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LIGHT AND COLOUR DYNAMY: THE BASIS OF VISUAL AND PERFORMATIVE DESIGN

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ABSTRACT

This paper articulates the fundamental currency between theatre arts on the one hand and plastic/visual arts on the other Although a very common assumption about the phrase, theatre arts, is that it is all about drama. But this paper draws attention to the flaw in this misconception and shows that the term refers to several other 'arts' of which drama is merely one. Although drama is part of the 'arts' of the theatre, so also are arts such as painting, sculpture, textile/costume design, scenic design etc, which are fine arts but inseparably subsumed in the practice of performance delivery. Theatre arts, then, is a composite of plastic/visual and performative arts of which light and colour are fundamental currencies. The paper then provides such understandings of the fundamental dynamics between light and colour in the specific context of visual design

KEYWORDS: Light, Colour and Visual Design.

INTRODUCTION

Performative or theatre design generally resides in the domain of visual or plastic arts As a term, visual/plastic art refer to a broad rang of allied specialized areas grouped separately as fine arts and applied arts. Fine arts include painting, sculpture, architecture and the arts of the theatre, while applied or industrial arte include graphics, textiles, ceramics, metal works interior/exterior decoration, fashion design, jewellery design etc 'Creative arts' is the umbrella term for describing all of these arts. In common parlance 'theatre arts' is often and glibly understood as the art of drama. The sweeping import of this is that all the arts subsumed within 'theatre arts' are all 'drama' Ogumor's (1993:1) insinuation, for instance, of a synonymous relationship between 'performing arts' and 'theatre arts' is dubious. For in all practical terms, 'performance' is just an aspect of the arts of the theatre While the dramatic element in a film for instance is performance, the elaborately designed, sculpted and painted set for the same film is pure plastic/visual arts. And although dramatis personae are rightly performers, artists that pull-off scenic and other designs like costume and makeup design are fine artists in every sense of the term In that respect the phrase, theatre arts, will then be a composite that describes the union of fine arts and performing arts. Between fine arts and theatre arts therefore, the relationship is symbiotic in very inseparable terms. Fine arts come in the service of theatre and theatre constantly provides avenue for fine arts' services. More than the relationship between these two inseparable professions, the one critical and technical denominator of both is the fundamental factor of visual perception – the dynamy between light and colour For light and colour are the fundamental bases for the perceptual processes of sight, design and artistic appreciation. Toward a sustainable strategy for the development of design in Nigeria, practitioners in allied fields like theatre arts, engineering, architecture etc, need to effectively understand and appropriate visual principles of creative perception long harnessed by fine arts. And the most basic of these principles bother on the dynamics of light and colour For light and colour are the bases for the production and consumption of visual design. The vital point is for designers of whatever leaning to understand colour and light as critical tools in the business of effective visual communication For, light is the onerous factor that produces "the sensation of sight" (*Light* 406) This paper is then purposed to provide such understandings of the fundamental dynamics between light and colour in the specific context of visual design.

Light

John Marburger has reviewed the concept of light extensively, and in a way that provides a crucial background for the conscientious visual artist or designer (2002). He writes that light is an energy form visible to the human eye and radiated by moving charged particles. In behaviour, light is often particle-like (when it is called photon) or wavelike (when it is called electromagnetic wave). Unlike natural waves such as those on water, light requires no medium, in which to travel. Traditionally, 'light' refers to the range of frequencies visible to humans (Marbuger 2002) And, both the sensation of colour and intensity of visible radiations depend upon the temperature and nature of the surface of the emitting source (*Light* 406). Visible light is just a small part of the electromagnetic spectrum (*Electromagnetic* 2002). This spectrum consists of gamma rays, hard and soft X-rays, ultraviolet radiation, visible light, infrared radiation, microwaves and radio waves – in order of decreasing frequency. Each different visible light frequency causes our eyes to see a slightly different colour And white light (as from the sun) is a mixture of all the visible colours in different proportions In the context of design, these attributes of light enable the designer to manipulate what the audience can perceive of any type of creative work – visual, performative, industrial or otherwise.

