imitates, not even the actual couch of the carpenter, but only one particular appearance of it*" (Pollitt, 1974, p.43).

Plato considers education as increasing interpretative skill. The '*sense of sight*' then must be educated and the true nature of things residing behind the "*changing appearances of sense experience*" (Pollitt, 1974, p.47) must be apprehended to decrease deception by the senses. Perception of the true nature of things is attained by education.

In opposition to Plato, the Sophist Gorgias of Leontine "*praised the power of deception, apaté, which the mimetic arts possessed, and apparently suggested that a kind of wisdom could be derived from it. He is quoted by Plutarch, in a discussion of the means by which tragedy affects its viewers, as having said, 'he who practices deception is more just than he who does not, and he who has yielded to deception is wiser than he who has not'*" (Pollitt, 1974, p.51).

Gorgias' standpoint can be traced to his book 'On Non-Existence or on Nature'. In this book it is asserted that "*(1) nothing exists (that is to say no unchanging reality); (2) even if anything existed, man could not comprehend it; and (3) even if he could comprehend it, he could not communicate it to others*" (Pollitt, 1974, p.51).

Gorgias then disputes the platonic 'idea' or true nature of things. He also disputes the communicability of sense perception. In this sense, he does not see any necessity to be critical of the arts who had at its basis illusion and deception because '*no unchanging reality exists*'. In the philosophical viewpoint of Plato a preoccupation with the true nature of things is central. He distrusts man's '*sense experience*'. The Sophists, on the other hand, focused on man and Pollitt describes the concern of the Sophists as 'anthropocentric' and continues: "*one result of this anthropocentric attitude was a tendency to feel that the final standard by which the nature of existence was to be judged was human perception. Moreover, whatever the basis of knowledge was, and some, like Gorgias, seem to have doubted that man could ever know, its value was to be judged by its utility in human life*" (1974, p.33).

Aristotle "*ascribes a new and more profound significance both to the nature of its (arts and crafts) methods and to its role in human thought*" (Pollitt, 1974, p.35). Aristotle says that if man creates a painting or builds a ship, a process is followed to produce an object just as nature follows a process when a living organism, such as a leaf, is produced. Aristotle concludes that "*art imitates nature (in the sense that its processes are analogous to nature's), but it can*

also be said to complete nature ... in that it brings about forms that are inherent in nature's materials but which nature itself does not produce" (such as building a ship from a natural material, wood) (Pollitt, 1974, p.36). The three views on art and its role in perception and thought mentioned above, follow chronologically: the Sophists of the period 450 BC - 400 BC predate Plato (429 BC - 347 BC) and Aristotle (384 BC - 322 BC) who was the pupil of Plato. In this chronology Plato was the philosopher who was most central to the classical period of approximately 480 BC - 338 BC, and who was also the least tolerant of the visual arts and of reliance on sense perception when it was not grounded in education in order to perceive the '*true nature of things*'.

(a) **Conclusion**

Interpretations of visual perception in classical Greece are mainly derived from philosophical sources. According to these sources human visual perception was considered easily deceived. However, it seems that little attempt was made to study, for example, visual perceptual anomalies.

The Greeks applied their powers of reasoning to many disciplines. Visual perception is central to these inquiries but is measured against other criteria and not just accepted. Visual perception must be educated and subjected to reasoning and interpretation to be of value. The hostile philosophy of Plato did not deter painters who experimented with various techniques such as light and dark rendering which Plato considered to deceive visual perception.

3.2.3 Visual perception in early sixteenth century Italian painting

A written and visual account that alludes to the importance of visual perception in sixteenth century Italy, is by the painter Leonardo da Vinci. As an example to illustrate Da Vinci's approach to visual perception, E.H. Gombrich compares two of Da Vinci's drawings of the movement of water. The first is 'Deluge'; a later

drawing of about 1512-1516. The second is an early scientific study of a 'Waterfall' of 1492, with accompanying text. Da Vinci strives to capture the "*form of movement in water and air*" (Gombrich, 1993, p.39) in these drawings. Gombrich writes that both of the drawings "*share the interest in swirling movements and vortices that is so characteristic of Leonardo. Note that in the 'Deluge' drawing it is the descending waters that appear to curl back in these spiralling movements, while in the scientific drawing the water is shown to well up and to form these complex curls and eddies round the rising rings of bubbles, which surround the minor whirlpools*" (1993, p.39). Gombrich asserts that these drawings and notes form part of a large group of studies of falling water dating from approximately 1490 to 1510. Gombrich sees in these drawings a clear correlation between thought and perception. He says that Leonardo "*represents a test case for those of us who are interested in the interaction of theory and observation and are convinced that the correct representation of nature rests on intellectual understanding as much as on good eyesight. To Leonardo* [da Vinci] *this would have been a commonplace. He would not have written the 'Treatise on Painting' with all its scientific observations if he had not been convinced that a painter must be more than 'merely an eye'*" (Gombrich, 1993, p.40).

The drawing of the 'Waterfall' is not an exact representation of a waterfall but "*is an abstract, stylized representation, a visualization of forces, not a record of individual observations*" (Gombrich, 1993, p.41). In the drawing the flow of the water is represented by lines and the bubbles in the foam is clearly distributed. In nature the effect of water falling upon water would not be as neatly composed.

Leonardo da Vinci is also credited with a basic law formulated from a principle that he expressed. "*It says that 'a river in each part of its length in equal time gives passage to an equal quantity of water, whatever the width, the depth, the slope, or the tortuosity' ... (thus) 'a river of uniform depth will have a more rapid flow at the narrower section than at the wider, to the extent that the*

greater width surpasses the lesser' " (Gombrich, 1993, p.43). Gombrich states that Da Vinci arrived at this principle through reasoning rather than visual perception. The date of the manuscript is also quite early (1492) if the studies of water commenced in 1490 and continued until approximately 1516. Da Vinci's drawings of water are illustrations of principles. Gombrich says of these drawings that "*they are neither stylized nor observed; they are an indication of the strength of the water's impact which spends itself in these spiralling movements*" (1993, p.46). The drawings have to be considered in conjunction with the principles illustrated to be fully appreciated.

A characteristic of visual perception seems to emerge when comparing the dates of the two drawings and the principle of the movement of water that Da Vinci expressed. The scientific study of a 'Waterfall' dates from around 1492 and the principle of the movement of water is also from about 1492. The drawing of the 'Deluge' dates from approximately 1512. The earlier work depends more on grasping the scientific principles and forces at work behind the movement of water, while in the later drawing, the principles are applied to represent a catastrophic and probably imaginary event in which the force of moving water is the main subject. The characteristic of visual perception derived from this, is that visual perception can be viewed as part of a cycle in which the repetition of reasoning, perception and representation reinforces one another. Perceptual skill therefore becomes more acute through studying different examples of, in this instance, the same force. Eventually a chaotic event, such as a deluge, can be clearly perceived and represented in a composition if the principles and forces behind the event are understood.

In a sense, this supports Plato's cautionary remarks regarding the weakness of the sensory organs because many of Da Vinci's studies of water are not based purely on visual information but on the interpretation of this information. Da Vinci differed from Plato because he did not reject the painter's skill of deceiving the eye. In these drawings Da Vinci used the visual arts as part of the cycle through which he enhanced his perceptual skill and understanding

regarding the movement of water. His drawings are not based only on visual perception but on his interpretation of the information gleaned through earlier cycles of work, yet the viewer can get a clear impression of Da Vinci's intention of representing the movement of water as an "*interlocking system of axioms*" (Gombrich, 1993, p.46). After viewing Da Vinci's drawings the viewer will also perceive the movement of water more accurately. Da Vinci accepted the inherent deception of two-dimensional representation and employed this to enhance his own and the viewer's perceptual skill.

(a) Conclusion

Thoughts on visual perception in early sixteenth century Italian painting are derived from Da Vinci's drawings and writings. Da Vinci's wide range of interests and persistent methods of inquiry demonstrate the cyclic nature by which visual perception is continually enhanced through reasoning, perception and representation as well as cross-references. The following paragraph by Gombrich illustrates this process. Gombrich writes that "*there is the famous passage in which Leonardo* [Da Vinci] *described and analyzed the effect of throwing a stone into a stagnant pool with the ripples spreading outwards in ever widening circles, adding that the movement of the waves did not shift the water masses, for he had observed the floating objects on the pond bobbing up and down on one spot. Da Vinci's splendid intuition also grasped the comparison of this swaying motion with waves appearing to run over a cornfield without the individual stalks being shifted from their place*" (1993, p. 46-47).

This is also an instance of an artist's relation to visual perception. Gombrich asserts that Da Vinci aimed to "*place the analyses of natural appearances on a new scientific footing*" (1993, vol 4, p.34).

Through his studies, some of which were included in the 'Trattato della Pittura', Da Vinci still relied on the "*tradition he*

had absorbed in the workshop of his teacher Verrocchio" (Gombrich, 1993, p.34).

Thus, although Da Vinci's studies were exhaustive and although he stressed the importance of visual perception as well as reasoning in establishing a scientific footing for the analyses of natural appearances, his paintings do no escape a reliance on traditional representational formulas of, for example, mountains. However, in his writings Da Vinci stresses that "*there is nothing that deceives us more than confiding in our own judgement without any further reasoning*" (Gombrich, 1993, p.34). He further attempts, for example, "*to overcome the limitations of the eye and to achieve what he calls 'the certainty of mathematical demonstrations'* " (Gombrich, 1993, p.35). This is, for example, applied in his study of trees. Gombrich writes that Da Vinci "*conceived the division of the branches more or less in analogy to the delta of a river. The more tributaries develop, the less water there is in each of them. This makes him conclude that after adding up the thickness of the branches or twigs after each division the sum must be the same as the width of the trunk or branch below* ... (Gombrich writes that) *it is a hypothesis of great simplicity and elegance, although it is an a priori construction arrived at by abstract reasoning rather than by measurement*" (1993, p.44-45).

Thus Leonardo, like Plato, considered the eye as limited but, unlike Plato, attempted to devise ways of structuring information which enhanced both visual perception and representation. (Although this method is not always scientifically correct, it takes into account the way one perceives). Also, although Da Vinci still relies on the tradition of his teacher Verrocchio, his representational and written studies were sufficiently skillful to enhance the viewer's visual perception and to overcome some of the limitations of the eye. In contrast, Plato sought to protect the eye from the representational 'deception' of the painter.

Da Vinci also studied the science of optics from ancient and medieval treatises. Da Vinci referred to "*visual images which fill the air - the doctrine according to which the sense of sight should be understood in analogy to the sense of smell. Just as particles of objects fill the air and are sampled by the nose in smelling, so in seeing, infinitely thin parts of visible objects fill the air and penetrate the eye*" (Gombrich, 1993, pp.39-40). Thus Da Vinci's work should also be seen from the viewpoint of his own era and not according to our perception of nature, and of visual perception.

3.2.4   Visual perception in the mid-twentieth century

The book 'Art and Illusion' by E.H. Gombrich was first published in 1960 and thus constitutes an approach to visual perception in the mid-twentieth century. Although Gombrich's book is not strictly an exposition on visual perception, it offers some insights relevant to a study of visual perception. In it, Gombrich displays one approach to visual perception and the imitation of nature in painting. He stresses that the function of a painting determines the nature of the painting. Visual perception is therefore subjected to other determinates in painting. For example, in some paintings the function of the painting prevents imitation; in the Middle Ages Jewish manuscript makers avoided adding facial details to figures because of a ban on idolatry. In other paintings, for example Greek classical painting, the paintings were, among others, influenced by classical Greek drama's requirement of realistic theatrical scenery, and thus became more realistic. Gombrich stresses that "*it is misguided to think of (painting) in terms of a singular function or end such as the imitation of nature*" (Conley, 1985, p.15).

Gombrich further maintains that painters also do not copy objects. "*A depiction of a person may, for example, consist of a set of interlacing lines outlining the figure and features of the individual. Clearly the actual person is not bounded by outlines. Rather, the outlines in the depiction serve to mark the boundaries between the features and the figure of the individual and the background. Another kind of depiction employs areas of light and*

dark abutting each other to define general areas of a figure and to distinguish the figure from the background" (Conley, 1985, p.16).

However, Gombrich notes that painters and students of painting do copy other depictions. These could historically be from pattern books which contained simplified shapes used to construct the outlines of figures, objects or animals. Painters (and other artists) also copy from other artists. This implies that visual perception does play a role in painting.

Gombrich concludes that in the process of copying other depictions, schemata are learnt. These schemata form the basis of "*the learning of art making*" (Conley, 1985, p.19). Gombrich stresses that the imitation of nature is not the essence of the learning of art making.

Gombrich does not advance a hypothesis explaining why artists would prefer to copy schemata rather than information gained through visual perception of nature. He only describes Leon Battista Alberti's (1404-1472) proposal that depiction was the result of prehistoric man accidentally discovering that a branch or a lump of clay could, with a light adjustment, look like another object. Gombrich proposes that this process could be described as '*finding and making*' and this illustrates how schemata originated. However, Gombrich stresses that the schema is only the starting point and that it has to be filled in with detail. To achieve this, drawing from a direct visual perception of nature is considered essential. Gombrich says that " '*a reliance on the schema can block the path to effective portrayal unless it is accompanied by a constant willingness to correct and revise.' The schema must be used, but it has to be corrected to accommodate the unique characteristics of the individual or object.*" (Conley, 1985, p.27).

Gombrich also compares the making and visual perception of depictions to the employment of a visual language. This visual language consists of a system of schemata. The analogy between visual imagery and language also points to the fact that the set of visual signs which constitutes this language, would require

interpretation. Thus "*because schemata form a language, the way in which the schemata are related to nature (or the world) is not self-evident just as the signs of natural language are not self-evident*" (Conley, 1985, p.28-29).

Conley compares the two theories of pictorial representation inherent in Gombrich's theory. He finds them incompatible.

In the first theory "*the viewer, according to Gombrich, plays an essential role in the production of pictorial realism. The viewer projects realism onto a picture ... the viewer projects some remembered bit of past experience into the schema. The result is an illusion, an illusion of the painter's subject*" (Conley, 1985, p.23). In the first theory then, "*the realism of pictures is in all cases an illusion. It is illusion which gives the viewer the sense of realism in a picture*" Conley, 1985, p.30).

In the second theory "*the realism of pictures is, in some cases, an illusion; pictorial realism is an illusion only in those cases in which the picture is 'ill-defined' and remains relatively close to the schema. These paintings act like a screen onto which the viewer projects an image*" (Conley, 1985, p.31). However, Gombrich concludes that in the case of highly realistic pictures, there is no need for the formation of the illusion of realism. All paintings, however, begin with a schema.

Conley describes the difference between the two theories as pertaining to "*realism, schemata and the relationship of depictions to the world they depict. These are not small differences. Such disagreements are the very substance of theories of pictorial representation, according to the former theory, realism is in all cases an illusion and pictures are mere vehicles for this peculiar perceptual phenomenon. Furthermore, schemata are necessary for depiction and constitute a language in which similarity has no role. According to the latter theory, realism is an illusion in some cases, though in others it is a result of matching and of partial similarity between the picture and the depicted*" (1985, p.33).

(a) Conclusion

Gombrich's book 'Art and Illusion' shows the dichotomy between the depiction and the perception of nature.

In essence, Gombrich exposes the difficulty painters experience in composing the formal properties to complete a realistic painting. He concludes that they overcome this through the study of other works of art to obtain a schema, rather than through the perception of nature. He does not offer a reason why this should be the case. He relies on Alberti's proposal that natural objects, that almost resembled other objects, led to the formation of schemata and to the beginnings of art.

Gombrich's book thus implies that visual perception does play a role in depiction. It is not primarily the perception of nature but the copying of solutions of other works of art or schemata that is the decisive factor in depiction. The question arises: what then does a work of art correspond most to? Has it a closer connection to the perception of works of art than to the perception of nature? It is possible that depiction is linked to other visual perceptual solutions. These solutions firstly satisfy the visual perception of the artist and they are thus closer to the artist's representation than the characteristics of nature.

If art and, in this instance, painting expound to a large degree possibilities of visual perception rather than aspects of nature, it could explain why painters look at other paintings even when composing realistic paintings of objects. In these schemata obtained from other paintings patterns exist for depiction. These patterns are projected onto nature by the painter and the formal properties of painting are arranged according to these schemata by the painter to impart a specific meaning to his visual perception. However, the pattern or schemata is varied, to fit the memories and intention of the individual painter.

3.3 REFERENCES TO THEORIES OF VISUAL PERCEPTION

Early scientific theories on visual perception are mostly not deductible from art historical references to visual perception. Therefore, although Plato, for example, did not have a high regard for the accuracy of the sensory organs and of contemporary paintings which, to his mind, deceived visual perception, he formulated a theory of visual perception which can be discussed separately here. This theory is not deductible from his approach to painting. Therefore, although some opinions on visual perception can be derived from a study of paintings and commentaries on paintings, the history of theories of visual perception should be considered separately to obtain a historical background to current scientific theories of visual perception and the structuring elements employed in these theories. It is not easy to establish a link between painting and scientific theories on visual perception. However, many of the writers on art also produced theories of visual perception, for example Plato. Also, the visual perceptual process is closely involved in every aspect of the production and appreciation of a painting. This thesis will endeavour to establish that painting can analogously be regarded as a representation of the visual perceptual process. In his book 'Theories of Vision from al-Kindi to Kepler' David Lindberg studies early scientific theories of visual perception from Greece to the seventeenth century.

