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## Cubic optical paradox

### Abstract

*It is said that the perception of the image of the environment and our interactions with it define us. However, an image could be seen differently depending on where it is located. Some questions concerning how we see have been raised: How do we see? How does connectivity come about through viewing or seeing? How do we see what we see? and how do we interpret what we see? The process of seeing establishes many connections between ones past and present and this reconciliation is necessary for better appreciation and interpretation of objects being looked at. The aim of this project largely pivoted on how we look at objects as observers as well as the various relationships that exist between objects being looked at and the observer. The project further explores the optical effects and how it relates to what we see, and consequently making cubic representations to express these relationships. Coloured paper cubes were created as the building blocks of this project. From it, eleven (11) relief sculptures were created with each possessing distinct visual qualities guided by certain visual principles including the Gestalt laws of grouping as well as Aristotle's laws of association. The findings revealed that, the position of an object has an effect on how it is seen and every change in position can cause a change in the visual perception of that object. The environment of an object, which refers to the immediate surroundings of the object being observed, has an effect on how it is seen.*

### Introduction

'We don't always see what is really there' (Cherry, 2010). This statement by Kendra Cherry suggests that, seeing may be a complex process than can be imagined. One part of the statement suggests that when observers look at objects, there are certain attributes of the object that are hidden from the observer. In other words, those attributes are more paradoxical in nature, meaning they may not be easily seen until after a closer observation or repeated looks. However, it can be argued that, a lot of things happen in the process of seeing which observers take for granted and for which we seldom give recognition to. One of these is that, seeing could be considered as a window through which the past reconciles with the present (Carol, 1999). It does so by connecting objects that are seen or being seen to past knowledge of that object acquired through a set of experiences. This suggests that, observers are surrounded by sets of experiences, or better still are imbued with sets of experiences, which make them look at things the way they do. Just as experiences have their effects on our 'seeing', the environment also plays a very vital role in seeing. The environment may refer to all the elements that play a role in seeing and may refer to the physical environment around an object being seen (Carrol, 1999; Cherry, 2010).

Almost everybody is an observer at a point in time and we tend to set our gaze on certain objects at various points in time. As we do this, a lot of factors come into play before we are able to see what we see. It must be noted however that, we do not see everything in the same way; as a matter of fact, two (2) people may

be looking at the same thing but will be seeing two different things when asked to express what they see. This shows that, vision is a much complex phenomenon which we usually take for granted. This situation of different observers seeing the same thing differently is sometimes deliberately created by artists in their works. Contextually, this would be explained as optical effects. Hence, the focus and central theme of this project is to identify relationships between how we see and what we see by using similar units, specifically cubes, as the objects of our gaze. Furthermore, the project explores connectedness (network) and its effects on what we see and how we see what we see.

### **Understanding Seeing**

It is known that without light, seeing (vision) is impossible. For instance in a very dark room where there is not even a ray of light, one cannot identify for instance a coloured object. On the other hand, in a broad daylight, one can easily see the object. This could be linked to the fundamental light theory. This is because when light falls on a green object for instance, it is seen as green because the object absorbs all the colours in the light except the colour green which it throws to the eye in the form of rays (Bryan, 2010). These rays enter the eye through the pupil which can be located in the middle of the iris when the eye is being looked at from the front. The pupil directs the rays through the lens to the retina where images are formed however; the retina converts the rays into nerve pulses (stimuli) and sends it to the brain for interpretation. It must be noted however that the retina works by means of photoreceptors, which play a major role of relaying the type of light (colour) entering the eye to the brain through the retina. This is because the brain cannot interpret rays but can only interpret stimuli from various parts of the body therefore the retina converts the light rays to the 'language' the brain can understand. This looks like a very simple process since all these processes occur within a matter of split seconds however it involves a whole lot (Bryan, 2010).