Sources of Light

In terms of how they provide energy to the charged particles, sources of light differ When the light comes from heat, the source is incandescent. but when the energy comes from other sources (like chemical or electric energy), the source is luminescent Hot atoms collide with one another in an incandescent source. Candlelight is incandescent, as is the house bulb whose filament heats by the passing of electric current Incandescent sources have colours that are related to their temperature. hotter sources having more of blue and cooler sources more red. About 75 percent of the radiation from an incandescent light bulb is however infrared, unperceivable by the human eye without instrumentation (Marburger 2002).

Luminescent light sources are usually cooler than incandescent sources because they absorb energy in forms other than heat Their colour is therefore not related to their temperature The florescent light is a luminescent source. The tubes are coated with phosphors on the inside and filled with

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mercury vapour Current in the tube excites the mercury atom to emit blue, green, violet and ultraviolet light. The electrons in phosphors atoms absorb the ultraviolet radiation and then visible light with lower frequency is released. Phosphorescent materials can glow in darkness several minutes after exposure to strong light. When chemical reactions produce the light the source is chemiluminescent, as with fireflies and some deep-sea fish. Light behaves in two categorical ways (1) how it interacts with matter and (2) how it travels These two distinct behaviours of light are critical for all forms of visual design

Interaction of Light with Matter

Light interacts with the atoms of any material it strikes Denser materials tend to slow down light more than less dense ones (Marburger 2002). Light travels at the speed of 299,792,459 meters per second (about 186,000 miles per second). Non-transparent materials either absorb light or reflect it. In absorbing light, the material heats up since the energy of the oscillating electrons are retained. Optics is the term for the study of light's behaviour In interacting with materials light behaves in three crucial ways refraction, reflection and scattering

Refraction is the bending of light rays as it passes from one type of material into another The speed of light is different in different materials Thus light changes speed at the boundary between the two materials (Marburgar 2002) Different light frequencies also travel at different speeds in materials Thus each colour of light bends at different angles as it passes from one substance into another This is why we see a colourful spectrum as sunlight is passed through a glass prism

Reflection happens when light hits the boundary between two substances If the beam hits the boundary at an angle, it is reflected at that same angle When light reflects from a flat boundary (as in between air/lake, air/glass) it forms a mirror image And depending on the curvature, curved surfaces will reflect and focus light into a point, a line or onto area

Scattering happens as atoms of any transparent material are lumped and bunched up, rather than being smoothly distributed over a distance. As it were, air molecules scatter sunlight in the atmosphere, making the sky bright Higher frequency and shorter wavelength of light scatter more than lower frequency and longer wavelengths This then makes it possible for a designer to pre-conceive how he wants an audience to see a particular artistic representation By employing refraction, reflection and scattering properties of light in illuminating a work of art, moods, feelings and ideas can be suggested and effectively manipulated in the audience

How Light Travels

Although most phenomena suggest that light waves travel in straight lines, and artists have also come to accept it as such, it is not quite true (*Light* 407) For the diffraction of light is a demonstrable fact in the laboratory But for design purposes, it is usually enough to assume a general direction of projected light Christiaan Huygens demonstrated three dimensional light wave motions in 1678 He suggested that light travels in an envelope of several curved wavelets that touch other curves This explains the fact that light does spread away from a pinhole rather than beaming in a straight line through the hole. It is the same reason why shadows have blurred edges (Marburgar 2002). When light waves travel, they experience interference and diffraction Wavelength and frequency are two characteristic quantities associated with wave motion. Wavelength is the distance between two corresponding points on successive waves, while frequency is the number of waves passing a fixed point in unit time (see fig 1)