3.3.1 Theories of visual perception in Greece

Although Plato did not have a high regard for the accuracy of the sensory organs, he formulated a theory of vision. Principally, according to this theory *"a stream of light or fire issues from the observer's eye and coalesces with sunlight"* (Lindberg, 1976, p.3).

The origins of this theory are not clear but, according to Lindberg, can be linked to the school of Pythagoras which held the *"theory of a visual current coming from the eye"* (1976, p.3).

Plato fully developed the theory of intraocular fire. He describes this fire as having "*the property, not of burning but of yielding a gentle light ... whenever there is daylight round about, the visual current issues forth, like to like, and coalesces with it [i.e. daylight] and is formed into a single homogeneous body in a direct line with the eyes, in whatever quarter the stream issuing from within strikes upon any object it encounters outside. So the whole, because of its homogeneity, is similarly affected and passes on the motions of anything (the emissions of effluence from an object) it comes in contact with or that comes into contact with it, throughout the whole body, to the soul, and thus causes the sensation we call seeing*" (Lindberg, 1976, p.5).

Plato therefore conceives of a '*single homogeneous body*' (which consisted of the visual fire from the eye and daylight which bears resemblance to the visual fire) which reached from the eye to the object. The homogeneous body that formed is more important than emissions of effluence from the eye and the object. (Because of the importance attached to effluence, both from the eye and the object, the theory is called intromission-extramission.) This body provided the substance needed to form a sympathetic medium between the visible object and the eye.

Plato also associates the different motions transmitted to the soul with particles of different sizes and these particles with the various colours. "*Particles of different sizes produce different motions (dilation and contraction are Plato's examples), and different motions lead to the sensation of different colours*" (Lindberg, 1976, p.6).

Although Aristotle does not agree with Plato on the theory of emissions of effluence that issue from the visible object and the eye, he does concur that a sympathetic medium is formed between the visible object and the eye.

Aristotle also draws a distinction between light and colour. He asks "*if light is that state of a transparent medium in which transparency is actualized, what is colour?* [He then answers that]

colour ... is that which overlies the surface of visible objects and has the power to set in motion (i.e., to produce further qualitative change in) the actually transparent: 'every colour can produce movement in that which is actually transparent, and it is its very nature to do so. This is why it is not visible without light, but it is only in light that the colour of each individual thing is seen.' The colour of a body 'moves the [actually] transparent medium, e.g. the air, and this, being continuous, acts upon the sense organ.' Thus what is visible, that is, the proper object of sight, is colour. A transparent medium is first moved to actuality by the presence of a luminous body, such as fire; it is further moved or affected by the colour of bodies in contact with it and the change thus produced is communicated to the observer" (Lindberg, 1976, p.8).

Aristotle conceives of the eye as mostly consisting of water which is a transparent medium. Its transparency permits participation in the transparent medium formed between the visible object and the exterior of the eye and thus the transparent medium continues into the interior of the eye. The water contained in the eye is affected by the visible object and takes on the same qualities. This is a mediumistic theory. It is important, in the context of this thesis, to note that Plato speaks separately of light (as interior fire or daylight) and colour (as particles of different sizes). Aristotle also distinguishes between the effect of light on the transparent medium and the effect of colour on the transparent medium. The difference in the effect is noticed by the observer as light or colour.

Further theories of perception are composed by Euclid (a mathematician) and Ptolemy. This post dates the classical Greek era but is valuable to consider as it contributes to the understanding of the development of linear perspective.

In his book 'Optica' Euclid (about 300 BC) restricts himself to aspects of visual perception which can be expressed geometrically. He bases the geometrical theorems on seven postulates. Lindberg lists these postulates as:

"1. That the rectilinear rays proceeding from the eye diverge indefinitely;

2. *that the figure contained by a set of visual rays is a cone of which the vertex is at the eye and the base at the surface of the objects seen;*

3. *that those things are seen upon which visual rays fall and those things are not seen upon which visual rays do not fall;*

4. *that things seen under a larger angle appear larger, those under a smaller angle appear smaller, and those under equal angles appear equal;*

5. *that things seen by higher visual rays appear higher, and things seen by lower visual rays appear lower;*

6. *that, similarly, things seen by rays further to the right appear further to the right, and things seen by rays further to the left appear further to the left;*

7. *that things seen under more angles are seen more clearly"* (1976, p.12).

Lindberg describes the first three postulates as the geometrical mould in which Euclid casts the visual process. From these postulates it follows that the rays, issuing from the eyes, proceed in straight lines, and collectively these rays form a cone. Furthermore, to be visible, an object must intercept a visual ray. The first postulate, which describes the visual rays as proceeding in straight lines, makes possible the formation of a geometrical theory of visual perception. Lindberg writes that this continues a rule which governs "*the propagation of light ... [and which permits the use of] the straight lines of a geometrical diagram to represent visual rays and thus transform optical problems into geometrical problems*" (1976, p.12).

Although, in this instance, rays issuing in straight lines from the eye constitute a cone, in the Renaissance, the light paths entering the eye (in the representation of linear perspective) are also represented by straight lines constituting a cone of which the vertex is at the eye.

Lindberg asserts that Euclid's theorems are mainly based upon the seven postulates. In these theorems "*the majority ... treat problems of perspective - that is, the appearance of an object as a function of its special relationship to the observer*" (Lindberg, 1976, p.13).

Depth perception is not considered extensively and Euclid concludes that an object viewed from different distances will appear larger from closer by and smaller from further away.

Euclid also does not include external light into his geometrical construction of perception. Lindberg points out that Euclid does refer to external light in a few instances and that he, in one instance, describes a solar ray which comes to an end at the viewer's eye.

Lindberg concludes that Euclid's theory of perception was restricted to geometry, and that the visual rays issuing from the eye make this an extramission theory. Cladius Ptolemy (active from approximately 127 AD to 148 AD) followed Euclid in his mathematical analysis of perception. He also pursued an extramission theory but, according to Lindberg, added physical and physiological elements. Ptolemy's 'Optica' originally consisted of five books. Today only four books are still in existence and only in translation. The original Greek was translated into Arabic and from the Arabic into Latin. The first book, which dealt mainly with the more physical aspects of perception, is lost. However, Albert Lejeune endeavoured to reconstruct the main aspects of this book. Lindberg employs this reconstruction in his discussion of Ptolemy's theory.

Ptolemy still ascribed perception to a visual flux which emanates in a cone shape from the viewer's eye. His mathematical analysis of perception also followed Euclid's conic approach. According to Lejeune, Ptolemy "*assigned the visual flux to the same genus as external light - the luminous - and hence attributed physical reality to it ... Ptolemy [also] conceived the visual radiation (as well as external light) as a transfer of energy, concluding: 'it*

seems that he conceives all radiation to be endowed with a certain quantity of energy, which its emitter communicates to it and which is diminished by the impact that accompanies reflection and by the resistance to penetration offered more or less by all transparent media. Applied to a single point of the object, the heterogeneous energies add their effects' " (Lindberg, 1976, p.15-16).

Although these features of Ptolemy's theory are natural extensions of Euclids theories, Ptolemy differed from Euclid in the following: "Whereas Euclid had posited discrete rays, separated by spaces that increase with distance from the eye, Ptolemy maintained that the visual rays form a continuous bundle or cone; if this were not so, he argued, objects could not be seen in their entirety at a glance. But this is to deny that discrete, numerable visual rays (whether one-dimensional entities or thin three-dimensional pencils) exist at all. Rays may represent the geometry of sight, but they have nothing to do with the physical reality" (Lindberg, 1976, p.16).

Although Ptolemy considered the continuous band of radiation from the eye to be of cardinal importance to perception, he also had to describe the visual object's role in perception as well as the role of external radiation from a light source such as the sun.

In order to describe these roles in his theory of perception, Ptolemy considered the colour of the object as "an inherent property of bodies, a quality, which produces a modifaction (passion) in the visual cone. Colour is the proper object of vision, and it is through patterns of colour and their effect on the visual radiation that other sensible characteristics of bodies (shape, for example) are perceived. However, as in the theories of Plato, Aristotle and Galen, colour cannot affect the visual cone ... without the presence and cooperation of external light. In the extant books of the 'Optica', Ptolemy does not inform us of the mode of action of external light or how it makes vision possible; he simply asserts that 'colour is not seen unless light cooperates' " (Lindberg, 1976, p.16).

Ptolemy thus asserted that perception is the combination of visual radiation and colour and with some contribution by an external light source. He did not describe the nature of the change introduced by the colour of the object on the visual radiation.

Arguably Ptolemy's two most important geometrical contributions are firstly that perception is clearer along the axis of the cone than along the side of the cone, through the lateral rays; secondly, Ptolemy located the apex of the visual cone inside the eye "*at the centre of the curvature of the cornea and also at the centre of rotation of the ocular globe*" (Lindberg, 1976, p.17).

3.3.2 Theories of visual perception in the Islamic world

The works of Greek philosophers and mathematicians were widely available in Arabic translation in 900 AD. The Islamic philosopher Abu al-Kindi wrote 'De Aspectibus' in reply to Euclid's 'Optica'. Al-Kindi endeavoured to fill in some of Euclid oversights in the 'Optica' and to redress other points.

In order to fill in some oversights, al-Kindi, for example, sought to demonstrate the rectilinear nature of visual rays (or, as he called it, luminous rays) through the various shadows cast by an opaque body illuminated by a luminous body, such as a candle, at different angles and distances from the opaque body. As another example of filling in an oversight, al-Kindi endeavoured to refute the intromission theory which features to some extend in all but the Euclidean theory which is exclusively an extramission theory. "*Al-Kindi's key argument against the intromission theory is a mathematical one. If sight occurred through intromission of the forms of sensible things, he argues, a circle situated edgewise before the eye would impress its form in the eye and consequently would be perceived in its full circularity. But this does not occur. 'On the contrary, when circles and observer are in the same place, the circles are by no means seen [except as straight lines]. Therefore, it remains that a power proceeds from the observer to the visible objects, by which they are perceived'. This power*

proceeds from the eye in straight lines and falls only on the edges of the circles, perceiving them as straight lines ... if we are to grasp the argument at all, we must first understand what al-Kindi means by 'form'. What he does not mean is a composite impression produced by a large number of individual rays, as in the modern conception of an optical image. Rather, it seems that forms are coherent images or likenesses, not susceptible of analysis into individual rays ... they bear a strong resemblance to the 'Eidola' or thin films of the Epicurean theory of vision, except that they represent the entire object rather than merely the surface facing the observer. There is no justification, of course, for al-Kindi's attribution of the same conception of forms to Plato and Aristotle, who made no attempt to treat the perception of shape. But whether fair to his predecessors or not, al-Kindi's conception of vision by intromission ... is clear: if a circle placed edgewise before the eye were seen by the entrance of its form into the eye, this would not be because radiation from each point on the near edge of the circle entered the eye to produce an image (as in the modern view); rather, the form of the circle would enter the eye as a unit, and there its spatial orientation would have nothing to do with its perception, for within the eye the laws of perspective no longer apply. Indeed, this appears to be the essential point of al-Kindi's argument: if the perception of an object is to depend on its spatial orientation, if visual theory is to be submitted to mathematical analysis one must hold to the theory of visual rays. In short, al-Kindi sees no means by which the intromission theory, which for him is the theory of coherent forms, can be made compatible with the laws of perspective" (Lindberg, 1976, pp.22-23).

According to Lindberg, from a modern day perspective al-Kindi's argument seems groundless. In the modern view, light radiates from every point on the surface of the object. This makes possible the formulation of an intromission theory which states that visual perception is determined by the position in space of the visual object. However, it is only the insights subsequent to al-Kindi, those of Alhazen and Kepler, which provide proof of an intromission theory.

To describe the intromission theory, al-Kindi could only conceive of a coherent visual impression which is the result of a coherent process of radiation and through which the image travels from the object as a unit, . Lindberg concludes that "*al-Kindi has thus taken the intromission theory as he conceived it (or more specifically, the only intromissionist account of the perception of shape yet presented) - the theory of coherent forms - and demonstrated that it is not viable from a mathematical standpoint*" (1976, p.24).

This reference to the formal property of form, that is to say in the perception of shape, demonstrates the gradual emergence of a view which treats the property of form as a definable entity. (Plato and Aristotle did not attempt "*to treat the perception of shape*" (Lindberg, 1976, p.23).

In addition to these two oversights in Euclidean thought, al-Kindi sought to redress Euclid on the nature of the visual cone that issues as radiation from the eye. Euclid regarded the cone as separate rays with spaces in between. Al-Kindi regarded the cone as a "*continuous body of radiation*" (Lindberg, 1976, p.24).

Although al-Kindi's criticism of Euclid's conception of separate rays is difficult to follow and refers indiscriminately to both luminous and visual radiation, it employs a definition of line which is still in use today in the terminology employed in painting. Al-Kindi adheres to the assumption that Euclid's visual rays consist of geometrical lines which have only the dimension of length - they have no width. Al-Kindi considers this definition of line as inappropriately applied to visual rays. He conceives of a ray as "*an impression of luminous bodies in dark bodies denoted by the name 'light' because of the alteration of accidents produced in the bodies receiving the impression. Therefore, a ray is both the impression and that in which the impression is. However, the impressing body has three dimensions - length, width and depth. Thus on account of their nature as impressions made by three-dimensional bodies, rays must themselves be three-dimensional;*

it is therefore self-contradictory to speak of one dimensional rays issuing from the eye" (Lindberg, 1976, p.24).

Al-Kindi's remarks are thus important not only to indicate the historical development of theories of perception, but also because of the emergence of definitions later applied to the structuring elements used in painting, such as this definition of line. Knobler, a contemporary writer on the formal properties of painting describes line in almost the same words as those employed in al-Kindi's time. He says that line is "*a form so long in proportion to its width that we tend to overlook the dimension of width and assume that the element has only the one dimension of length*" (1971, p.99). This similarity in the definition of line (as describing visual rays and lines in painting) establishes a tenuous verbal analogy between theories of visual perception and painting.

Let's return to al-Kindi's criticism of Euclid's assumption that equates visual rays with geometrical lines: al-Kindi argued that visual rays must possess width because visual rays perceived small areas on which they fall and these cannot be perceived if they have no width in addition to their length. Furthermore, al-Kindi conceived of visual rays as a single, continuous light-emitting cone, but the viewer sees "*clearly only that which is directly opposite the centre of the eye, and as objects increasingly diverge from opposition, they are seen with decreasing clarity*" (Lindberg, 1976, p.25). Al-Kindi endeavours to explain why differences in clarity exists within the visual cone. He first refutes claims by the followers of Euclid who argued that "*the axis of the visual cone is the shortest of all rays, and therefore that it perceives most strongly, the assumption being that strength of perception varies inversely with the length of the ray*" (Lindberg, 1976, p.26).

Al-Kindi refuted this argument by pointing out the obvious phenomena in which an object nearer to the viewer, but to the edge of the visual cone, is not seen as clearly as an object on the axis. He explained the difference in sensitivity in the visual cone as being the "*apparent strength of axial rays* [is traced] *ultimately to the fact that the central region of the visual field receives more visual*

radiation (from various points on the surface of the eye) than any other region; it is not true, apparently, that individual points of the eye emit rays in various directions that actually vary in strength" (Lindberg, 1976, p.28).

To further explain the difference in sensitivity within the visual cone, al-Kindi also referred to the "*analogous behaviour of light and colour. Colour is not perceived unless illuminated by light, and the stronger the light the clearer the perception of colour. Similarly, the stronger the visual ray, the clearer its perception of colour. But what does it mean for a visual ray to be stronger? Where does its strength lie? The operation of sight is to produce a conversion or transformation in the surrounding medium - though on the nature of the transformation al-Kindi does not at this point elaborate. A strong ray, then, is simply that which produces a perfect or complete transformation, and a weak ray that which produces an imperfect or incomplete transformation. The axial ray produces the most perfect transformation of the medium and therefore perceives its object most clearly; other rays produce transformations that decrease in perfection with the distance of the ray from the central axis"* (Lindberg, 1976, p.27).

Al-Kindi's extramission theory had a wide influence on later Islamic scholars' view on visual perception. However, although this theory was known and discussed, it was less widely adopted in Europe than in the Arabic countries. In the west it was usually referred to in order to support a combined extramission-intromission theory. For example, Lindberg says that Roger Bacon in the thirteenth century "*appealed to the authority of al-Kindi to support their contention that rays issue from, as well as enter, the observer's eye*" (1976, p.32).

Al-Kindi's main legacy can be considered to be in the gradual emergence of the properties of visual perception as separate definable entities. Al-Kindi's contribution to theories of visual perception thus seems to be the further separation of the properties of visual perception such as shape, line, light and colour.