The brain acts on what it is fed with, therefore any obstructions along the feeding process could affect the interpretation. Some of these obstructions could even be fatigue cells in the visual system. Others could even be misapplied knowledge or misleading visual principles (Gregory, 1974). In addition, all the visual action occurs within the Field of View (FOV), which could be explained simply as that part of the environment which the eyes can capture at a time (Gregory, 1974; Bryan, 2010). In other words, it is that frame which presents us with a portion of the outside world at a time. For humans, our horizontal FOV is almost 180°, which means that we have a wide platform to see at a time and this is where focusing becomes necessary (Bryan, 2010). The Spotlight model, as described by Eriksen and Huffman (1972) explained visual focusing by three terms known as Margin, Fringe and the Focus. The margin could be explained as the frame of the field of view (FOV) which separates what is seen from what is not seen at a time. This means that, anything within a particular environment and outside the margin cannot be seen by the observer. The fringe is also the area which is available to the viewer but is not the main point of attraction. Therefore, the fringe becomes the observable field around the main focus which is available to the viewer because of the wider field of view but is not the main point of attention. The focus however is the main point of attraction which receives all the necessary attention from the gaze. It must be quickly added that the focus can easily be changed at any point in time, which means that a point in the fringe could be the focus in a matter of seconds. A perfect example is the act of reading, for instance, as you read this, your focus keeps changing from word to word. This is what the spotlight model entails and if artists are able to control and direct their attention in appreciating a piece of work, they may understand it better.

### **Visual Perception**

Understanding however is based on visual interpretation which is facilitated by the brain. For visual interpretation to be complete, the mind most of the time, fills in some parts assumed to be missing or not seen. This is what Eriksen and Huffman (1972) referred to as Visual perception. For instance, when one looks at a ball behind a door, though part of the ball is hidden behind the door, we still perceive it as a ball because we have probably seen a ball before and so we assume that the other half of the ball is there behind the door, so the mind fills in the missing variables for interpretation to be complete. When one is playing a guitar, the mind once again fills in the missing parts and does its own interpretation, as a person playing a guitar and not a hand. This is perhaps why Pearson and Kosslyn (2013) described visual perception as

seeing with the mind's eye, which is also referred to sometimes as Mental imagery. The examples above is typically a perception based on past experience since it may be quite difficult for a person who has never seen a guitar to interpret the stringed part of the image as a guitar. Gregory (1974) describes retinal images as merely elements of art; lines, shapes, contours, colours etc, however, for there to be an interpretation, visual perception must be applied. This is an interpretation related to the Amodal perception which is credited to two (2) psychologists, Albert Michotte and Fabio Metelli (Breckon and Fischer, 2005).

The amodal perception also suggests that the part of the object being looked at which is visible to the retina represents the whole. Therefore, if one sees only the tail of a whale in an ocean, it is perceived as a whale and not just as a shape in water. This perception could be likened to the literary device 'synecdoche' which means representing the whole with its part. An interesting example is a statement like "she now has many more mouths to feed" which means that there are a lot more people who now depend on her for daily bread, or better still, for survival. In the sentence above, human beings are being represented with parts of their body which in this case is the mouth. In the same way, when only a part of a ball is seen and the other part is occluded by say a door as seen earlier, it is still considered as a ball and not as a semi circle as may be thrown unto the retina. Visual perception is most of the time based on past experience and sometimes certain laws of seeing (visual laws) affirm these. These laws sometimes complete and give their interpretation to what we see. One of these sets of visual laws is the Gestalt principles (laws) which were developed by German psychologists around the late 1900s (Humphrey, 1924). The core of the principles posits that the brain, in an attempt to interpret the retinal feed, organizes the visual elements into unified wholes (groups) when certain principles are applied suggesting that the whole is greater than the sum of its parts. Due to this, the brain has the tendency of anticipating a whole even when the parts are not integrated or complete and hence the idea of Reification and Emergence. Reification is a more generative property of the gestalts principles, in that, it tends to perceive more than is available to the eye (Sternberg, 2003)

### **Gestalt Principles and Seeing**

The gestalt principles are also known as gestalt laws of grouping. The first of the gestalt principles to be discussed here is the principle of similarity. This principle states that objects being observed which are similar in nature are likely to be seen as one. The similarity could be in any form; colour, shape, size etc however, the brain is likely to interpret them in groups. Another principle is the principle of proximity which posits that objects closer to each other are likely to be seen as a group than objects far apart. Yet another gestalt principle is the principle of closure which has been mentioned earlier. This principle explains that the mind is likely to fill in the visual gaps to make the retinal feeds complete and much easier to interpret. Pearson and Kosslyn (2013) also explains that the brain is conditioned to store items in groups, which means that similar items are likely to be stored in one group. For this reason, any other object which looks like the one already stored is likely to be compared for resemblance and if the resemblance is there, the brain perceptually fills in the gaps as it tries to interpret the physical retinal feed to resemble the stored item for easier storage and query.