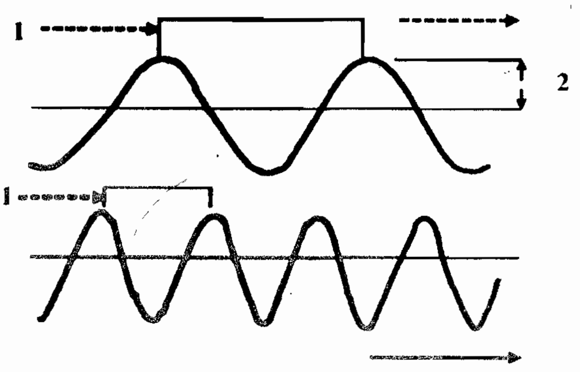

Fig. 1. Characteristics of Wave Motion. 1 Wavelength 2. Amplitude, or maximum displacement from mean value. Wavelength equals velocity divided by frequency, hence halving wavelength doubles frequency (bottom).

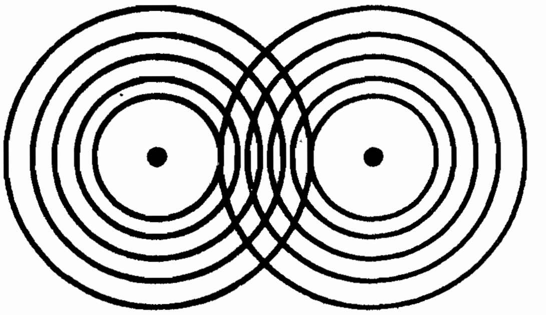

Fig. 2 Interference. Trains of waves radiating from two point sources interfere when they impinge on one another.

When two waves overlap, there is said to be interference (Marbugar 2002). That is, waves interfere when they radiate from two points (see fig 2) and then impinge on one another (Light 407) 'Interference' is the reason why thin films exhibit colours – as with when gels are placed in front of two light sources, and the gels' colours interfere to give the scene designer a different colour over the scenery.

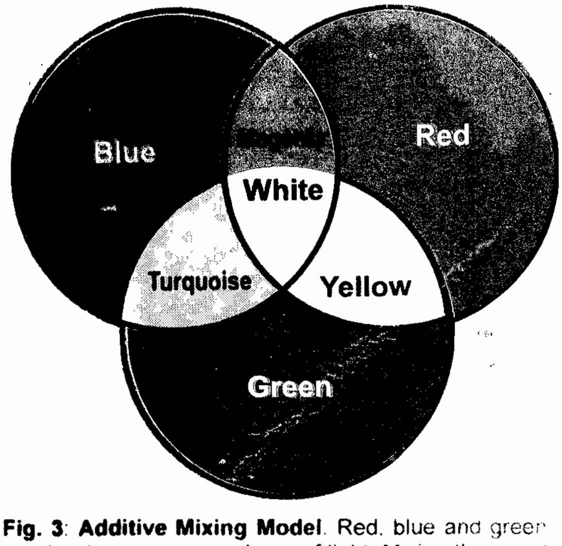

Fig. 3: **Additive Mixing Model**. Red, blue and green are the three primary colours of light. Mixing these will achieve any desired colour within the visible spectrum