Up to this point three interest groups are distinguishable regarding theories of visual perception. Firstly, there is the group of physicians, the Aristotelians whose main preoccupation is anatomical and physiological. Secondly, there is the group of natural philosophers, also Aristotelians, whose main preoccupation is physical and psychological. Thirdly, there is the group of Euclideans whose main preoccupation is mathematical. The groups only represent primary orientations because the boundaries were often not clearly distinguishable and tended to overlap. Lindberg draws attention to the fact that "*the Euclidean theory of vision (especially in its Ptolemaic and al-Kindian forms) was not devoid of physical content, nor were the Galenic and Aristotelian theories devoid of mathematical content*" (1976, p.57). Thus, although the different approaches to theories of visual perception tended to focus on the debate between the extramission-intromission theories, the more fundamental chasm was between physicians, natural philosophers and mathematicians. The non-mathematical approach of the Aristotelian theories omits geometrical analysis such as the rectilinear propagation of radiation or light and concentrate on "*ocular anatomy and physiology and an analysis of physically possible modes of radiation*" (Lindberg, 1976, p.57). Euclidean theories contained geometrical analysis and attempted to find mathematical proof of the rectilinear propagation of radiation.

Alhazen, born in Basra around 965 AD, was an important figure who managed to incorporate aspects from all the traditions. He had a wide field of interest and wrote on physics, mathematics, astronomy, cosmology, meteorology, optics, medicine, metaphysics and theology. Ten works by Alhazen on the subject of optics are known. His extensive knowledge on many subjects provided him with the resources to formulate an intromission theory along new lines.

Alhazen was a key figure who attempted to integrate the three approaches into one theory of perception. He aimed to integrate the anatomical, the physical and the mathematical approach into a single theory.

Before Alhazen, the intromission theory (as conceived by the Aristotelians) stated that coherent images or forms enter the eye. Lindberg says that "*Alhazen was the first to utilize the analysis of the visible object into point sources, each of which sends forth its ray, as the basis of an intromission theory of vision*" (1976, pp.59-60).

To the Aristotelian physiology of vision, Alhazen added that "*the parts of the form must be properly arranged on the surface of, and within, the glacial humour* [the crystalline lens] *arranged, that is, in the same order as the parts of the visible object from which the form originated*" (Lindberg, 1976, p.71).

(a) **Conclusion**

Alhazen's intromission theory satisfied not only physical and physiological criteria, but also assimilated the mathematical framework of Euclid and al-Kindi. For example, Alhazen's scheme of incoherent radiation from point sources (applied to visual perception) employed the principle that a "*one-to-one correspondence between points on the object and points in the eye [is crucial to perception]*" (Lindberg, 1976, p.86).

Lindberg contends that Alhazen's theory of perception had a great influence on later work. He states that "*it was the source of fundamental conceptions on which Kepler based his theory of the retinal image*" (Lindberg, 1976, p.86). Some of the fundamental conceptions include Alhazen's scheme of incoherent radiation from point sources, "*a recognition of the need for a one-to-one correspondence between points on the object and points in the eye ... and, indeed it could be argued that from Alhazen to Kepler one of the principal aims of visual theory (within the mathematical tradition) was to explain how this one-to-one correspondence is brought about*" (Lindberg, 1976, p.86).

3.3.3   Theories of visual perception in the sixteenth century

During the later middle ages ray-geometry and the physiology of the visual process were neglected in preference to the ontology of radiation and the psychological aspects of visual perception. The ontology of radiation evoked questions such as "*do distinct rays really exist? Are light and colour of the same species? What is the relationship between lux and lumen?*" (Lindberg, 1976, p.144). The psychological aspects of visual perception evoked questions such as "*what is the proper object of sight? Are all things known by means of vision known equally? What is the relationship between sensation and cognition?*" (Lindberg, 1976, p.144). The focus of perceptual research thus shifted away from the ray-geometry and the physiology of the visual process which ultimately lead to Johannes Kepler's (1571-1630) theory of the retinal image. The basic issues were not questioned and the intromission theory was accepted in principle; the theory of point radiation and the visual pyramid satisfactorily explained the mathematics of visual perception. During the sixteenth century Italian Renaissance, the framework of theories of visual perception remained virtually unchanged. (Only during the early seventeenth century did the traditional framework change.)

Of interest was the development of the representation of visual space on a two-dimensional surface, as in painting, during the early Renaissance. Lindberg cited the example of Giotto di Bondone (about 1266-1337). His frescoes in the Arena Chapel in Padua broke with medieval painting which were characterised by decorative, flat colour and little attempt at the suggestion of depth. Giotto attempted to endow "*his figures with a more human, three-dimensional, lifelike quality; by introducing oblique views and foreshortening into his architectural representations, thereby creating a sense of depth and solidity; and by adjusting the perspective of the frescoes to the viewpoint of an observer standing at the center of the chapel*" (Lindberg, 1976, p.148).

The quest to represent nature led to the invention of linear perspective in the early fifteenth century, allegedly by Filippo

Brunelleschi (1377-1446). Brunelleschi "*studied the mathematical laws underlying appearance, by [the] use of which artists could give an appearance of reality and depth*" (Hawkins, 1986, p.111).

In the treatise 'On Painting' by Leon Battista Alberti, which is a theoretical exposition of Brunelleschi's techniques, Alberti includes a description of "*the visual cone or pyramid, with base on the observed object or scene and apex within the eye. This pyramid includes three classes of rays, differing in strength and function, but all rectilinear: extrinsic or extreme rays, which form the outer surface of the visual pyramid and communicate the size and shape of the object: median rays, which fill the interior of the visual pyramid and, chameleonlike, assume the colours of objects in the visual field and convey them to the eye; and finally, the central and strongest ray of the pyramid, the 'prince of rays', through which objects are seen most clearly and 'which is the last to abandon the thing seen'* " (Lindberg, 1976, p.149). Alberti thus reduce the formal properties of size, shape and colour to visual rays that fit into a mathematical framework. He considers the theory of linear perspective not to be concerned with the physics or the physiology of visual perception. Alberti advises painters on the employment of linear perspective and writes that the visual pyramid and the rectilinear rays intersect with the painter's panel as if it were a window. Thus the painter "*should only seek to present the forms of things seen on this plane as if it were of transparent glass. Thus the visual pyramid could pass through it, placed at a definite distance with definite lights and a definite position of center in space and in a definite place in respect to the observer ... he who looks at a picture, done as I [Alberti] have described, will see a certain cross-section of a visual pyramid*" (Lindberg, 1976, p.150).

Lindberg also attempts to show the connection between linear perspective and visual theory. He questions the knowledge of the artists who invented linear perspective. Regarding medieval theories of visual perception, he asks if this knowledge was relied upon during the development of the theory and techniques of linear perspective. Lindberg concludes that Alberti's "*description of the*

visual pyramid clearly reveals knowledge of the perspectivist tradition" (1976, p.152).   Lindberg also says that "*the most celebrated of Alberti's construction is that all lines perpendicular to the plane of the picture will recede toward a single vanishing point - Alberti's 'centric point'* " (Lindberg, 1976, p.150).

In this case artists, mostly painters, referred to a theory of visual perception to invent linear perspective in order to represent the formal property of depth.   A theory of visual perception thus influenced painting.

Although a certain amount can be deducted about Leonardo da Vinci's approach to visual perception by studying his drawings and paintings, a summary of his investigations into visual perceptual theory throws more light on his grasp of the subject.

Lindberg criticises Da Vinci's incomplete knowledge of traditional visual perceptual theory and also the fact that Da Vinci referred to medieval treatises without full comprehension of their contents. For example, Da Vinci did not understand the "*problem of a multiplicity of rays from every point in the visual field influencing all parts of the eye. Instead [Da Vinci] tended to treat radiation in an entirely unsatisfactory holistic manner*" (Lindberg, 1976, p.168).

However, Da Vinci did make original contributions to visual perceptual theory. "*He noted the variability in the size of the pupil and demonstrated that the eye perceives from more than a point. He viewed the eye as analogous, in certain respects, to the camera obscura, so that intersection of rays from the visible object must occur within the pupil; and he treated the crystalline humour [aqueous humour] or transparent substance between the lens of the eye and the cornea' of the eye strictly as a refracting device*" (Lindberg, 1976, p.168).

Lindberg contends that even if Da Vinci made a fundamental contribution to visual perception, he was too isolated to influence the course of the history of visual perception.

The study of the anatomy of the eye in sixteenth century Italy contributed little to solve the basic issues of visual theory. For example, the knowledge gained from dissections of the tissue of the eye (such as the muscles, the structure of the cornea, conjunctiva, sclera, areola and retina and the three humours of the eye) did not automatically lead to an insight into the functioning of the different tissues of the eye.

However, in his book 'De Corporis Humani Structura et Usu ... Libri III Felix Platter wrote: "*The primary organ of vision, namely the optic nerve, expands when it enters the eye into a hollow retiform hemisphere. It receives and judges the species and colour of external objects, which along with brightness, fall into the eye through the pupil and are manifest to it through its looking glass ... [The crystalline humour] is the looking glass of the optic nerve; and placed before the nerve and the pupil, it collects the species passing into the eye as rays and, spreading them over the whole of the retiform nerve, presents them enlarged in the manner of an interior looking glass, so that the nerve can more easily perceive them*" (Lindberg, 1976, p.176). Platter thus concluded that the optic nerve and the '*hollow retiform hemisphere*', the retina, was "*the only seat of the visual power in the eye*" (Lindberg, 1976, p.176). He also concluded that "*the crystalline humour was only an optical lens, through which the retina or retiform nerve views the external word*" (Lindberg, 1976, p.176). Although it was previously hinted (by for example Da Vinci) that the optic nerve and retina are sensitive, Platter attributed the most importance to it as '*the only seat of the visual power in the eye.*' This became a central aspect in Kepler's theory of visual perception.

Johannes Kepler's achievement was to explain how the image was formed on the retina. His work was the culmination of a long tradition of theories of perception which could be traced back to Greece.

In short, Kepler's theory of the retinal image can be interpreted to be the outcome of ray-geometry studiously applied. Lindberg

explains Kepler's theory as follows: "*If it is understood that rays issue from a point before the eye, and if the principles of [optical lens] refraction are known and properly applied, one will inevitably discover that the rays issuing from that point in the visual field converge to a focus on the retina; and by tracing many such points, one will perceive that an inverted picture of the visual field is traced on the surface of the retina*" (1976, p.206).

Both Kepler and Alhazen drew certain conclusions regarding the character of visual perception. They concluded that there were optical and quasi-optical elements at work in visual perception. "*Optics strictly defined ends when radiation reaches the seat of visual power within the eye (the crystalline humour for Alhazen, the retina for Kepler), whereupon there ensues a transmission involving visual spirit (which in some measure violates the laws of optics while still belonging to the science of vision) and an act of visual perception*" (Lindberg, 1976, p.205). Kepler thus could not offer an explanation of how the quasi-optical elements or the 'visual spirit' operated; in other words how the picture on the retina was communicated to and interpreted by the brain. However, he was the first to employ the term 'pictura' to the image formed on the retina "*for this is the first genuine instance in the history of visual theory of a real optical image within the eye - a picture, having an existence independent of the observer, formed by the focusing of all available rays on a surface*" (Lindberg, 1976, p.202).

(a) Conclusion

Early scientific theories of visual perception focused mainly on the optical elements of visual perception. How the information was communicated to and interpreted by the brain was not understood. Three main approaches to visual perceptual research can be distinguished. Firstly, the physicians' approach was through anatomical and physiological research. Secondly, the natural philosophers' approach was physical and psychological. Thirdly, the mathematicians' approach was through geometry.

Kepler combined information assembled by Greek, Islamic and sixteenth century scholars from the three main approaches to perception. He succeeded in showing how an image was formed inside the retina of the eye.

3.3.4   A theory of visual perception in the twentieth century

Physicians of the late nineteenth century believed that reflected or emitted light contained visual codes transmitted by objects, and that this impressed an image on the retina. They also believed that the image on the retina was relayed to an area in the brain concerned with visual information, namely the visual cortex. The visual cortex decoded the contained codes. This process constituted 'seeing'. Understanding what is seen was considered to be a different process and included reference to information stored in the memory. Semir Zeki considered this distinction between seeing and understanding what is seen as based on Kant's distinction between sensing and understanding. However, Kant's predecessors, Johannes Kepler (1571-1630) and Alhazen (born around 965 AD) also adhered to this distinction.

Zeki writes that the nineteenth century evidence to support the dualistic concept of the visual system was thought to reside in the fact that the retina is primarily connected to one area. This area is called the primary visual cortex or V1. Injury along the pathway from the retina to V1 resulted in an area of blindness in V1 which was comparable to the size and location of the injury. This led the neurologist Salomon Henschen to conclude that V1 was the area where seeing occurred. Furthermore, at the end of the nineteenth century Paul Emil Flechsig demonstrated that V1 appeared mature at birth, but that adjacent cortical areas (called the visual association cortex) continued to develop as if they depended on experience to achieve maturity. Flechsig concluded that V1 was the entrance "*of the visual radiation into the organ of the psyche, and the areas around it were the repositories of higher psychic functions related to sight*" (Zeki, 1992, p.45).

Only during the nineteen seventies did a modern conception of visual perception gradually develop away from the dualistic concept of the visual system. The focus of late twentieth century research resides in how the brain extracts information from constantly changing visual stimuli. Zeki cites three examples of changing visual stimuli.

Firstly, the wavelengths of light reflected to the eye from the surface of an object can change as the light changes. However, the brain is able to assign a constant colour to the object.

Secondly, the image on the retina produced by an irregularly shaped, moving object (such as a hand) changes continually. The brain is able to categorise the object as a hand. This could also be described as pattern association.

Thirdly, an object appears to be smaller if it is further away from the viewer, but the brain can gauge the true size of the object.

The brain thus has to extract the unchanging characteristics of the object and the environment from the great amount of constantly changing information it receives. Zeki asserts that understanding what is seen or the interpretation of the information, cannot be separated from seeing. He insists that the brain does not merely decode images impressed on the retina, but actively invents visual world. Most importantly, Zeki says that the visual cortex actually consists of specialised areas of specific visual functions which divide the labour. In normal visual perception none of the specialisation and division within the brain is apparent. However, when one of the specialised visual areas in the cortex does not function, some specific aspect of visual perception is compromised or impaired.

Of interest then is the specific functional specialisations in the cortex and also how these cooperate to give a coherent picture of the visual world.

Zeki arrived at the concept of functional specialisation in the visual cortex while conducting research into the cortical area adjacent to V1, the visual association cortex. In the early nineteen seventies Zeki, John Allman and Jon Kaas conducted research into the visual association cortex of monkeys. This research suggested that this area could be divided into different cortical areas; the visual association cortex is separated from V1 by an area called V2.

Zeki's experiments consisted of showing specific stimuli to monkeys such as "*colours, lines of various orientations and dots moving in different directions*" (1992, p.45). Through the use of electrodes, Zeki could pinpoint the response of cells in different areas of the visual association cortex. He found that all the cells in an area in the visual association cortex called "*V5 are responsive to motion, that most are directionally selective and that none is concerned with the colour of the moving stimulus. These facts suggested to ... [Zeki] that V5 is specialized for visual motion ... in contrast, ... [Zeki] found that the overwhelming majority of cells in another area, V4, are to some extent selective for specific wavelengths of light and that many are selective for line orientation, the constituents of form, as well. By far most of the cells in two further adjoining areas, V3 and V3A, are also selective for form but like the cells of area V5 are largely indifferent to the colour of the stimulus. These studies led ... [Zeki] to propose in the early nineteen seventies the concept of functional specialization in the visual cortex, which supposes that colour, form, motion and possibly other attributes of the visible world are processed separately*" (1992, p.45).

In addition, Zeki proposed that V1 and V2 should also have a functional specialisation. He compared these two areas to a post office which conveys signals to the correct functional areas. Zeki succeeded in confirming this proposition in the early nineteen nineties through tissue-staining techniques combined with physiological studies.

It then became possible, through instruments which "*can measure increases in regional cerebral blood flow when people perform*

specific tasks ... to apply these findings, which were derived from experiments on monkeys, to a direct study of the human brain" (Zeki, 1992, p.45).

When a human subject perceives only colour, the most significant increase in regional cerebral blood flow is measured in a specific cortical area, referred to as human V4. (Zeki's subjects viewed a Piet Mondriaan painting - an abstract painting containing bright colours - while he measured the regional cerebral blood flow.)

In contrast, when a human subject perceives a motion, for example *"a pattern of moving black-and-white squares: The highest cerebral blood flow then occurs in a more lateral area, quite separate from V4, which we called Human V5"* (Zeki, 1992, p.45).

Zeki considers the experiments that monitor the increase in regional cerebral blood flow to constitute evidence that functional specialisation systems also occur in the human visual cortex as they do in monkeys.

Zeki is further able to identify two form systems. The first form system is closely associated with colour and V4, and the second form system with the perception of the shapes of objects in motion. The activity of the second form system is measured in the V3 area.

Although Zeki is able to distinguish between four systems, one system for motion, one for colour and two for form, the systems for colour and motion are the most distinct.