The next gestalt principle to consider is the principle of continuity, which states that elements of objects being observed which seem to be moving in a particular direction will be seen as a group and will continue to do so irrespective of overlapping. All these gestalt principles explained are rules that consciously or unconsciously affect our visual perception as we observe objects in the field of view. Though these principles were developed by astute psychologists and have been in existence for long, they have been criticized by Gregory (1974) stating that the gestalt principles only describe what happens but does not explain why that happens. He goes on to describe the gestalt principles as misleading rules. Again, he says that when these principles are misapplied, they cause the objects to be mis-seen. In other words, the mind gives wrong interpretations to the retinal feeds given to the brain when these principles are wrongly applied and this is what results in optical effects. He sums it up by saying that illusions are as a result of errors in seeing or errors of perception. This means that, illusions could be created by deliberately breaking some of these principles.

### **Seeing and Optical Effect**

When optical effect is mentioned our minds quickly slip to visual effects in film technology which involves adding after effects to already shot scenes. However, the term 'optical effect' has come to mean more than just visual effects in film technology and the eye interacting with light and colour. It has now more or less come to mean the interpretation the brain gives to what the eye sees which may be different from what really is, as Kendra Cherry puts it; 'we don't always see what's really there' (Cherry, 2010). Imagine walking down a Museum aisle, a man turns to look at collections behind him and almost immediately runs to prevent a statue from falling only to realize that the falling statue has been like that for over a decade. In actual sense, it had been created to possess and portray a sense of a fall. Day in and day out our eyes deceive us in one way or the other; perhaps, our minds rather misinterpret what we see. For instance, one looks at a picture and exclaims "I like his glasses!" only to realize that the image in the picture being looked at has no glasses at all. Some of these scenarios encountered day in and day out, confirm that the brain sometimes interprets things in its own way which may not necessarily be what is. These may be because of Optical effects. This explanation however applies to exactly what the eye sees and not what the eye perceives since the perception of this image is that the sizes of the boxes are the same however there is a sense of depth at the middle right side of the pattern. Beside Bridget Riley, whose works have been known to possess characteristics of optical effects, Akiyoshi Kitaoka's works also depict visual illusion as a result of certain techniques he employs. His work titled 'Rotating Snakes' possesses a strong sense of motion when observed carefully. It is made up of varied sizes of circles, which have been arranged such that the entire composition consists of circles that are made of circles.

Istvan Orosz, another visual illusion artist, also has various ways of expressing his visual effects. A look at his work titled 'Crossroads' reveals that he was inclined towards geometry and Mathematics by reason of the accuracy of his planes and the kind of symmetry in his works.

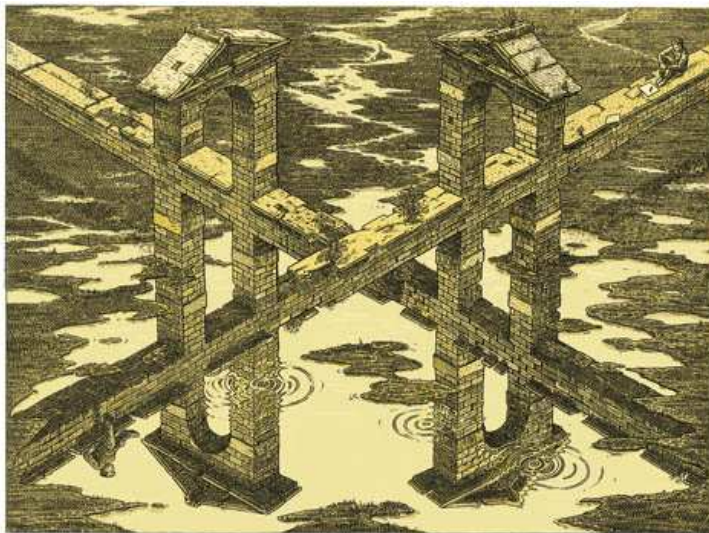


Figure 1: Istvan Orosz, *Crossroads*, 1999, Copper plate etching (photo by: Keresztut)