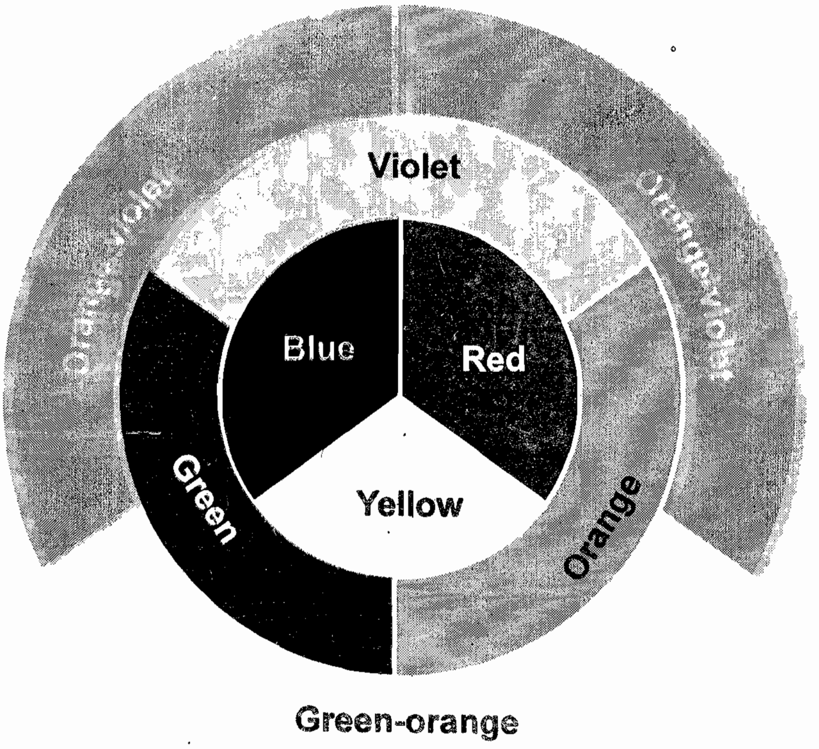

Fig. 5: The Colour Wheel. This is a simple illustration of the range of subtractive colour mixes. There are three inscribed circles in this diagram. The innermost circle contains the primary colours red, yellow and blue. These mix to produce the secondary colours as obtained in the central circle orange, green and violet. In turn, secondary colours mix to give tertiary colours green-orange, orange-violet and green-violet Note the progressive similarity between the colours in the tertiary range Complimentary pairs are red/green, orange/blue and yellow/violet

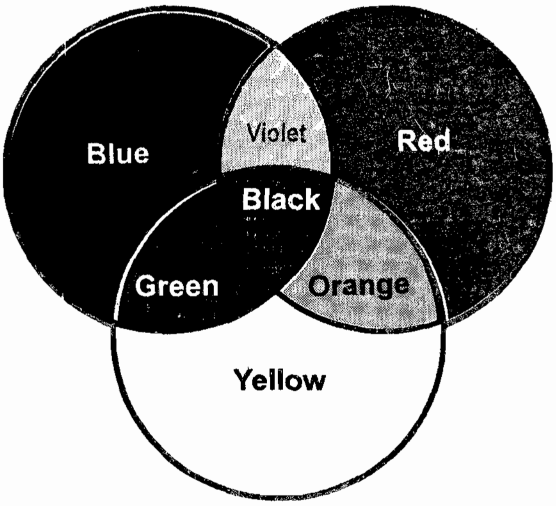

Fig. 4: Subtractive Mixing Model. With red, yellow and blue, a designer can replicate the chromatic quality of anv visible colour.

)iffraction refers to the spreading of light wave as it passes ırough a small opening or around a boundary. Diffracted ght exhibits fringe patterns. As light waves stream from a slit nto a screen, the beam will consist of overlapping wavelets om different points in the slit's opening. Because of the ifference in distances of the wavelets from different parts of ıe slit, they interfere and form a pattern of light and dark egions on the spot upon which the light strikes. (Marburger 002)

Colour

From the foregoing, it is clear that white light is really the combination of all the visible colours referred to as spectrum. Colour is a physical phenomenon of light (*Color* 2002). And unlike other design/artistic properties like size, shape, distance, texture, movement etc colour is experienced through the sense of vision (*Colour* 1973). Colour is also the quality by which we can distinguish between one uniform visual area and another. Hue and saturation are the two qualitative differences of physical colours, while the quantitative difference is brightness (brilliance or intensity). These three qualities are also the variables of perceived colour. The way colours appear can be described and ordered in terms of these three independent variables

Hue refers to the similarity between colours in a cyclic series that range from red, yellow, green, blue. purple and back to red. Chromatic colours have hues that can fit at some point on this series (e.g. greenish yellow, flesh pink tobacco brown etc). Black, white and grey have no hue at all and are called achromatic colours.