Also, although the systems are distinct, all the areas in the visual cortex constantly communicate with one another. Therefore, although V1 and V2 compartmentalise and relay signals to the specialised visual areas, the compartments in V1 and V2 and the specialised visual areas communicate all the time.

The specialisation and separation of functions are most apparent when certain abnormalities occur in the visual cortex. Damage to specific areas in the visual cortex results in a specific visual

impairment. For example, damage to the colour sensitive V4 results in achromatopsia. These subjects cannot perceive colours and also cannot recall memories of colour from experience gathered before the damage occurred. Zeki tries to offer an explanation for the fact that no complete loss of form perception has been described. He argues that the damage that would result in the complete loss of form perception would have to be extensive. Both V3 and V4 would have to be destroyed in this instance. Anatomically, V3 forms a ring around V1 and V2 and extensive damage to V3 and V4 would also destroy V1 and V2. This will result in total blindness and not just a loss of form perception. However, carbon monoxide poisoning can approximate loss of form perception. Carbon monoxide poisoning, which results from smoke inhalation during fires, can starve tissues of oxygen. This damages the visual system, but for some unexplained reason the perception of colour remains comparatively intact. A person suffering from this condition will try to classify objects according to colour. Zeki quotes the example of such persons classifying all blue objects as 'ocean'.

Similarly, when the V5 area is damaged, inability to perceive the direction and logic of movement occurs. This condition is termed akinetopsia. Often, however, regardless of these pathologies, some residue of awareness persist. For example, in both akinetopsia and achromatopsia some awareness of movement and colour persist. Zeki refers to Robert Hess's findings in this regard and concludes that V1 and V2 do not only relay signals to specialised areas, but actively contribute to perception. Therefore, although a person suffering from akinetopsia cannot perceive the direction and logic of movement, he may be aware that movement is taking place through the contribution of V1 and V2. The specialisation in the visual cortex raised the question of how the information is eventually integrated to form one image. Experiments conducted by Zeki and his colleagues could not establish anatomic evidence of a distinct area connected to all the specialised areas that could serve as an integrator. "*Instead the specialized areas connect with one another, either directly or through other areas. For example, areas V4 and V5 connect directly and reciprocally with each*

other. Both of them also project to the parietal and temporal regions of the brain, but as [Zeki's] ... work with ... colleagues has shown, the outputs from each area occupy their own unique territory within the receiving region. Direct overlap between the signals from V4 and V5 is minimal. It is as if the cortex wishes to maintain the separation of the distinct visual signals ... any integration of the signals within the parietal or temporal regions must occur through local 'wiring' that connects the inputs" (Zeki, 1992, p.49).

Although the separation of the visual signals is maintained, Zeki asserts that a very extensive network of anatomic links between the visual areas is necessary to achieve integrated perception. For example, to perceive movement the direction and speed of an object in a field have to be determined. The V5 area specialising in movement can determine this because it has a larger receptive field than V1. However, because V5 has a large receptive field, it forfeited the ability to ascertain the precise position of elements in the visual field. V1 is the visual area that has the ability to organise information spatially because it has a topographic map of the retina and thus of the visual field. The information on movement from V5 must therefore be returned to V1 so that it can be positioned into the visual field.

Conflicts or illusions are also resolved through this ability of areas to return information to V1. For example, the cells in V2 have different abilities to the cells in V1. Therefore, if the form-sensitive cells in V1 do not respond to conflicting information or illusions, such as an incomplete circle, the cells in V2, which have larger receptive fields and more analytic functions, will respond. The cells in V2 will, for example, complete an incomplete circle by deduction. A normal observer will then perceive a circle even though the lines forming the circle are incomplete. *"To settle the conflict, the V2 cells must have re-entrant inputs to their counterparts in V1"* (Zeki, 1992, p.50).

A major difficulty arises from the fact that cells responding to different qualities of the same object can reside in two or more

different visual areas. The process of integration thus poses the problem of binding. Zeki says that the signals from the diverse cells must be bound so that they are perceived as belonging to the same object. The binding problem is not yet solved. Two questions arise. Firstly, how the specialised areas of the brain manage to work together so smoothly and secondly, whether the activities of the specialised areas are coordinated by a central or a distributed network. Horgan quotes Steven Petersen who supports "*a localized region or a small number of localized regions where perceptions, memories and intentions are integrated*". He also quotes Patricia Goldman-Rakic who conversely "*is leaning toward a non-hierarchical model in which separate but equal partners are interconnected, communicating with each other*" (Horgan, 1993, p.16). However, what the binding mechanism is, is not yet resolved. Larry Squire predicts that experiments conducted through the use of non-invasive imaging technologies, such as electrodes, and also empirical data will provide some answers to explain the binding mechanism. (Non-invasive imaging technologies include the use of electrodes such as Zeki employed in his experiments to measure the response of cells to visual stimuli. Empirical data can, for instance, be obtained from further studies of visual pathology.)

(a) Conclusion

The theory of visual perception in the twentieth century, as discussed above, is characterised by specialisation of the different areas of the visual cortex in the brain. According to John Horgan the specialisation is carried to extremes and experiments reveal "*increasingly finer subdivisions of the brain ... in the visual cortex ... one set of neurons is dedicated to orange-red colours, another to objects with high-contrast diagonal edges and still another to objects moving rapidly from left to right*" (1993, p.16).

Zeki describes less specialised areas in the visual cortex, namely V1 and V2. V1 and V2 distribute the information received from the retina to the specialised areas. The

specialised areas consist of V2, V4, and V5. In V3 the cells are selective for dynamic form but indifferent to the colour of the stimulus. The cells in V4 are sensitive to specific wavelengths of light, therefore to the colour of the stimulus and also to form with colour. The cells in V5 are sensitive to movement.

A study of different types of blindness caused by damage to the specialised areas of the cortex reveals loss of the ability to perceive, for instance, colour or movement. Zeki employs drawings produced by patients who suffer different types of blindness to illustrate their impairments. Their inability to reproduce a given form or colour is clearly visible in their drawings. The specialisation in the visual cortex introduces the difficulty that cells responding to different qualities of the same object can reside in two or more different visual areas. A process of integration thus poses the problem of binding. The signals from the diverse cells must be bound so that they are perceived as belonging to the same object. The mechanism of binding is not yet understood.

3.3.5   Summary

Historical and current theories of visual perception do not seem to be relevant to prove that painting influences the painter's visual perception.

Historical theories of visual perception concern the gradual emergence of insight into the eye's reaction to the structuring elements of visual perception. It is a history of physiological studies.

In contrast the influence of painting on the painter's visual perception is an abstract statement. However, the history of the physiological study of visual perception closely follows the historical inflence of painting on the painter's visual perception.

The historical overview of theories of visual perception broadly prepares the ground for understanding the current theory of

fractured perception. Historically, theories of visual perception were often further developed through the influence of painting on the painter's visual perception as described here. Painters wrote treatise on aspects of visual perception that were influenced by their painting. The development of the theory of point radiation and the derivative influence of the visual pyramid and the development of linear perspective by Alberti is an example.

This chapter introduced the historical development of fractured perception. The process of binding, in other words, of making sense out of fractured perception without being aware of the process is still poorly understood and will be examined in detail in chapter five. In this thesis the process of binding is examined through a study of painting therefore, the inferences drawn are only relevant to visual binding in painting and the painter's visual perception.

A theory of visual perception is valid if it can be tested according to the scientific insights and instruments of the time.

'Historical development' implies that theories are adapted or that new theories are formulated as new information is discovered.

A painting is valid if it reflects the reality of the time. A painting is no longer a valid reflection of reality when spiritual changes occur and painting no longer reflects the beliefs of the time. A different way of representation then has to be found to make a valid representation of reality. This is, for example, reflected in the history of linear perspective and in the history of the theory of point radiation and the visual pyramid. When the church was the main influence in all spheres of life a fixed point of view seemed to reflect this spiritual focus. Linear perspective was experienced by painters as a valid reflection of this reality.

The theory of point radiation and the visual pyramid also satisfied this requirement and the scientific insights of the time. When a spiritual change occurred and the church was no longer the main influence in all spheres of life, linear perspective no longer satisfied

the painter's visual perception of reality. The presumed fixed viewpoint of the painter was no longer valid. To accommodate the new beliefs of the time in the first phase of Cubism (1907 - 1912) objects were depicted as a series of planes as seen from multiple viewpoints. Theories of visual perception in the twentieth century also reflect the spiritual change. Although point radiation and the visual pyramid is still accepted, the focus of twentieth century visual perception research is on how the brain manages to extract information from constantly changing visual stimuli or how the binding process works - thus not from a fixed viewpoint.

The impression that a painting is a valid reflection of reality is thus closely connected to the historical development of theories of visual perception and spiritual changes that occur.

In the third chapter the history of visual perception is considered. Theories of visual perception are continually enhanced and developed through reasoning, perception and depiction. It can be described as a cyclic process. This process adds to the ever increasing store of knowledge. More knowledge advances the ability of the painter. For instance linear perspective representing the visual pyramid in visual perception allowed for a new painterly depiction of nature during the renaissance. In that way Giotto and Da Vinci belonged to different worlds of knowledge (or had different concepts of the world) and in effect perceived the world differently.

CHAPTER 4

4. AN ANALOGY BETWEEN PAINTING AND VISUAL PERCEPTION

4.1 INTRODUCTION

The analogy between painting and visual perception is based upon the fact that the same elements can be discerned in painting as in visual perception. It is also possible to consider both painting and visual perception as consisting of separate elements that are integrated through a binding mechanism to form a whole.

The elements in painting are referred to as the formal properties of painting. The formal properties of painting are colour, form, depth and light. The binding mechanism can be regarded as the composition through which the formal properties are deployed in a painting.

The elements in visual perception are referred to as the structuring elements of visual perception. The structuring elements of visual perception are colour, form, depth and movement. The characteristics of the binding mechanism in visual perception have not yet been described.

4.2 HISTORICAL CONTRIBUTIONS TO AN ANALOGY BETWEEN PAINTING AND VISUAL PERCEPTION

4.2.1 The contribution of prehistory to an analogy between painting and visual perception

The formal properties are already evident in prehistoric painting. Prehistoric painting can thus be analysed according to the use of colour, form, depth and light and dark.

Although one intuitively accepts that visual perception consists of different elements, the visual perception of the environment gives the impression of wholeness. It was therefore initially very difficult

to separate perception into the different elements and to describe the structuring elements. An accurate description of the structuring elements then has a very long and arduous prologue commencing in prehistory. In prehistory, evidence of visual perceptual sophistication is derived from a study of prehistoric painting rather than verbal description, because no written records exist.

The most valuable prehistorical contribution to the analogy between perception and painting was to equate two disparate entities and to overcome the conceptual contradiction that coloured earth can represent, for instance, an animal. Inherent in this discovery is that perceptual wholeness (perceiving the whole animal) can be divided into different elements, such as colour and line, in order to make a painting of an animal. Thus in prehistory, the great contribution to the analogy between visual perception and painting, that opened the door to other perceptual possibilities, was the division of the impression of wholeness into separate elements, and to reassemble the elements in a painting.

4.2.2 The contribution of classical Greece to an analogy between painting and visual perception

The contribution of classical Greece to the analogy between painting and visual perception consists mainly of the formulation of terminology used to describe painting and perception.

As no paintings by the foremost painters of ancient Greece survived, it is significant that the sophisticated colour harmonies, the depiction of depth and shading techniques are revealed mostly through fragmentary references in ancient literature. The interpretation of the references in ancient literature is enhanced by existing examples of vase painting and examples of provincial painting in Macedonia and Thrace (in present day Bulgaria).

Examples of painting in Bulgaria at Kazanlak (from the late fourth or early third century BC) and Lefkadia (second half of the fourth century BC) enlighten some aspects of importance in Greek

painting. These include the rendering of three-dimensional form through shading and the restriction of colour by classical painters.

By rendering three-dimensional form through shading, figures could move and turn in space in an atmosphere of light and air. The shading is accomplished through two approaches. Firstly, through a complex system of overlapping tones in which every individual stroke is a slightly different colour and the forms are not clearly outlined. Secondly, through linear hatching and clear outlines.

The restriction of colour points to the fact that ancient Greek painters were aware that a range of colours can be mixed from the primary colours. Greek painters introduced the full range of colours that occur in nature through mixing the primary colours. In the paintings at Kazanlak and Lefkadia, depth is suggested through light versus dark, foreshortening and figures moving behind and in front of others, although the background is still devoid of activity. The articulation of depth was thus restricted to a narrow corridor and concentrated on one plane.

Light and dark were denoted by white and black. Because no paintings by the foremost classical Greek painters survives, ancient literature together with provincial examples of ancient painting, such as those described above, have led modern scholars to make intelligent guesses on classical Greek painting. It is, however, not possible to imagine the actual appearance of an artist's style only through the literary references and provincial examples. However, of importance in this context is the existence of written descriptions which, because of the sophistication of available examples of painting, enabled the emergence of a sophisticated vocabulary regarding the formal properties of painting. The development of such a vocabulary would be essential in establishing a basis for an analogy between painting and visual perception.

In J.J. Pollitt's book 'The Ancient view of Greek Art: Criticism, History, and Terminology' it is stated that, as in painting, no ancient treatise survived exclusively on Greek art. The most

ancient extant treatise is 'De Architectura' by the Roman architect Vitruvius (late first century BC). However, some fragmented references to fine art by Vitruvius exist. Also, to capture the original thought behind the concepts formulated in Greek, the extant Latin source, such as Vitruvius, is often translated back into Greek.

Thus, although both the original Greek paintings and writings that deals exclusively with art have not survived, they are accessible to a certain extent.

In 'De Architectura' Vitruvius provides a list of treatises written by early Greek architects. One of the earliest was written by Theodorus on the temple of Hera at Samos (approximately 570 BC). Existing fragments of the text suggest that it mainly dealt with the construction of and materials used in the building. Pollitt convincingly argues that questions of form and proportion were also included in the treatise.

If this was the case then Theodorus, who was also a sculptor and painter, was already part of a tradition of writing about art and had access to a system of terms used in art.

According to Pollitt the earliest known Greek treatise on the theory of painting was a study on the formal property of depth, specifically on perspective or skénographia. It is dated approximately the mid-fifth century BC and written by Agatharchus. Already, the Greek term skénographia includes the meaning "*the art of depicting spatial perspective*" (Pollitt, 1974, p.234). Vitruvius' writing on Greek painting, in a complex paragraph, seems to ascribe the invention of perspective painting to Agatharcus. In this text Vitruvius seems to describe the construction of perspective on a two-dimensional surface in ancient Greek painting.

Vitruvius writes that "*it is necessary that, a fixed center being established, the lines correspond by natural law to the sight of the eyes and the extension of the rays (the sympathetic medium), so that from an uncertain object certain images may render the*

appearance of buildings in the paintings of the stages, and things which are drawn upon vertical and plane surfaces may seem in one case to be receding, and in another to be projecting" (Pollitt, 1974, p.235). In a monograph on ancient perspective, John White connects this text to Vitruvius' interpretation of skénographia. Vitruvius describes skénographia as "*the semblance of a front and of sides receding into the background and the correspondence of all the lines* [in this representation] *to* [a vanishing point at] *the center of a circle*" (Pollitt, 1974, p.231).

White proposes that these two paragraphs "*describe an application to the visual arts of the analysis of optical experience which is elsewhere presented in purely theoretical terms, without reference to art, by Euclid* [in his 'optics'] ... *in this analysis the field of vision is seen as a cone with its apex at the eye and with a vanishing point at the center of its circular base. The Vitruvian description of skénographia, White maintains, is in fact 'a description of perspective method', while the description of Agatharchus's achievement 'complements it with a reference to the latter's [i.e. perspective's] basis in the fundamental optical principles of the visual cone'* " (Pollitt, 1974, p.235).

To further support his supposition that Vitruvius describes a perspective method, White points out that Vitruvius refers "*to the convergence of lines toward a single point [and] ... when Vitruvius says that 'the lines correspond by a natural law' to 'the sight of the eyes and the extension of the rays' he means that drawn lines converging on a central vanishing point in a painting are analogous to the rays of vision which converge at the apex of the Euclidean visual cone*" (Pollitt, 1974, p.235).

Pollitt draws no conclusion about the possibility that Agatharchus was the inventor of a comprehensive system of perspective. Pollitt more favorably considers the possibility that Agatharchus and other painters of the fifth century took the first theoretical and practical steps in the development of graphic perspective. Although no date for the invention of skénographia can be fixed, it was gradually incorporated as a subdivision of the science of optics. Pollitt

speculates that by Euclid's time, about 300 BC, skénographia was part of Greek epistemological thinking. Pollitt also considers the possibility that skénographia was incorporated in Euclid's 'Optica' because "*its place within optics is described clearly by Proclus (fifth century AD) in a commentary on the optics of Euclid*" (Pollitt, 1974, p.239).

One conclusion can be drawn from this discussion of the term 'skénographia'. It can be concluded that an extensive vocabulary of the formal properties of art existed through which complex descriptions of early Greek art were made possible. Pollitt estimates that criticism of the visual arts in Greek philosophy became well established in the second half of the fifth century BC.