Source: [http://www.artnet.com/artists/istvan-orosz/crossroads-oLxghll\\_HsUV5bYYwzx1EQ2](http://www.artnet.com/artists/istvan-orosz/crossroads-oLxghll_HsUV5bYYwzx1EQ2)

In Istvan's work (Figure 1), there is an interplay of 'visual confusion' which even makes the work more engaging in that the viewer tries as much as possible to understand what is happening in the picture. In the picture, the two bridges with the arc seem to be reflecting in the seemingly water-filled foreground and at a point the reflection becomes the real image while at another point, the real image becomes the reflection. Indeed, optical effects have been explored by a lot more artists and may not be an entirely new area, however, its further exploration may facilitate further discoveries and this has necessitated its employment in this project. For the reason that optical effect, is basically perceived with the eye, the look or gaze of the

viewer becomes very important. Whenever there is a gaze, there is concentration of attention on the subject. Chandler (1998) categorizes attention of a gaze into four (4). These are Reciprocal attention, Divergent attention, Object-oriented attention and semi-reciprocal attention. In the context of the project, Reciprocal attention is when the object being looked at mutually returns the attention to the viewer. This means that the attention is evenly distributed. Divergent attention on the other hand is when the attention of the viewer is not on a particular subject or component but rather on various subjects within what is being looked at. The third, object-oriented attention, is where the attention of the viewer is on a particular component of the object being looked at. In other words, it is only a small part of the object being looked at which receives all the attention. The last, Semi-reciprocal attention, is when the attention of the viewer is on a particular component of the object being looked at which also directs the attention to another component which also redirects the attention once more to another component of the object being looked at. In other words, the attention does not stay on a particular object or component but moves round.

Visual system simply refers to all the elements which play a role in the process of seeing including the eye and all its tissues as well as the object itself and the light being thrown on it (Brofman, 2004). This involves the various categories of the gaze and visual perception. Thus, some interpretations the brain gives to various images and objects the eye sees may not really be what it seems. This means that perception and sensation may not necessarily be the same. Sensation in this context refers to what the eye sees whereas perception refers to what the brain sees, which may not necessarily be the same as what the eye sees. Both sensation and perception have a role to play in the creation and understanding of optical effects. Clearly, optical effects are usually created on purpose to achieve various outcomes. Some of these are created by simply employing various principles of design and applying them in unique ways to the work. As the project sought to explore what we see and how we see what we see, cubes were used as the building blocks to explore the theme and to explore the possibility of creating optical effects. The next few paragraphs now take a look at the cube and its journey over time.

### **The Cube**

The power of Geometry in art cannot be overemphasized. It is the bedrock of artistic expressions and the mother of all forms in art, be it painting, sculpture or architecture (Ivins, 1946). The cube is a perfect example of a polyhedron which could be explained as any three dimensional (3D) geometric solid which has flat surfaces and straight edges. The cube has six (6) flat surfaces and twelve (12) straight edges making it also a polyhedron. Secondly, the cube also falls in the category of platonic solids since it is a regular polyhedron with congruent faces and has the same number of faces which meet at the vertexes. It could be used to build anything even if a rounded form is desired. Since a cube can connect with another cube easily on any of its sides, it makes the cube very receptive and adaptive too. Again, because of the special characteristics the cube has, one can have a very compact art piece if so desired and one can also have not so compact art forms if so desired. Again, mounting cubes is quite an easy task since any of its side can rest on the floor, wall or ceiling. The cube, being a fascinating object was explored in this project just as an artist like Sol Lewitt also did.