Saturation describes a chromatic colour's position on a radial series in terms of its distance from the nearest achromatic colour. It is the difference of any colour from grey (*Colour* 181). White, grey and black have no saturation. The more brilliant or vivid a colour is or the farther away from neutral (white, grey, black) it is the higher its saturation. Chroma on the other hand is the distance of a colour from grey, taken as the amount of colourdness. When a scene is dimly lit (or when an object is in a shade) the saturation of its colour remains the some but its chroma is reduced. This is because the object then appears less colourful.

Brightness describes a colour's position in a vertical series on a scale form lighter to darker Light is thought of as something that travels through space and shines on objects to make then visible. Thus the more light floods, the brighter every thing looks around us.

Colour, Contrast and Harmony

Light, colour and harmony are critical fundamentals of visual design. In the specific context of lighting and colouring the sharpest contrasts in combination are achieved when complimentary colours are used. Complimentary colours are two colours that lie diametrically opposite each other on the colour wheel (Andrewes 1979). Examples are red and green; yellow and purple; blue and orange. Colours are grouped into cool, warm or cold (neutral) colours. Cool colours include blue and shades of green. 'Warm' colours range from yellow-green to red, while black and white are said to be 'cold' colours.

Colour harmony refers to the pleasing combination of colours in a visual design (Ajibade 1999). Colours can be combined in shades, tints, tones and intensities of various degrees. A shade of any colour is obtained by the addition of some amount of black pigment. When this is done, an entirely new hue is produced. For example, when we mix some quantity of black pigment with some of red pigment, we get a shade of red which is called brown. This brown is another hue in its own right, that is, it is a new 'colour' A tint of a colour is obtained by the addition of some amount of white pigment. When this is done, a new hue is produced too e.g. mixing some amount of white with the same red pigment, we get a tint of red which is called pink. A tone of a colour is derived by mixing of grey pigment to that pigment. Intensity refers to the brightness or the dullness of a colour.

Importance of Colours and Symbolism in Design

The importance of colour in visual design cannot be over emphasised. Colour serves as a means of identification communication. Each country of the world is identified by its flag which carries its national colours. For example, the Nigerian flag is green-white-green and the colours of the defunct Nigerian Airways, as a national airline, was reflective of the national colour as a means of establishing the nation's identity. In the interpretation of Nigeria's flag, for instance, green is vegetation (life), white is peace.

People have their own colour preferences and their related meanings. To some, black is beautiful whereas to others, black is only worn as a sign of mourning. Children like bright colours. This accounts for why children's cloths and toys are always made in bright colours.

Yellow and red are colours of fire and denote warmth or heat, as against the blue of shadows and white of ice. In the same vein a lady in blue has, by this colour alone, quite a different effect from a picture of a woman done in tones of red. The expression "scarlet woman" gives us the symbolic meaning of the colour, scarlet. A colour can symbolise two rather opposite meanings. For example, while blue means piety as in the "halo" of saints in religious pictures, it could also symbolise vulgarity as in "blue jokes" and "blue films". Also, life is often depicted as green (vegetation) while a person is often said to be "green with envy". Although a few examples have been given in the foregoing, it should however be born in mind that it is the specific design context that ultimately determines the interpretative meaning of colour For just as the writer has poetic license the designer also has spectral license. As, for instance, the lighting of a performance scenery is both subject to the interpretations of the director and the conceptions of the scene designer. It is therefore the alignment of the action's meaning, the director's interpretation and the scene designer's conception that determines the overall visual meaning in a performance setting.