Therefore, although the original meaning of the terminology is not always clear and the original texts are lost, it can be deducted that complex descriptions of art were possible. Moreover, it seems possible that Agatharchus initiated the theoretical and practical development of skénographia which led to graphic perspective. This invention was later incorporated into the study of optics. Painting thus was associated with and influenced the study of optics and of visual perception.

Classical Greece's main contributions to the analogy between painting and visual perception can be regarded as the formulation of terminology and the creation of a tradition of writing on art. This inevitably led to correlations being discovered between art and other fields of study, in this instance optics and visual perception. Art terminology which originated in Greece and are still used today though in a derived form, include rhuthmos (rhythm), symmetria (symmetry) and teine or tonos (tone).

4.2.3 The contribution of the sixteenth century to an analogy between painting and visual perception

The sixteenth and early seventeenth centuries' contribution to the analogy between painting and visual perception is the distinction made between optical and quasi-optical stages in visual perception.

Early on, Alhazen (born in 965) came to the conclusion that optical and quasi-optical stages were present in the visual perceptual process. In the early seventeenth century, Kepler made a more definite division between these two stages in the visual perceptual process. Kepler also acknowledged more openly than Alhazen that he could not explain the quasi-optical state.

However, visual representations of optical and quasi-optical stages in the visual perceptual process seem to exist to some extent through artworks. Some aspects of the quasi-optical stage in the visual perceptual process, that are difficult to describe theoretically and which Kepler found elusive, can in some measure be deducted from artworks. (However, it is only in the twentieth century that this stage can partially be exposed through imaging technologies, such as electrodes, which capture activity in the brain.) For example, an aspect of the quasi-optical stage of visual perception can be deducted through a study of Leonardo da Vinci's drawings of the movement of water.

In writing his 'Treatise on Painting' which includes many scientific observations, Da Vinci states his conviction that a painter must be more than merely an eye. In other words, he must not be satisfied with superficial appearances. Da Vinci thus instinctively recognised that the visual perceptual process consisted of more than just an optical stage. His drawings are visual representations of his conviction and can be described as visual representations of some aspects of the optical and quasi-optical stages.

Through the controlled composition of the formal property of line in Da Vinci's drawings of the movement of water, he progressively shows the principles underlying the movement of water more clearly than a purely visual representation of, for instance, a waterfall can. A characteristic of the quasi-optical stage of the visual perceptual process can to some extent be deducted from this. Da Vinci's series of drawings of the movement of water reveal a basic characteristic of visual perception. This is that visual perceptual skills become more acute through studying different examples of the same phenomenon and the underlying principles

behind phenomena. Eventually a very complex visual experience can be so accurately perceived that it can be represented by means of the formal properties of art.

However, the main achievement of the sixteenth and early seventeenth century is in describing the optical stage of visual perception.

The optical stage "*strictly defined ends when radiation reaches the seat of visual power within the eye (the crystalline humour for Alhazen, the retina for Kepler), whereupon there ensues a transmission involving visual spirit (which in some measure violates the laws of optics while still belonging to the science of vision) and an act of visual perception*" (Lindberg, 1973, p.205).

A satisfactory description of the optical stage was achieved by Johannes Kepler who was active during the early seventeenth century. This most important achievement in the field of visual perception was in describing how an image was formed inside the eye. He was the first to describe the formation of an image in the eye (on the retina) by using ray geometry.

Parallel to this the sixteenth century Italian painters used linear perspective to project an image onto the canvas. The rectilinear rays of the visual pyramid intersect with the painter's panel as if it were a window.

The similarity between Kepler's description of the formation of an image on the retina and the sixteenth century Italian painters' employment of linear perspective rests in the fact that both were inheritors of a long tradition of the geometrical analysis of perception. This tradition includes Euclid and Alhazen, and possibly originated in the painting of Agatharchus. Kepler considered the visual pyramid to have its base at the visual object and the apex in the eye.

A further reference to which both painting and visual perception had access was the camera obscura. It had an influence on the

understanding of the optical stage and the principle of rectilinear propagation of radiation. Kepler and predecessors such as Da Vinci and Giovanni Battista della Porta (1535-1615) had access to the camera obscura. Da Vinci compared the eye to a camera obscura. Through the camera obscura he demonstrated "*that rays from various parts of the visual field must intersect within the pupil and thus present an inverted view unless caused to intersect a second time through reflection or refraction*" (Lindberg, 1973, p.164). However, Da Vinci did not state that the retina can be compared to a screen onto which an image is projected.

In the work 'Magia Naturalis', Della Porta regarded the eye as a miniature camera obscura. However, he failed to use this insight to further his understanding of the visual process. He considered the crystalline humour as "*the screen onto which the images are projected*" (Lindberg, 1973, p.185) instead of equating the retina to a screen.

Kepler, in his studies of radiation through apertures, stretched "*a thread through an aperture from a luminous source, or rather from a book meant to simulate a luminous source, to a surface on which the image was formed. Tracing out the image cast by each point of the book in this manner, Kepler could see the geometry of radiation in material, three dimensional terms and was able to formulate a satisfactory theory of radiation through apertures, based firmly on the principle of rectilinear propagation*" (Lindberg, 1973, p.187).

Due to his understanding of the radiation through apertures, Kepler began to question the geometrical theory of visual perception as it stood at the time. The power of visual perception was thought to be the crystalline humour, and vision was thought to be a form of touch - the eye feels the light and colour entering it. However, due to his understanding of the radiation through apertures, Kepler's did not consider the formation of an image in the eye as a form of touch. He conceived visual perception as an image reversed, inverted and projected onto the retina as in the example of the camera obscura.

Kepler was therefore the first to describe the formation of an image inside the eye and to give a satisfactory description of the optical stage of the visual perceptual process.

The contribution of the sixteenth and early seventeenth centuries to the analogy between painting and visual perception is therefore by the distinction made in the optical and quasi-optical stages in visual perception. This enabled Kepler to offer a satisfactory description of the formation of an image on the retina.

4.2.4   The contribution of the twentieth century to an analogy between painting and visual perception

An analogy between painting and visual perception would not be possible without reference to the cumulative contributions throughout time.

The prehistoric insight that the seeming wholeness of visual perception can be divided into the formal properties of painting (namely colour, form, depth and light and dark) is crucial to the study of visual perception. It points to facts regarding the fractured nature of visual perception that are emerging only now during the late twentieth century. These facts can only be verified by means of advanced imaging technologies used in studies of the visual cortex in the brain.

The Greek formulation of terminology regarding the visual arts and visual perception, and the establishment of a culture of writing about art and visual perception contributed to the analogous development of the two subjects. The influence that the two subjects exerted on one another (for example in the study and visual representation of the geometrical propagation of light) would probably not have been possible without terminology to describe the phenomena. Some of the original Greek terms form the basis of twentieth century terms used in art and visual perception. Examples of these terms are linea (line), tonos (tone), symmetria (symmetry) and rhuthmos (rhythm).

During the sixteenth and early seventeenth century, a distinction was made between the optical and quasi-optical stages in visual perception. Johannes Kepler succeeded in describing the optical stage in the visual perceptual process. He showed how an image was projected onto the retina. Although Semir Zeki (in the twentieth century) asserts that the visual process cannot be divided into optical and quasi-optical stages the distinction drawn between optical and quasi-optical stages aided Kepler. Without recourse to twentieth century technology, and with only the geometrical propagation of light and the camera obscura as reference, Kepler could not draw conclusions regarding the quasi-optical stage or the interpretation of visual information. However, describing the formation of an image on the retina was a momentous achievement under these circumstances; an achievement which would not have been possible without making a distinction between optical and quasi-optical stages.

In the twentieth century we rely on the contributions of previous eras to describe the analogy drawn between painting and visual perception.

The twentieth century's contribution to the analogy between painting and visual perception would logically follow the exploration of Kepler's quasi-optical stage of visual perception. Semir Zeki, however, asserts that understanding what is seen (the quasi-optical stage) and seeing (the optical stage of visual perception) cannot be separated. Zeki contends that the brain does not merely decode images impressed on the retina, but actively invents a visual world. Thus Kepler's description of the formation of an image on the retina is not disputed; this description freed later scientists to explore the question of the interpretation of visual information. It is only Kepler's separation of the stages of visual perception that is put aside.

The twentieth century contribution to the analogy between painting and visual perception could be in showing that the painter paints

148

© University of Pretoria

Digitised by the Open Scholarship & Digitisation Programme, University of Pretoria, 2016

how he perceives and not *what* he perceives. Painting can thus be used in an analogy of how visual perception takes place.

Zeki's contention, that the visual cortex consists of specialised areas of specific visual functions, is the focus from which the analogy emerges. As mentioned earlier, Zeki proposed "*in the early nineteen seventies the concept of functional specialization in the visual cortex, which supposes that colour, form, motion and possibly other attributes of the visible world are processed separately*" (1992, p.45).

Zeki's experiments and proposition concur with the prehistoric insight that made painting possible. This insight was that the seeming wholeness of visual perception can be divided into the formal properties namely colour, form, depth and light and dark. The formal properties of painting mirror the structuring elements in visual perception and by analogy the functional specialisation in the visual cortex. The explanation of how it was possible for painting to evolve would seem to be because visual perception is fractured by the visual cortex. It only became possible to investigate the nature of visual perception during the twentieth century, because instruments for the measurement of brain activity during visual perception was not previously available.

Painting would then seem to mirror the visual perceptual process. If painting mirrors the visual process in the areas that can be measured in the twentieth century, it can conjecturally also mirror areas or processes that are as yet not understood. Such a process would, for example, include the binding mechanism through which the separate elements are integrated to form a meaningful whole.

4.3   SUMMARY

In the fourth chapter the artist's role in the development of visual perception is established through an analogy between painting and visual perception.

Through the analogy it is established that the painter paints how he perceives and not what he perceives. Thus by studying painting certain aspects of how visual perception takes place can analogously be understood, such as binding in fractured visual perception.

The fact that the painter paints how he sees is also reflected in the following. A modern visual researcher, Zeki, contends that the brain does not merely decode images impressed on the retina but actively invents a visual world. Through continually inventing new ways to arrange the formal properties, the painter is inventing new ways to represent and perceive meaningful aspects of the visual world.

Therefore, the artist's role in the development of visual perception when regarded through an analogy between painting and visual perception, is that the artist paints how he sees and not what he sees. Thus, by studying painting, certain aspects of how visual perception takes place can analogously be understood.

CHAPTER 5

5. THE ANALOGOUS INFLUENCE OF PAINTING ON THE ARTIST'S VISUAL PERCEPTION

5.1 THE INFLUENCE OF PAINTERS' PREFERENCE FOR HOLISTIC THINKING ON VISUAL PERCEPTION

If, as it was supposed at the end of the previous chapter, painting mirrors the measurable areas of the visual process, then it can conjecturally also mirror as yet unmeasured areas of the visual process. One area that is as yet unmeasured is the binding mechanism or the integration of fractured perception.

In the article 'Fractured Functions' in 'Scientific American', John Horgan writes that *"The brain as depicted by modern neuroscience resembles a hospital in which specialization has been carried to absurd lengths ... in the visual-cortex ... one set of neurones is dedicated to orange-red colours, another to objects with high-contrast diagonal edges and still another to objects moving rapidly from left to right. The question is how the fragmentary work of these highly specialized parts is put together again to create the apparent unity of perception and thought that constitutes the mind. This puzzle, known as the 'binding problem', has loomed ever larger as experiments have revealed increasingly finer subdivisions of the brain ... It needs to be asked how all the specialized parts of the brain manage to work together so smoothly? Are their activities co-ordinated by a central office or through some form of distributed network? Peterson favours 'a localized region or a small number of localized regions', where perception, memories and intentions are integrated. Goldman-Rakic leans toward a non-hierarchical model in which 'separate but equal partners are interconnected, communicating with each other' "* (1993, p.16).

The question posed due to the existance of fractured perception is thus how to describe the characteristics of binding or the brain's integrator.

One attempt to arrive at an understanding of binding can be made by considering the working methods of painters and their paintings. In a painting, many different elements have to be integrated to form a whole. This can point to a general painter preference for holistic thinking. Thus, a study of painters' working methods could analogously correspond to general characteristics of visual perceptual binding. The aim is to explore the possibility that painting can correspond to some characteristics of the binding mechanism of the visual perceptual process. In this way painting can influence thoughts on the artist's visual perception.

Of course, integration in painting cannot simply be equated with the concept of a binding mechanism as found in visual perception. However, the crucial skill of a painter seems to reside in integrating large amounts of information to form an image. (This characteristic is also attributed to painters by Neethling author of the book 'Creative People can Perform Miracles' and is contained in the term 'holistic thinking'.) Analogously, the binding mechanism in visual perception integrates large amounts of information to form an image. It can therefore be stated that integration in painting, or holistic thinking, can be used as an analogy of the binding mechanism in visual perception.

5.1.1 Painter's preference for holistic thinking as descriptive of the binding mechanism in the visual perceptual process

(a) A brain profile of Giotto as an example of holistic thinking

(i) What is a brain profile

A brain profile plots an individual's preferred way of thinking. It was originally devised by Dr K Neethling to facilitate interpersonal relationships in the workplace. This profile facilitates interpersonal relationships because it exposes an individual's strengths and weaknesses and

these can be taken into account when allotting tasks in the workplace. In order to compile the profile, the brain is divided into quadrants. The concept is expressed as a quartered circle. Each quadrant represents a specific preference on the part of the individual. The first quadrant is called L1 and represents factual information. The second quadrant is called L2 and represents detail and structure. The third quadrant is called R1 and represents holistic thinking. The fourth quadrant is called R2 and represents people-orientation and empathy.

The brain profile is usually compiled individually through listing, according to individual preference, four given responses. A score is calculated for each quadrant and the quadrant obtaining the highest score is considered to represent the individual's preferred interest. The quadrants obtaining lower scores represent lesser interest or weaknesses in the individual. For example, if the L1 quadrant obtains the highest score and the R2 the lowest score, the individual prefers to work with factual information rather than people.

The following paragraphs aim to construct the brain profile of the Florentine painter Giotto di Bondone (1267-1337). Furthermore, the aim is to reveal a general preference for holistic thinking in painters.

A brain profile of Giotto is constructed through a study of his paintings. The demands of the visual image produced by a painter and the requirements of the techniques chosen by him, reveal specific preferences on the part of the painter. From a study of Giotto's working methods, insight into his strengths and preferences can be gained. It is thus important to first study an example of his painting from which information on his working methods can be gathered. Then, from the information gathered, his preference can be deducted and his brain profile constructed.

[ii] The preferences of Giotto derived from a study of his working methods

Giotto was an important painter because his work introduced naturalistic, three-dimensional representation and also the representation of human emotion. He rejected the stylised formulae of medieval art. He included, for example, landscapes into the compositions to create a feeling of depth, and a variety of facial expressions and gestures to suggest human emotion.

The Arena Chapel in Padua was decorated with frescoes by Giotto in 1305-1308 and is used here, as an example of his work, to study his working methods.

The decoration consists of a cycle of works telling the story of the life of Christ. It was a difficult assignment because of the physical scale of the work and the exacting theological demands posed. The viewer was supposed to be correctly instructed regarding liturgical matters through contemplation of the frescoes. Giotto's working methods, which led to the solution to the problem, should expose some areas of his preferences.

1. In order to achieve the desired result, Giotto had several advisors and assistants. He was advised by a scientist and a scholar of theology and matters of learning and assisted by apprentices and craftsmen. Giotto had to translate verbal communiqués from scholars into images, give clear instructions to the apprentices and work with craftsmen on technical matters. From the successful outcome of the frescoes one can conclude that Giotto had the ability to communicate well.

2. Giotto had a wide field of reference. For example, he used the Golden Section and perspective, and he had to have a great knowledge of materials and their reaction to

the environment to master the fresco technique. He also collected and experimented with new information and knew of "*devices not yet adopted by the workshop of other painters*" (Basile, 1993, p.16). These facts imply that Giotto was inquisitive and intelligent.

3. Giotto created unity and maintained continuity throughout the cycle of works. He created unity by keeping the background and the characters constant. He achieved continuity by making cross-references throughout: for example, he used recurring motifs in a widespread and systematic way in order to characterise an individual. He also depicted the main characters from birth to death such as Christ and Mary. He maintained the impression of wholeness by focusing only on the most important ideas and painterly detail. Giotto thus had the ability to think holistically.

4. He was a master of variation. Giotto used variation to avoid monotony in the repetitions he employed, for example: a building seemingly identical in repetition was varied through the play of light painted on its walls. The ability to make variations on a theme is one of the measures of creativity. One can deduct that Giotto was creative.

5. Giotto used symbols. "*The colour, for example the clothing, serves to emphasize the character of its wearer*" (Basile, 1993, p.14). Judas thus wears yellow clothes - yellow being the colour of betrayal.

6. Giotto not only employed perspective but any other formal and technical instruments, selecting and subordinating them to obtain the effect that he intended to achieve: this points to Giotto's flexibility.

7. Giotto worked with a sureness of touch and a rapidity that were extraordinary. His techniques were highly

sophisticated and complex and many were revolutionary for his time. For example, Giotto used even and muted colours that varied only between light and shade to create a three-dimensional effect, and the colours are soft and blended. From this one can conclude that Giotto was technically superb.