The works of Sol Lewitt possess characteristics of the minimalists' art movement. His works are very fascinating to watch though they are very simple geometric shapes. His *Pyramid* possesses characteristics of echo phenomenon, in that, the bigger square at the base diminishes gradually into smaller ones with the only difference being that it rises to the top as it diminishes. Though his works are quite simple, they raise many questions and are very interactive. The cube has been an intriguing object for art creation and many artists have employed it in their works. Various art movements employed cubes, geometric shapes and cubic ideas in their works. Cubism, spear headed by Pablo Picasso and Georges Braque made use of geometry and Mathematical rules in creating masterpieces which were not completely abstract pieces but were gradually veering towards abstraction (Cottingham, 2004). They opened up the various objects they wanted to represent in their works and rearranged them following mathematical rules of basic geometry. Another unique technique they employed was that after opening up the objects in their work, they represented them from various viewpoints instead of one. This opened up the subject for more discussion by viewers. Sculptors of the time also reduced their works to basic geometry and planes which also resulted

in a similar effect as the cubist paintings. For instance, a look at Alexander Archipenko's *La Vie Familiale*, would reveal that the sculptors of the time were not left out in the cubism movement. The idea of cubes connecting and in relationships were explored in the execution of the project, thus bringing on board the concept of networking. Here, cubes are joined together at various points according to particular arrangements.

Networking in terms of connections is involved with many fields of study and art is no exception. Networking here has to do with connectivity and associations, which could be tangible or intangible. Aristotle's set of laws of association is a point to consider with regard to this research. Like the gestalt law of proximity, Aristotle's laws of association explain the relationship between various objects and how they come about. For instance, the law of contiguity is related to the laws of proximity which implies that objects which are close together are usually seen as one (George Boeree, 2000). In other words, such objects are grouped as one. Again, his law of attention refers to exogenous attention and not endogenous attention since the point of attraction is from the object being observed and not from within or to, the observer. This is where the top-down processing and the bottom-up processing come to play. The top-down processing of attention refers to the observer deliberately making a conscious effort to look at an object over the other, and it is more endogenous. The bottom-up processing of attention is however the exogenous type of attention where the object being observed itself demands the attention by being out of the norm (Posner, 1980). This could be where optical effects are experienced, in the sense that some artists deliberately make use of optical effects to draw attention to the work.

#### **Materials, Techniques And Methods**

The approach for this research embraces a process from the choice of materials, the process, techniques and methods used in developing four main works depicting *Cubic Paradox*. The titles of these works were *The Weave*, *Infinity*, *Reflections of Falsehood* and *Inside Out*. The idea behind these titles were towards creating works that explore how we see and what we see. With the topic in mind, the thought was to adopt an approach of "play" with the tints and shades of certain colours but in a very deliberate and carefully planned manner to depict some of these visual laws, and of course having networking in mind. The various works used for the practical artistic expression of the project included relief sculpture pieces using cubes made of paper. This confirmed the fact that materials could have multiple uses in art. If paper could be used to achieve the effects desired, it is good enough for use (Scott, Abbott and Trosset, 1995). In this work, cartridge and eggshell papers were the main types of papers used. The project took into consideration various colours since optical effects could be associated with colour as well. It experimented with various colours to ascertain varied optical effects that could be obtained, taking cognizance of various colour types and theory including analogous colours, complementary colours, warm colours and cool colours among others. Again, the colours were selected based on their ability to attract attention, redirect attention and reduce attention. Since the project involved using specific coloured cubes, some already coloured papers were purchased and the rest were manually painted. White cartridge paper painted using acrylic paints, with the help of assistants. Acrylic paint was chosen over oil because after trying oil on the cartridge paper, it was realized that the colours become dull upon drying especially the tints of the cool colours. The acrylic paints did not show those characteristics and therefore they were chosen over oil paints.

They were painted to the desired colours which were: red, yellow, green, blue, orange, red-orange, yellow-orange, powder green, purple, pink, light pink and light yellow. The making of these cubes could be likened to producing items in the factory where a product goes through several stages. In this vein, while I was painting the various sheets of papers, the first assistant dried them in the shade ensuring that they were well laid on the drying panels. They were not dried in the sun because after a couple of trials, it was realized that the coloured Papers were warping after drying them in the sun. The second assistant collected the dried papers to the folding and cutting unit. At this stage, there were twelve assistants helping with marking, folding, cutting and gluing of the cubes.

Three-quarter (3/4) plywood was cut according to these measurements; 1.5", 2", 2.5" and 3" all squared. These were then used as patterns for marking out the measurement on the coloured papers using HB pencil.