Although we have outlined realistic design interpretation above, it is pertinent to note that abstractions are also common in the actualisation of visual design. A great artistic problem of our time is to come to terms with abstract visual rendition. The experience of the abstract presupposes, in the artist, a particular mental or spiritual attitude, which is fundamentally the same for all branches of the visual arts including architecture, film and the plastic arts. It is only the means of expression that differ, the nature of the experience is of a particular kind and is often equally expressible in drawing, painting, sculpture and performance. What then is abstract? It is derived from a Latin word meaning "drawn out" or "extracted" (from objective reality). The abstract is conceived of as unreal, conceptual and only thought (Ajibade 1999). These thoughts can be conceived and perceived in visual, plastic and performance modes.

Principles of Colour Application

Colour is a sensation caused by the eyes' response to different frequencies of light waves. Elizabeth Andrews is conclusive that the "colour of light is additive" (Andrewes 1979: 129). This means that the three primary colours of light (red, green and blue) when beamed together, in equal intensities, add up to white (Colour 2002, Andrewes 1979). Any colour sensation can be achieved by mixing varying quantities of red, green and blue these are the additive primary colours (fig. 3). The mixing of these primary colours result in white light (Parker and Wolf 1996).

On the other hand, an object's colour is subtractive (Andrews 1979). This is because the colour the eye perceives on an object depends on the rays that are reflected rather than those absorbed by the object's surface. A red object has a surface that absorbs all other colours in the light and reflect only 'red'. Subtractive primary colours – red yellow and blue – are also called pigment primaries (*Colour* 2002). They can match practically every hue when mixed together in the right amounts An equal mix of these pigment primaries will produce black (fig. 4). The offset (lithographic) printing process is an example of the mixing of subtractive primaries. In this process the CMYK (Cyan [blue], magenta [red], yellow and black) colour separation principle is used to produce four individual plates of an image in each of these colours. When the impression is made – when all four plates are pressed unto paper – it results in a photographic replica of the original image. The colour wheel (figure 5) illustrates the range as can be derived from pigment primaries (or subtractive primaries). The inner circle contains three primaries; the outermost circle contains tertiary colours; and the central circle holds the secondary colours (orange, purple and green). Two primaries mix to give one secondary, and two secondaries mix to give one tertiary. Mixing a primary and a secondary or a secondary and a tertiary will give you an intermediate colour

Colours that lie diametrically opposite each other on the colour wheel are referred to as complementary colours. Each pair of complimentary colours has a noticeable relationship of sharp contrast (Andrews 1979, Ogumor 1993). This property in colour relationship is particularly useful in design considerations for creating contrast in a theme Thus complimentary pairs include red/green, orange/ blue and yellow/ purple.

From the foregoing, it is very clear that light, visibility and colour are prime factors in both the natural environment and in the principle and practice of visual arts and performance arts. Whereas light is what enables visibility, colour (in its many shades) is what gives form to matter For, *shade* is the interaction between light and the obstruction caused by matter. Since, more or less, light waves travel straight, light tends to strike matter in proportions corresponding to the angle at which the object's parts deviate from the direction of the light's source. And, the darkness of any shade is equal and opposite to the intensity of the source of light. Thus, each part of an object receives a different amount of light – resulting in various degrees of shade – which in turn adds solidity or threedimensionality to visibility. Whether light and colour are considered in the context of visual or purely scenic design, scene lighting or fabrication, what is crucial is for the artist or designer to be more than familiar with the light/colour dynamics highlighted in the foregoing discourse. For, while the "average person" makes colour choices on a subconscious level, the artist/designer makes these same choices on the conscious and deliberate level (Parker and Wolf 1996:403). More than this perhaps the successful designer will have to understand light and colour as the foremost tools (requisites) in the business of visual communication. For colour is not just a property of light – it is vehicled in light. And, light and colour dynamic is the basis for sight, perception and visual design. Thus, the need for designers to properly understand this criticality in terms of properties, characteristics, symbolisms and manipulability, in the overall context of visual design.

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