8. Giotto introduced a new way of executing mural decoration in terms of composition. This meant that he took risks.

9. Giotto's main theme was man. He was intent on depicting the whole range of human emotion, activities and events. People of all age groups, mostly male but also female, were represented. Single figures but also groups of interacting figures were painted. The main characters were depicted from birth to death. Giotto used animals, the landscape and architecture as secondary to man and to support the human drama. For example, the same architectural setting was used as backdrop in solitude and happiness: Giotto emphasised the "*different psychological implications of the two scenes in the same setting*" (Basile, 1993, p.121) by, for example, the variation in the play of light on the walls. Giotto was thus interested in depicting human emotion.

10. Giotto had a clear concept of good and evil as shown in the painting of the 'Last Judgement'.

11. Giotto's workshop was organised along traditional lines.

From these working methods the following preferences and strengths emerged. He was able to conceive of a cycle of works that depicted clearly and without contradiction the life of Christ. He was able to understand and depict a wide range of human emotion.

His other capabilities employed in running a successful workshop, such as his communication skills and organisational skills, are also noteworthy. However, his communication and organization skills are employed to support and strengthen his main preferences.

(iii)   **Compiling a brain profile of Giotto**

The decoration of the Arena Chapel as a whole, the account taken of the ensemble effect and the legibility of the life story of Christ combine many factors, not only painterly compositional factors. However, these factors combine to form a whole. In the paintings Giotto's preference was to subjugate detail to the overall effect or to leave out detail that would not contribute to the whole. Giotto used detail sparingly in the paintings so that it would not detract from the over-all effect.

Giotto's strength was to take into account the big picture and to this end he used detail sparingly. His interpretation was a synthesis of many ideas and influences.

From the summary of the brain quadrants, Giotto's preference would be best expressed by the R1 quadrant because of his emphasis on the big picture and holistic thinking. Giotto also had a strong preference for people and empathy with their plight. This can be deducted from his ability to depict the wide range of human emotion contained in the story of the life of Christ. The R2 quadrant would then be the second strongest quadrant.

Giotto also had many other capabilities. For instance, it can be deducted that he had to be able to communicate and organise well in order to gather the information needed for the cycle of works and to run his workshop. He thus had insight into facts and skills which would

resort under the L1 and L2 quadrants such as collecting information and organisational skills. However, he seemed to use skills from the L1 and L2 quadrants to strengthen, complement and support his main preference, namely to combine many disparate elements into a whole.

Based on these deductions, a brain profile of Giotto can be approximated. The total score out of which the brain profile is compiled is two hundred and eighty points. A score of seventy points therefore indicates an average.

Giotto's preference for the R1 quadrant would then be best indicated by a score of ninety points. The second strongest quadrant, the R2 quadrant, can be indicated by an above average score of eighty points. The L1 quadrant can be indicated by the score of sixty because Giotto meticulously gathered information, but mainly used the information to support his preference and left out information that would detract from the whole.

(b) **Do all painters prefer holistic thinking**

Because Giotto's cycle of works in the Arena Chapel in Padua is so vast, it amplifies the working method that a painter undergoes when painting. As with Giotto, a painter always combines many factors when painting. However, these factors, such as the technique used, the subject matter, a wide field of reference and experiments with new or different methods, always have to be integrated to form a whole. Giotto maintained the impression of wholeness by focusing only on the most important detail and by excluding detail of lesser importance. In the same way, to create a successful painting, any painter first has to leave out unnecessary detail and also subjugate the detail used to fit into a coherent whole. The painter has to consider the whole consistently while working. The painter thus has to have a preference for holistic thinking.

In this sense it can be stated that all painters prefer holistic thinking.

(c) **Characteristics of the binding mechanism in visual perception derived from the painter's preference for holistic thinking**

It is important to show that painters favour holistic thinking so that painting can be established as an analogy to the binding mechanism in the visual perceptual process. An attempt can be made to derive certain characteristics of the binding mechanism in the artist's visual perception from the painter's preference for holistic thinking.

Firstly, the order of preference for types of information (other than the strongest preference for the R1) of the quadrants do not appear to be of crucial functional importance in holistic thinking in painting and analogously in the binding mechanism. Therefore, although two people may have different orders of preference, both can function equally well.

Secondly, Giotto did not seem to have weaknesses that he could not overcome. He even used lesser interests to support his preference. By means of his communication and organisation skills he could, for example, run a workshop. However, running a workshop was not his main aim, painting was his main aim. Holistic thinking, and by implication the binding mechanism in visual perception, also implies using lesser interests to support strengths.

Thirdly, while the order of preference of information is not functionally important, holistic thinking (and analogously the binding mechanism) can from the information received, build up a comprehensive picture and process diverse information to form a whole. Cross-references would seem to inform areas of which less or incomplete information is received. It also seems to delete superfluous information, because binding or integrating the information to form a whole is usually more

important than the separate fragments of information. A possible characteristic of the binding mechanism that can be derived from these facts is that it overrides certain pieces of information in preference to the whole.

5.2 THE INFLUENCE OF SEQUENTIAL EMPLOYMENT OF THE FORMAL PROPERTIES IN A PAINTING, ON VISUAL PERCEPTION

5.2.1 The formal properties used in the construction of a painting

In this paragraph the influence of the sequential employment of the formal properties in a painting, on visual perception, is analysed. In this approach to painting, the formal properties of painting are considered to be clearly definable and the sequence in which they are employed, can be determined. The sequence is also considered to be of definitive value to the character of the painting. The construction of a painting consists, in this instance, of the formal properties of art. Only those properties which can have a decisive influence on the completed painting, are considered here, namely light and dark, colour, line and to a lesser degree texture. Change as a formal property is, for example, excluded because a painting is considered not to have this property as an option. When constructing a painting, the painter does not usually include change, as will occur in the future existence of the painting, in his calculations.

(a) The formal property of line (shape)

The formal property of line can be the determining factor in the construction of a painting. Line is equated with line drawing. The techniques used in line drawing included in this concept, are drawing on a ground prepared for painting with pencil, charcoal or brush and paint.

(b) The formal property of colour

The formal property of colour is also considered to be a main property in painting because it can dominate all the other properties employed in the construction of the painting. The techniques used to apply colour include transparent overlays of colour and opaque applications of colour. The colour scheme of the painting can be monochrome or filled with contrasting colour.

(c) The formal properties of light and dark

The formal properties of light and dark can have a decisive influence on all the other properties employed in the painting. The source of light, that can be used to create a pattern of light and dark, can be natural, for example the sun, or artificial, for example fire. The source of light can also be strongly directional, as in an indoor scene lighted from a window in a side wall. The intensity and the pattern of the play of light and dark will thus be determined by the source and position of light and the position of objects and figures.

(d) The formal property of texture

The formal property of texture is included here although it is not considered to be a definitive element in this instance. Texture, as a property in a painting, can be tactile or visual. The techniques involved in creating texture include frottage, collage, photographs, monoprints and grattage. The property of texture in the paintings considered in the following paragraphs, is mostly determined by the support and ground on which the paint is applied. It is also determined by the manner of application and manipulation of the paint, in the act of painting.

5.2.2 The role of the sequential employment of the formal properties in painting

The sequential employment of the formal properties in painting can play a major role in the eventual focus and character of the completed painting. As such, the concept that the painter wishes to express through painting, will be influenced by the choice, for example, of beginning the painting with a line drawing or areas of colour. This will emerge when comparing paintings that exhibit the characteristics of the different preferences.

It is possible to "take apart" a painting and study the sequence through which the formal properties were employed in a painting. This is done by studying, for example, painting techniques in general, by studying the technical writings on painting of a specific era and by a study of the oeuvre of the painter and any unfinished paintings.

Januszczak in his book 'Les grands Peintres et leur Technique' studies the techniques of painters. His interest is not the possible influence that, for example, beginning with the formal property of line rather than colour, would have on the completed painting, but he does show this sequence in his study on the techniques of painters. By using Januszczak's analysis it is thus possible to group paintings together that follow the same sequence in the application of the formal properties.

(a) **Paintings classified according to the sequence of the employment of the formal properties**

In this paragraph the paintings and painters are classified according to the sequence in which the formal properties of art are employed in the execution of a painting. A painter may employ different sequences during different periods of his career. The four painters whose paintings are used later on in the comparisons do, however, show a relatively consistent preference for a specific sequence.

In this classification the formal properties are represented by symbols.

The key to the symbols is that:
- \-   represents the formal property of line
- ●   represents the formal property of colour
- ϕ represents the formal properties of light and dark
- \#   represents the formal property of texture

The classification of - ● ϕ #, will, for example, show how the painter used the formal properties. The painter commenced with a line drawing, secondly added light and dark tone, thirdly applied colour and lastly considered the formal property of texture.

- ● ϕ #	- ϕ ● #	● ϕ - #	ϕ ● - #
1. Van Eyck	1. Da Vinci	1. Watteau	1. Velasquez
2. Della Francesca	2. El Greco	2. Turner	2. Rembrandt
3. Bosch	3. Rubens	3. Monet	3. Reynolds
4. Titian	4. Gainsborough	4. Van Gogh	
5. Caravaggio	5. Blake	5. Klee	
6. Vermeer	6. Constable		
7. Renoir	7. Ingres		
8. Seurat	8. Delacroix		
9. Gauguin	9. Miller		
10. Matisse	10. Courbet		
11. Kandinsky	11. Manet		
12. Léger	12. Munch		
13. Dali	13. Cézanne		
14. Hockney	14. Hopper		
15. Lichtenstein	15. Mondriaan		
	16. Stella		

This relates to visual perception in the following way: the most important aspect in the theory of fractured visual perception is that

it implies a sequence of awareness. Here painting reveals a sequence. In fracture visual perception different structuring elements have to be integrated in a binding process as the structuring elements in painting have to be integrated.

(b) The different classifications of paintings

From the classification of paintings into different groups, two primary classifications emerge which can be further divided into four main classifications.

In this section the four main classifications are firstly considered and after that the two primary classifications.

The four main classifications are as follows:
The first group of painters starts a painting with the formal property of line, then adds colour, then proceeds to define light and dark areas and texture. The work of Jan van Eyck, 'The Arnolfini wedding portrait' represents this group.

The second group out of the four main classifications, also starts with the formal property of line, but then adds light and dark tone, colour and texture. The painting 'The Virgin of the rocks' by Leonardo da Vinci illustrates this sequence.

The third group first applies the formal property of colour, then applies the formal properties of light and dark, then line and lastly texture. A painter whose work reflects this sequence is Antoine Watteau, as for example in his 'Venetian Feast'.

The fourth group to fall under the four main classifications commences with the formal properties of light and dark, then follows with colour, line and texture. The work of Diego Velàsquez is used as an example of this. Velàsquez's 'Las Meninas' was painted in 1656.

COMPARING THE FOUR MAIN CLASSIFICATIONS

The Arnolfini Wedding Portrait by Van Eyck	Virgin of the Rocks by Da Vinci	Venetian Feast by Watteau	Las Meninas by Velasquez
▪ Van Eyck begins with a precise line drawing. The addition of the other formal properties heightens the delineation of the figures and objects.	▪ Da Vinci begins with a line drawing. The line is softened by the sfumato technique, but retains the accuracy of the drawing.	▪ Watteau begins without a line drawing. The line is a result of the process of defining figures and objects and the third formal property in the sequence.	▪ Velasquez starts without a line drawing. The line is formed in the process of painting and is often broken. Line is the third formal property employed in the sequence.
▪ Colour is the second formal property used. White is overpainted in transparent layers of colour – thus the white is visible through the colour, resulting in intense and pure colour. The colour composition is balanced and the colours delineated and contribute to the static composition.	▪ Colour is the third formal property used. The light and dark is modelled first and then transparent colour is overpainted onto the modelling. The light and dark is visible through the colour and dominate the formal property of colour.	▪ Colour is the first formal property used. The planes of colour are for example in a few areas, shaped into tree trunks and leaves before receding into the background of colour again.	▪ Colour is the second formal property. A colour repeated throughout the composition is used to lead the eye through the composition. Furthermore, the area of colour is not outlined. Both these qualities suggest movement.
▪ Light and dark are the third formal properties used. The areas of pure colour are modelled with more dense layers of pigment. Although the light and dark modelling gives a three-dimensional quality to the figures, the outline remains the most important element and is descriptive.	▪ The second formal properties are light and dark. They have a strong influence on the first formal property used namely line. The properties of light and dark soften the outline and detail. The precise outline of the corners of the mouth, for example, are hidden by a light shadow and this suggests rather than describes the expression.	▪ The second formal properties are also light and dark. The contrast between light and dark can be very pronounced. For example, a figure is darkly profiled against a very light background. Light and dark strongly influence the first formal property employed, namely colour.	▪ The first formal properties used are light and dark. The areas of light and shadow are the first to be arranged and influence all the other formal properties. These properties are also used to suggest depth: *"The play of light and dark on the side wall, augments the painting's illusion of depth"* (Cumming, 1995, p.56).

Although the comparison between the four main classifications will show significant differences between the four paintings, the difference between paintings that begin with the formal property of line and those that begin with the formal properties of light and dark, are marked and also subject to a separate comparison.

Texture is perceived as the fourth formal property in all four the paintings. The texture in the paintings considered here, is mostly visual rather than tactile. The preparation of the support and ground of these paintings resulted in a very smooth painting surface; The influence of the original texture of the support (for example of wood or canvas) and ground are difficult to discern. In the Van Eyck very little texture from the brush and the layers of paint is visible. The textures of the different surfaces in the picture, such as fur and metal, are depicted with great care.

In the painting by Da Vinci the painted surface is also very smooth. In the areas of shadow, fingerprints are visible as Leonardo sometimes used his fingers to blend the different tones from light to dark. The texture of the different surfaces is depicted with care.

In the painting by Watteau the paint is quite thickly applied and the modelling of the paint is visible. It therefore has a tactile quality. The texture of the different surfaces are suggested by touches of impasto paint modelled to imitate, for example, skin, clothes or foliage.

In the painting by Velàsquez the layers of paint are, in many areas, applied quite thickly. The layers of paint form a texture that suggests rather than describes, different surfaces.

Texture, as a formal property in the paintings by Van Eyck and Da Vinci, occurs mainly in the visual depiction and description of the different surfaces in the picture. The texture is thus more visual than tactile.

Texture as a formal property in the paintings by Watteau and Velàsquez, is more suggestive and tactile and not mainly visually descriptive.

From the comparison of the four main classifications the following emerges: although there are marked differences between the paintings in the four main classifications, the formal properties which seem to have a decisive influence on the nature of the painting, the property of line and the properties of light and dark. If the formal property of line is applied firstly in a painting, the words which occur in the comparison are, for example, "descriptive", "delineation" and "static". If the formal properties of light and dark are applied firstly the words used are, for example, "suggest", "movement" and "broken line". To study this influence, a comparison between a painting that begins with the formal property of line and a painting that begins with the formal properties of light and dark, in other words the two primary classifications, is included.

Starting with a line drawing seems to result in a painting that is more descriptive. The line describes the figures and objects. The line continues to be the most important element and decisively influences the elements added later. Every detail of colour, light and dark and texture is described by the linework.

In contrast, starting with the formal properties of light and dark seem to result in a painting that is more suggestive. Patterns of light and dark are deployed across the picture plane. The eye is lead through these patterns by, for example, a colour scattered by the areas of light and dark. The linework either disappears into the shadow or is difficult to discern in the brilliant light. The other elements are thus dominated by the element of light and dark.

COMPARING THE TWO PRIMARY CLASSIFICATIONS

'The Arnolfini Wedding Portrait' by Van Eyck	'Las Meninas' by Velasquez
▪ Van Eyck begins the painting with the formal property of line – a line drawing. He continues with the formal properties of colour, then light and dark and lastly texture.	▪ Velasquez begins with the formal properties of light and dark, then follows the formal property of colour, of line and of texture.
▪ Van Eyck begins with a detailed line drawing and the delineation and detail are reinforced with the subsequent addition of the other formal properties. Line thus remains the most important formal property and as a result the figures, objects and background are sharply defined and in focus. The line describes the shapes and detail.	▪ Line is the third of the formal properties employed. The linework is formed through the process of painting. The figures, objects and background appear to be slightly out of focus and not sharply defined. The lines are broken and the outline is subservient to the formal properties of light and dark and colour.
▪ Colour is the second formal property employed. It is, however, dominated by the sharply defined linework. The colour is contained in specific areas by the outline. The colour composition is also carefully balanced and static. For example, the strong red and green in the right hand area of the composition are balanced by a dark brown and black area on the left. This static and balanced composition gives the impression of timelessness.	▪ Colour is also the second formal property employed by Velasquez. However, one is primarily conscious of a play of light and dark on the colour, and the colour is not contained in one area. The red, for example, appears on the cuffs and chest of the infant's dress (which is the strongest lit area in the painting) and also in the decoration on Velasquez's chest, while the artist appears to be in shadow. Therefore the touches of red scattered throughout the composition and in the light and dark areas, lead the eye through the composition and give the impression of movement.
▪ Light and dark are the third properties employed by Van Eyck. They are used to describe the volume and three-dimensional quality of the figures, objects and surrounding space in the painting. The outline of the detail and of the larger shapes is never lost in or broken by the play of light and dark.	▪ Light and dark are the first properties employed. The light and dark are deployed in broad patterns that envelope the figures and objects. Because there is no definite outline, this gives a slight feeling of uncertainty, causing the impression that the figures are either emerging into the light from the shadow or are on the verge of disappearing into the shadow. The image is thus suggestive and the play of light and dark dominates the other elements.
▪ Texture is the fourth property. The application of the paint shows almost no tactile texture. The surfaces of the different materials are carefully depicted and the texture is thus mainly visual.	▪ Texture is also the fourth element. In some areas the layers of paint are applied rather thickly. The painting thus has some tactile quality. The surfaces of the different materials are suggested by loose brush strokes and overlays of light and dark and colour.

(c) Conclusions drawn from the comparisons between the different classifications of paintings with reference to classical and romantic painting

The first conclusion drawn is that the classification of paintings according to the sequence in which the elements are employed, is somewhat problematic. The reason is that making a painting is not a clear-cut process: the sequence can be interrupted and a way of working can be adapted to obtain a specific quality in a painting. Furthermore, extremes of types of painters are rare. However, a preferred way of working does emerge and makes possible a study of specific paintings.

The second conclusion is that the comparison between a painter who commences a painting with a line drawing and a painter who commences a painting with the properties of light and dark, highlights a fundamental difference in approach between the two painters.

If the painter begins the painting with a line drawing, the delineation of objects or figures gives the impression of control and order. The continued interest in the work of Van Eyck by, for example, visitors in museums such as the Louvre in Paris, shows the satisfaction that can be derived when viewing this kind of painting.

If the painter begins the painting with the properties of light and dark, the delineation is not as important as the light and dark patterns. The images become suggestive. Hidden analogies and buried memories are stirred by viewing the images that seem to appear from the shadows or seem to be in the process of receding into the darkness. The viewer tends to project his own emotions and memories onto an image that is not as clearly defined.

The fact that it is possible to vary the sequence of the elements in the construction of a painting, is thus crucial to the eventual emotional response to the painting.

As a conclusion the two different approaches by the painters can be construed as classical and romantic.

The third conclusion is a more speculative than firm conclusion. *"The characteristics of the two different approaches apparent in this discussion, point to a differentiation made in art of any epoch ... at all times some artists have appealed to our emotions by analogies, buried memories or the sensuous use of colour; others have satisfied our need for order and permanence by creating structures or compositions that seem complete in themselves"* [Clark, 1973, p.19]. This quotation describes the basic difference between romantic and classical art. It seems to reflect the difference found also in the work of the painters that do not primarily use the element of line and those that use the element of line to begin their paintings. However, Clark warns that *"often the words classic and romantic can be applied to the same painter. Poussin, as a young man, painted a number of deeply sensuous pictures that can be called romantic; his later work is the epitome of classicism. Some of Rembrandt's greatest works are based on classical construction ... classicism and romanticism in artists of the first rank always co-exist and overlap"* [1973, p.19]. The third conclusion thus points to a connection between line as the most important element in a painting and a classical approach to painting. It also points to a connection between light and dark as the most important properties in a painting and a romantic approach to painting.

The conclusion is thus that the role of the sequential employment of the properties in painting is fundamental. The eventual accent of the specific painting is determined by the sequence in which the properties are employed. The sequence can also be varied to suit either information or the subject. Two elements that seem to exert much influence on the eventual character of the painting, are line and light and dark. Beginning a painting with the property of line points to a

classical approach, and beginning a painting with light and dark points to a romantic approach. A painter will also show a preference for a specific sequence.

Thus painting influences the visual perception of the viewer because the viewer responds differently to different approaches by the painter. The viewer responds to hidden analogies and buried memories when confronted by a romantic painting. On the other hand the same viewer can be influenced by a classical painting to respond to his need for order and permanence. He can perceive the different qualities and interpret them correctly and respond appropriately to the painting's influence on his perception.

5.2.3 An analogy between the sequential employment of the formal properties in a painting and the sequential employment of the structuring elements in visual perception

It is not yet known if the sequence of the integration of the structuring elements of visual perception can be changed or can differ in individuals. Following the previous line of thought whereby analogies were drawn between the characteristics of painting and those of visual perception, the inference is that the sequence of the elements can also be varied in visual perception as it can be varied in a painting. The concept of fractured perception in the theory of perception under consideration, would then explain why a viewer is able to appreciate both paintings that reflect a classical approach and paintings reflecting a romantic approach. If the perception is fractured, the sequence in the perception of the elements can be varied, and the viewer can respond appropriately and firstly to the predominant element. If the dominant element is line, for example, the response will be to the feeling of control and order or a classical approach.

However, one can appreciate various approaches not because of the possibility of fractured perception but because of the human mind's interpretational faculty or faculty to make sense or bind.

If the role of the sequential employment of the properties in painting is definitive, then in the analogy, the role of the sequence of the employment of the properties in a theory of visual perception, will also be definitive. In this argument, the eventual accent of a painting is determined by the sequence in which the properties are employed by the painter. In the theory of visual perception, the sequence of importance of the properties will then also determine the interpretation and accent that the viewer will place on the perceived scene.

In different paintings the sequence can be varied to suit the painter's subject or preference. In the analogy it explains the viewer's capacity to have different and appropriate emotions and experiences as the sequence of important of the elements vary.

A painter would often have a preferred sequence and would perhaps favour a classical approach. However, the viewer in the theory of visual perception could also prefer to respond to information in an ordered fashion rather than to suggestions, but the viewer would be able to vary his response. The viewer would be able to adapt in order to respond appropriately to the circumstances, but he could prefer paintings that are ordered and balanced and can be described to be of a classical nature. A viewer who prefers to respond to suggestions and hidden similarities would still be able to respond to information that is ordered and balanced, but would perhaps prefer paintings that are of a romantic nature.

The conclusion is that the sequence of the employment of the structuring properties in a theory of visual perception, is also definitive as it is in painting. The sequence will determine the viewer's response. The viewer can vary his response to the sequence of the employment of the formal properties in a painting because of the theory of fractured perception. Because of fractured perception he can, for example, respond either to ordered, balanced information if line and delineation are the most important formal properties or to suggestion and hidden similarities if light and dark are the main formal properties.

Although the viewer can vary his response, he would often have a preferred sequence of structuring properties. This can explain why one viewer would prefer a painting that has a classical approach, another would prefer a painting that has a romantic approach, but some viewers would be able to appreciate both a romantic and classical approach.

5.3 THE INFLUENCE OF PAINTERLY COMPOSITION ON THE PAINTER'S VISUAL PERCEPTION

Another attempt to study the influence of painting on visual perception is through a short look at the influence of painterly composition on visual perception. Yet another attempt to come closer to an understanding of the binding mechanism in visual perception can be made through a study of painterly composition. By means of painterly composition the formal properties are deployed in a painting. Analogously, by means of the binding mechanism the structuring properties are deployed in visual perception.

5.3.1 Aspects of painterly composition

In this instance form is the only formal property discussed in relation to painterly composition. It includes the meaning of the arrangement of all the formal properties.

(a) Recreating traditional form in painterly composition

Clark says that the composition should be *"a confluence of memories and emotions forming a single idea and a power of recreating traditional forms so that they become expressive of the artist's own epoch and yet keep a relationship with the past"* (1979, p.10).

Clark cites the example of a Greek vase in the British museum, with a composition showing the burial of a warrior. Clark says

that the form of the burial of a warrior occurred through the ages in painting. Later on, this form was adopted by Christian tradition to represent the burial of Christ. Therefore the basic form of the burial of a warrior has evolved to represent the burial of Christ. The adoption by Christian tradition of this form does not eliminate the original meaning but incorporates it. The traditional form thus evolves and becomes more complex. In this way the 'Pietà Militaire' evolved: the figure of the crucified Christ also having absorbed the meaning of the fallen warrior.

The evolvement of this form enabled the Venetian painter Titian (1488-1576) to paint 'The Entombment of Christ'. In this sense Clark remarks that "*a masterpiece should not be one man thick, but many men thick*" (1979, p.11). Titian had the advantage that his predecessors shaped and adapted the form to incorporate many meanings. Therefore, although a viewer would not necessarily be aware of all the meanings contained in the composition, the form of the fallen man evokes many memories and emotions.

Form in painterly composition is thus not only viewed in isolation but is part of a tradition and as such evokes memories and emotions. The traditional form in painterly composition is recreated and accumulates meaning to be relevant to the artist's own era, and also keeps a relationship with the past.

Therefore in a traditional composition, such as the composition of the fallen warrior, the formal properties of painting are deployed in a recognisable manner. This manner forms a recognisable pattern. This pattern is distorted, varied or adopted with some variation in later forms of this traditional composition. The pattern, however, still remains recognisable.

5.3.2 Conclusion : the influence of painterly composition on visual perception

Firstly, in a painterly composition the formal properties are often deployed according to a recognisable pattern. Therefore, form in painterly composition should not only be viewed in isolation but as part of a tradition. The traditional composition is enriched by subsequent additions. Meanings relevant to contemporary thought are, for example, added to original meanings.

Secondly, the coherence of the composition in painting is often determined by the fact that one aspect (such as the figure of Christ in the example above) determines the deployment of the formal properties in the composition.

In the book 'Human and Machine Vision' DN Perkins states that human visual perception is superiorly adept at recognising pattern. Humans are able to recognise "*things that are only partly visible or considerably distorted ... consider how easy it is to recognize the form of a person in a hydrant, the face of a person in a house, the shape of trees or landscapes in mottled walls, an effect Da Vinci was familiar with and recommended as a means of artistic invention. Such recognitions are not, of course, mistakes. The perceiver is well aware that the human shape in the hydrant or the landscape in the wall is not a real instance. But the recognitions occur nonetheless, and demonstrate the remarkable stretch the human recognition apparatus has*" (Beck, 1989, p.353).

Because human visual perception can recognise a pattern under less than optimal conditions, this could explain why the recreation or distortion of a traditional painterly composition is still recognisable.

The study of the influence of painterly composition on visual perception makes visible those areas at which visual perception is most adept, such as the recognition of pattern and coherence in a composition. The influence of painterly composition on visual perception is therefore to make visible the abilities of visual

perception. (This fact influences the approach to the study of the binding mechanism.)

Analogously, the binding mechanism in visual perception also does not function in isolation. In the chapter on the characteristics of visual perception it is said that the specialised visual areas communicate all the time. Although the separation of the visual signals is maintained, a very extensive network of anatomic links is necessary between the visual areas to achieve integrated perception.

5.4   SUMMARY

In the fifth chapter the study on the artist's role in the development of visual perception centers around the analogous influence of painting on visual perception as circumstances change. Three areas are explored. Firstly only the most essential information is included in a painting to fit the set or circumstances so that nothing will detract from the painter's search for meaning. Secondly, two main sequences can describe different circumstances which correspond to a classical or romantic orientation in painting. Thirdly, recognisable compositional patterns are employed to describe different circumstances.

Thus in chapter five, through the analogy with painting, the influence of changes in circumstance on perception, is the focus. It is also important to note that one can accommodate various visual perceptual approaches and circumstances not because of the possibility of fractured perception but because of the human mind's interpretational faculty or faculty to make sense or bind.

CHAPTER 6

CONCLUSION

6.1   THE AIM OF THE THESIS

The aim of the thesis was to investigate the influence of painting on the painter's visual perception. The problem was to prove causality in other words that painting can influence the painter's visual perception. Picasso's 'Guernica' and Pierneef's rendering of trees served as examples to prove causality. An aspect of the fractured visual perception that is poorly understood, namely binding, was explored through a study of painting and of visual perception to further investigate the influence of painting on the painter's visual perception. To expose aspects of binding in the painter's visual perception, the similarities in the formal properties of painting and the structuring elements of visual perception, were illuminated. Because of the similarities, an analogy was established between painting and visual perception. Aspects of binding in painting such as holistic thinking, sequential employment of the formal properties and painterly composition were analogously regarded as aspects of the binding mechanism in the painter's visual perception.

6.2   THEORETICAL BACKGROUND OF THE THESIS

In order to investigate the possibility of an analogy between painting and visual perception a theoretical overview of the concepts of visual perception and painting was given in chapter one. It was concluded that both visual perception and painting share the same structuring properties.

In order to show the development of the formal properties of painting a historical overview of these properties was given in chapter two.

As the crux of the thesis lay in the theory of fractured visual perception, the historical development of visual perception and of

fractured perception was traced in chapter three as the process of binding in fractured visual perception is poorly understood.

The fourth chapter was concerned with historical contributions to the analogy between painting and visual perception as deduced from chapters two and three. The painter's preference for holistic thinking, the sequential employment of the formal properties in painting and the influence of painterly composition were considered to illuminate aspects of the binding process in the painter's visual perception in chapter five.

6.3   INFERENCES

In this thesis the assumption was made that through a study of painting, the binding mechanism in painter's visual perception, can be explored.

Thus certain analogous inferences can be arrived at through painting, regarding the binding mechanism of the painter's visual perception. This was based on the analogous influences of painting on the artist's visual perception.

6.3.1   Analogous inferences drawn from painting regarding the binding mechanism in visual perception with reference to the viewpoints of Peterson and Goldman-Rakic on the binding mechanism

As stated earlier, because visual perception is fractured there is always a process of integration. The process of integration poses the problem of binding. Two questions arise from this problem. Firstly, how do the specialised areas of the brain manage to work together so smoothly? Secondly, are the activities of the specialised areas co-ordinated by a central area or through a distributed network?

Two viewpoints were quoted earlier.

Firstly, Steven Peterson supports the viewpoint of "*a localized region or a small number of localized regions where perceptions, memories and intentions are integrated*" (Horgan, 1993, p.16). This can be described as a 'central office'.

Secondly, Patricia Goldman-Rakic supports the viewpoint of "*a non-hierarchical model in which separate but equal partners are interconnected, communicating with each other*" (Horgan, 1993, p.16). This can be described as a 'distributed network'.

Goldman-Rakic and Peterson both agree that, in their research to establish whether the different components of perception were relayed to a central zone, they again encountered subdivision. They expected areas of the brain that handle short-term memories to be a central zone or integrator. But in their separate experiments they established that for example, one part of the brain handles short-term memory that requires invention and another handles tasks that have become automatic. They agreed that memory was subdivided not only according to content, but according to function.

Both researchers try to establish a central region in the brain through imaging technologies. They are searching for a specific location where binding takes place and the question that they ask is what the binding mechanism is. They base their viewpoint on the physical areas of the brain that are engaged when specific short-term memory tasks are performed.

The shortcoming of this approach is that they cannot establish characteristics of binding mechanism through this route. They can only try by trail and error to discover the location of the integrator in the brain and the function through which it operates such as memory. Therefore, their viewpoints are not tested against some characteristics of the binding mechanism in visual perception. The question that is asked in this thesis is: what are the characteristics of the binding mechanism in artist's visual perception? Because this thesis is based on a product of visual perception, namely painting, in which the elements are integrated, the characteristics of the binding mechanism in painting can be explored. The

viewpoints in the thesis are tested against characteristics of the binding in painting and analogously in the painter's visual perception.

In the previous chapter possible influences of painting on visual perception were considered. Characteristics of the binding mechanism in visual perception were derived from painters' preference for holistic thinking. Also, an analogy was drawn between the sequential employment of the formal properties in a painting and the sequential employment of the structuring elements in visual perception. Lastly, the influence of painterly composition on visual perception was considered.

The influences mentioned of painting on the painter's visual perception can be referred to in order to draw inferences from painting, regarding the questions posed and the different viewpoints held, in connection with the binding mechanism in visual perception.

The aim of the following paragraphs is to try to establish which of the two viewpoints (the viewpoint of Peterson or of Goldman-Rakic) is supported through the analogy with painting.

6.3.2 Inferences drawn, through analogy, from holistic thinking in painting regarding the binding mechanism in visual perception

Holistic thinking in painting implies that, from diverse sources, a coherent whole is established in the finished painting. Often cross-references seem to fill in areas of which less is known. Also, superfluous information is left out because integrating the information to form a whole is more important in painting than the separate fragments of information. The order of preference for types of information does not seem to be of importance in holistic thinking.

Goldman-Rakic's viewpoint, that in binding in visual perception, separate but equal partners are interconnected and communicate

with each other, is not supported by holistic thinking in painting. Holistic thinking in painting points towards a hierarchical model. This could imply having a structure against which the importance of information is measured to be integrated or left out. Holistic thinking in painting points towards the integration or deletion of diverse and more or less important information into a coherent whole, while fragments of information are constantly measured against the whole.

Peterson's view of a localised region where perceptions, memories and intentions are integrated is supported by holistic thinking in painting.

6.3.3 Inferences drawn, through analogy, of the influence of the sequential employment of the formal properties in painting, on the binding mechanism in visual perception

The sequential employment of the formal properties in painting implies that the formal property that is employed first, exerts the most influence on the orientation of the painting. The painting can have a classical or romantic orientation. Paintings which commenced with an accurate and detailed line drawing, thus first employing the formal property of line, tend to be ordered and balanced and to reflect a classical orientation. In contrast, paintings which commenced with the formal properties of light and dark tend to reflect a romantic orientation.

It was concluded earlier that the sequence of the employment of the structuring elements in visual perception is analogously as definitive as it is in painting. Just as the sequence will determine the painting's orientation, the sequence will determine the viewer's response. However, because of the theory of fractured perception, it is analogously presumed that the viewer can vary the sequence of perception. The viewer can respond to ordered and balanced information if line is the most important formal property. But he can also respond to suggestion and hidden similarities if light and dark are the main formal properties. It is therefore presumed that

the viewer can vary his response to be appropriate to the information as it is presented, but also that the viewer would have a preferred sequence of the structuring elements.

Goldman-Rakic's viewpoint does not say anything about sequence. Two primary classifications, which could also be subdivided into four main classifications, again favour Peterson's viewpoint which tends to be more hierarchical.

Analogously, the two orientations can therefore be interpreted to support a "*small number of localized regions where perceptions, memories and intentions are integrated*" (Horgan, 1993, p.16).

Again Peterson's viewpoint is supported by the sequential employment of the formal properties in painting, rather than Goldman-Rakic's viewpoint.

6.3.4 Inferences drawn, through analogy, of the influence of painterly composition on the binding mechanism in visual perception

Two aspects of painterly composition are considered in order to determine the influence of painterly composition on visual perception. The first aspect is that traditional form in painting evolves and is continually recreated in painterly composition. The formal properties are thus deployed according to a basic pattern. The second aspect is that coherence in painterly composition is created through the fact that one formal property or grouping of formal properties determines the deployment of the other formal properties in painting.

The first aspect of painterly composition points to the superior visual perceptual ability of humans regarding pattern recognition.

In the examples of the 'Pietàs Militaires' of Titian and Giotto, the use of traditional form or the recreation of pattern and the coherence in painterly composition, are influences which can

predetermine aspects of the deployment of the formal properties in a painting.

As the formal properties can be deployed in a painting with reference to existing patterns, analogously the structuring elements in visual perception can be fitted to previously perceived patterns which could be part of the binding mechanism. The existence of pattern recognition as part of the binding mechanism supports Peterson's viewpoint that a region or small number of localised regions exist where perceptions, memories and intentions are integrated.

Pattern recognition does not support Goldman-Rakic's viewpoint of a non-hierarchical model because the pattern would be more important than the separate elements, therefore again favouring Peterson's hierarchical model.

6.3.5 Conclusion: Analogous inferences drawn from painting support Peterson's viewpoint of the binding mechanism in visual perception

Analogous inferences drawn from strategies in painting (such as holistic thinking, sequential employment of the formal properties and pattern in painterly composition) support aspects of Peterson's viewpoint of the binding mechanism in visual perception, rather than Goldman-Rakic's viewpoint.

However, as in painting, some information is more important in visual perception than other information. Therefore, some visual perceptual region could contain strategies to determine the hierarchy, such as the visual perceptual equivalent of the painterly strategies of holistic thinking, sequential employment of the formal properties and pattern in painterly composition.

Therefore in the analogy with painting Peterson's viewpoint on the binding mechanism in visual perception is favoured.

6.4   CONCLUSION

This thesis concludes that Peterson's viewpoint of the binding mechanism or integrator as a central office is supported by the analogous characteristics gleaned of binding through a study of painting. However, this view of binding is only relevant to binding in the artist's visual perception.

Furthermore, this thesis concludes that from the three characteristics of binding in the painter's visual perception, the following function of the integrator in the painter's perception emerges: the integrator overrides lesser detail that does not contribute to appropriate visual perception.

Therefore, firstly the integrator overrides detail that does not contribute to holistic thinking. It overrides detail in preference to the whole.

Secondly, it overrides personal preference in the sequential employment of the formal properties in favour of an appropriate response. Suggestion and hidden similarities or order and balance require different responses.   The integrator overrides to elicit the appropriate response.

Thirdly the integrator overrides variations in traditional form to allow recognition of a pattern.   Thus the integrator overrides to allow recognition of a pattern.

The conclusion of the thesis is therefore that the integrator in the painter's visual perception is an active central mechanism that prefers or chooses, elicits or draws out and allows or lets happen in order to arrive at an appropriate response.

6.5   CONTRIBUTION

The contribution of this thesis is to describe through aspects of painting characteristics of the binding mechanism in painter's

visual perception. The aspect of painting to emerge consistently throughout this thesis, is termed here the sequential employment of the formal properties. This sequence determines the romantic or classical orientation of a painting. The two strategies of the sequential employment of the formal properties, favouring either light and dark or outline, was introduced into painting by classical Greece. This thesis contends that the dichotomy between the two strategies are still apparent in painting and is as fundamental as the invention of the formal properties of painting in prehistory. The invention of the formal properties is echoed in the fractured nature of visual perception and the invention of the two strategies echoes the viewer's interpretative ability to vary his perceptual response according to the circumstances. This variability emerged as a primary characteristic of the binding mechanism in the painter's visual perception throughout history. In this way this thesis can answer the question: what is binding in the painter's visual perception? The answer is that binding is a variable response and makes possible interpretative ability.

This thesis supports the theory of fractured visual perception as it is analogously encountered in painting. The contribution of this thesis is towards an enhanced theory of fractured visual perception that states that the binding mechanism is variable in the painter's visual perception.

The particular contribution of this thesis as far as the artist is concerned, lies in the analogy that can be drawn between physiological visual perception as a consequential visual happening and the consequential construction of a painting.

6.6 CLOSING REMARKS ON VISUAL PERCEPTION, MEMORY AND INTENTION AND THE PAINTER

The same eye that sees is the eye that paints. But the difference between the painter's visual perception and ordinary perception, is the painter's intention. The painter uses his visual perception to seek meaning.

The tools that he employs to give concrete expression to this meaning are the formal properties of painting. Thus for instance a painting of grass is recognized as such not because the formal properties duplicate reality, but because of the viewer's interpretative ability.

Although painters employ the same formal properties the individuality of each painter cannot be ignored. Many issues influence the painter and cause each painter to arrive at a unique result. Therefore issues such as the environment, each individual's background and experience will exert a specific influence on each painter.

Furthermore, visual perception cannot take place without a process of creating order. The painter orders his perceptions along pictorial lines.

The painter also refers to memories during the process of perception and creating order. An important part of these memories are other paintings. Art produces art: the painter refers to other paintings and uses schemata from these, according to Gombrich, to aid his perception and create order in his perception. Thus the painter perceives and orders to give concrete expression through the use of the formal properties. However, by implication, the painter can only interpret his perception from his frame of reference through the constraints of his time. Leonardo da Vinci is regarded as an extraordinary figure because he seems to defy the constraints of his time.

The order that is created through the historical accumulation of knowledge is disrupted by Da Vinci's drawings of, for example, a helicopter. Helicopters only became a reality in the twentieth century whilst Da Vinci lived from 1452 until 1519. But knowledge usually has an historic accumulation.

From Peterson's viewpoint perception centers around memories and intentions. The accumulation of knowledge and experience

through the centuries form part of the vast store of knowledge through which perception is interpreted. But knowledge advances all the time. When advances in knowledge occur the spiritual perception changes and traditional depictions of reality are not valid anymore and do not match the new perception of reality. In this way Gombrich's theory of making and matching can be understood. The painter John Constable (1776 - 1837) can serve as an example. In Constable's time the tradition was to use the colour brown for the depictions of grass. When Constable used green to depict grass he broke with tradition. Thus the spiritual perception with which he studied nature did not match that of tradition. The changed intention with which he perceived nature changed his perception of nature to match the spiritual perception. Thus his perception was influenced by and contributed towards the historic accumulation of knowledge.

The personal ability of the painter also reflects an accumulation of experience and an advancement of perceptual ability takes place throughout his lifetime. It is a personal progression.

Thus painting and the painter's visual perception in the twentieth century are the product and result of a history of diverse influences. Twentieth century painting was initiated by Impressionism which was based on scientific research into the properties of colour and colour perception. Scientific research was therefore drawn into the realm of painting. Scientific research changed the spiritual perception of reality and then the visual perception of the painter. New visual possibilities were captured in painterly expression.

The painter takes trouble with visual perception and seeks meaning through his visual perception. He is more sensitive to visual perception than the casual viewer and his contribution is often in being open to and in introducing new influences into visual perception through painting.

Thus the painter will continue to contribute towards the historic accummulation of knowledge. This thesis contends that visual perception as capterued by the painter in a painting, can contribute

towards and influence research into, not only the painter's visual perception, but visual perception.

BIBLIOGRAPHY

ARNHEIM, R. 1986. New essays on the psychology of art. Berkeley: University of California Press.

BASILE, G. 1993. Giotto: the Arena Chapel frescoes. London: Thames and Hudson.

BEVERIDGE, W.I.B. 1979. The art of scientific investigation. Third edition. London: Heineman.

BORNSTEIN, M.H. 1988. Developmental psychology: an advanced text book. Second edition. Hillsdale New Jersey: Earlbaum Associates.

BRONOWSKY, J. 1973. The ascent of man. London: Joseph Causton & Sons Limited.

BROWN, H.I. 1977. Perception, theory and commitment, the new philosophy of science. Phoenix edition 1979. Chicago: University of Chicago Press.

BRUNO, V.J. 1977. Form and colour in Greek painting. London: Thames and Hudson.

BUETTNER, S. 1981. American art theory 1945 - 1970. Michigan: U.M.I. Research Press.

CARERI, B. 1989. Physicists and painters: the similar search for meaning. Leonardo, 22(1):113-115.

CIRLOT, J.E. 1962. A dictionary of symbols. Translated by J. Sage. Second Edition. London: Routledge & Kegan Ltd.

CLARK, K. 1979. What is a masterpiece? Hampshire: Webb & Sons.

CONLEY, B.G. 1985. Theories of pictorial representation: Goodman's relativism and the similarity theory. PhD-dissertation, University of Minnesota.

CORNSWEET, T.N. 1970. Visual perception. New York: Harcourt, Brace, Jovanovich.

CLARK, K. 1973. The romantic rebellion, romantic versus classic art. London: Murray.

CUMMING, R. 1995. Annoted art. Cape Town: Human and Rousseau.

DE KERCKHOVE, D. 1981. Brain frames, technology, mind and business. Utrecht. Van Lindonk Special Projects.

DESIGN EDUCATION FORUM CONFERENCE. (1994: Technikon Orange Free State Bloemfontein).

DHANENS, E. 1980. Hubert and Jan van Eyck. New York: Alpine Fine Arts.

DIXON, J.P. 19.. The spatial child. Illinois: Charles C. Thomas.

DOERNER, M. 1949. The materials of the artist and their use in painting with notes on the techniques of the old masters. Translated by G. Niehaus. London: Hart-Davis.

EATON, M.M. 1988. Basic issues in aesthetics. Belmont: Wadsworth.

Eye movement: cognition and visual perception. 1981. Edited by D.F. Fisher. New Jersey: Lawrence Erlbaum.

FOCILLON, H. 1989. The life of forms in art. Translated by C.B. Hogan. New York: Zone Books.

GOMBRICH, E.H. 1977. Art and illusion. Fifth edition. London: Phaidon.

GOMBRICH, E.H. 1993. Gombrich on the Renaissance. Volume 3, The heritage of Apelles. Second edition. London: Phaidon.

GOMBRICH, E.H. 1993. Gombrich on the Renaissance. Volume 4, New light on old masters. Second edition. London: Phaidon.

GORDON, I.E. 1989. Theories of visual perception. Chichester: John Wiley and Sons.

GREENBERG, C. 1955. Henri Matisse (1869 - 1954). Amsterdam: Collins.

HAAK, B. 1969. Rembrandt: his life, work and times. London: Thames and Hudson.

HALE, N.C. 1980. Abstraction in art and nature, a program of study for artists, teachers and students. New York: Watson-Guptill.

HARTEN, J. & HEINZ, M. 1984. Anselm Kiefer. Düsseldorf: Städtische Kunsthalle.

HAYES, C. 1978. The complete guide to painting and drawing techniques and materials. Oxford: Phaidon.

HEATON, J.M. 1986. The eye, phenomenology and psychology of function and disorder. London: Travistock Publications.

HINTON, G.E., PLAUT, D.C. & SHALLICE, T. 1993. Simulating brain damage. Scientific American, 269(4), October:58-65.

HORGAN, J. 1993. Profile: Marvin L. Minsky. Scientific American, 268(5), November:14-15.

HORGAN, J. 1993. Fractured functions. Scientific American, 269(6), December:16-17.

HORGAN, J. 1994. Particle metaphysics. Scientific American, 270(2), December:71-78.

HUGHES, R. 1989. Velasquez's binding ethic. Time, 134(15), October:68-69.

Human and machine vision. 1989. Edited by J. Beck. Orlando: Academic Press.

ITTEN, J. 1970. The elements of colour. Translated by E. van Hagen. New York: Van Nostrand, Reinhold.

KHATENA, J. 1984. Imagery & creative imagination. New York: Bearly Limited.

KITSON, M. 1969. Rembrandt. London: Phaidon.

KNOBLER, N. 1971. The visual dialogue. New York: Holt, Rinehart and Winston.

KNOX, I. 1936. The aesthetic theories of Kant, Hegel and Schopenhauer. New York: Columbia University Press.

Les grands peintres et leur technique. 1980. Edited by W. Januszczak. Translated by C. Lahanier. London: Q E D Publishing Limited.

LINDBERG, D.C. 1976. Theories of vision from al-Kindi to Kepler. Chicago: University of Chicago Press.

LIPPARD, L.R. 1981. Ad Reinhardt. New York: Harry N Abrams.

LIVINGSTONE, M. & HUBEL, D. 1988. Segregation of form, colour, movement and depth: anatomy, physiology and perception. SCIENCE, Volume 240:pp. -

LOWENFELD, V. & BRITTAIN, W.L. 1987. Creative and mental growth. New York: Macmillan.

LOVEJOY, M. 1989. Postmodern currents: art and artists in the age of electronic media. Michigan: Umi Research Press.

MAYER, R. 1991. The artist's handbook of materials and techniques. Fifth Edition. United States of America: Viking.

MERLEAU-PONTY, M. 1964. The primacy of perception, and other essays on phenomenological psychology, the philosophy of art, history and politics. Evanston: Northwestern University Press.

MURRAY, P. & DE VECCHI, P. 1967. The complete paintings of Piero della Francesca. Middlesex: Penguin Books.

NEETHLING, K. 1993. Creative people can perform miracles. Clubview: Benedict Books.

NEETHLING, K. 1995. Interview with Dr Kobus Neethling, Pretoria, 15 March.

NEETHLING, K. 1995. Interview with Dr Kobus Neethling, Pretoria, 19 May.

NIERENBERG, G.I. 1986. The art of creative thinking. New York: Simon & Schuster Inc.

Pablo Picasso: A retrospective. Edited by W. Rubin. 1980. London: Thames and Hudson.

Philosophy looks at the arts. Edited by J. Margolis. 1987. Third edition. Philadelphia: Temple University Press.

PIGUET, J.C. 1988. Some philosophical aspects of creativity. The creative mind. Edited by C.S. Findley and C.J. Lumsen. London: Academic Press, p.131.

POLLITT, J.J. 1974. The ancient view of Greek art: criticism, history and terminology. Student Edition. London: Yale University.

RADITSA, L. 1989. Academic questions. Spring 1989, vol. 2, no.2, p.37.

REDFERN, H.B. 1986. Questions in aesthetic education. London: Allen & Unwin.

Six children draw. 1981. Edited by S. Paine. London: Academic Press.

SKIRA, P. 1989. Still life: a history. Translated by Jean-Marie Clarke. New York: Rizzoli.

The dictionary of art. 1996. Edited by J. Turner. London: Macmillan.

THE METROPOLITAN MUSEUM OF ART. 1994. Guide. Second Edition. New York.

THE OXFORD ENGLISH DICTIONARY. 1989. Edited by R.W. Burchfield. Second Edition. Oxford: Clarendon.

THE OXFORD REFERENCE DICTIONARY. 1986. Edited by Joyce M. Hawkins. Oxford: Clarendon.

TODOROV, T. 1982. Theories of the symbol. Translated by C. Porter. Oxford: Blackwell.

TREVOR-ROPER, P. 1988. The world through blunted sight. London: Viking.

TWITCHELL, B.H. 1983. Cézanne and formalism in Bloomsbury. Michigan: U.M.I. Research Press.

<u>Visual culture, images and interpretations.</u> 1994. Edited by N. Bryson. Hanover: University Press of New England.

WATTS, H.A. 1980. <u>Chance: a perspective on Dada.</u> Michigan: U.M.I. Research Press.

WHITE, J. 1956. Perspective in ancient drawing and painting. society for the promotion of helenic studies. Supplementary Paper number 7. London.

WÖLFFLIN, H. 1958. <u>The sense of form in art.</u> New York: Chelsea.

ZEKI, S. 1992. The visual image in mind and brain. <u>Scientific American,</u> 267(3), September : 43-45