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While marking out, allowances were left on the sides of the measurement to be glued to form the cube. This means individual sheets were cut and joined to form the six (6) surfaces of the cube that measured 1.5”x 1.5”, 2”x 2”, 2.5”x 2.5” and 3”x 3”. After marking out, folding was done using a long rule. This was then followed by cutting of the edges of the folded sheets to ensure easy gluing and joining. The next stage was gluing using a synthetic adhesive popularly known as 99 (it is a type of leather glue) on the wings of the squares to be joined. This was left on a table for some time to dry before the various parts were joined together to form the cube. After this, the cubes were grouped according to their colours and packed to be used for the project. Four ply wood boards were purchased and each one was cut into two equal halves. Using acrylic paint, the various surfaces of the boards were painted, depending on the design to be created on them as seen in Figure 2. The cubes were arranged and later glued on these boards to reflect the four main themes for the project. The works capturing the four main themes of *The Weave*, *Infinity*, *Reflections of Falsehood* and *Inside Out* were then exhibited



Figure 2. Varied coloured boxes created, photo by Josephine Adu Boakyewaa



Figure 3: preparing the plywood for work (photo by: Enoch Nkansah)



### **The Weave**

Each of the plywood had a length of eight (8) feet (240cm) and a height of four (4) feet (120cm). The idea for the production of this work was to create an illusion of what is but in actual sense, is not. Black and white strips (like the zebra crossing on the street) were painted on the plywood appropriating the game draft. These colours were arranged in slanted strips of orange, dark green, red, light green, yellow-orange, light yellow, pink, deep blue, deep yellow, blue-violet, powder green, wine and sea green revealing “black and white” patches of the board using varied colours of same sizes of 6”squares, thus, giving equal spacing as the draft game (Figure 4). After arranging the cubes on the board, they were then taken one after the other and glued by applying glue to the board and then to the base of the cubes. It was left for some time to dry a little before sticking permanently. This stage was time consuming because care and patience was needed to avoid messing the surface that would be revealed. Viewing the work at a glance, one would think that, the blank spaces of the board are cubes but in actual sense are not.



Figure 4: Arranging the cubes before gluing, *The Weave* (photo by: Enoch Nkansah)

### **Infinity**

“Are you trying to draw the infinity sign?” a national service personnel asked when he went through preliminary sketches for the project. The researcher’s attention was drawn to that possibility which was not an initial idea. So then, why not maintain the sketch which at a glance, one would think of the infinity sign but on a second look, may not be. The design was then drawn on the board with the aid of a pencil. The colours Orange and Powder Green were chosen after several experiments using 1.5”to 4” square cubes as seen in Figure 1.6. After deciding on the colours, they were then arranged on the support without gluing first as usual just to give room for positioning corrections. With the aid of 99 adhesive, the cubes were glued one after the other until all were joined to the support.

### **Reflections of Falsehood**

“Reflections of Falsehood”, was the most difficult of all the works in terms of production since more specific cubes and excessive time was required. At a point, the work had to be paused for some time and continued later because the researcher had run out of cubes. The main rationale for this work was to test how same colours would behave on the same colour background and how same colours would behave on different backgrounds if their background colours were interchanged. The idea was to interchange backgrounds but this time not with a straight line but perhaps with a curve or possibly joining two curves to form a design that looks like a fan but at the same time interchanging their backgrounds. In this regard, two colours were chosen; Pink and Blue –Violet. Firstly, the board was divided into two equal halves vertically. The first half (section) was painted all pink background. Using an HB pencil, the fan shape was then drawn on the other side (second section) giving four different sections on this area. The first Column of the second



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section and its opposite were painted with blue –violet and the remaining and its opposite were also painted with pink colours. With the aid of a pencil, the fan design was drawn faintly on the first section that was painted with an all pink colour. Cubes were then arranged on the board according to how the background had been drawn but this time around, interchanging the colours. In this regard, with reference to the second section (interchanged colours), areas which were painted pink had blue – violet cubes arranged on them: whereas blue- violet areas had pink cubes arranged on them. Though the same designs were used for the first sector (all pink background), this time around pink cubes were mounted on pink background and blue –violet cubes on pink backgrounds as well. Cube sizes were varied ranging from one and half inches (1.5”) to four inches (4”) square. After arranging works accurately on the board, it was carefully taken and glued to the background without altering the design. This process was continued until the whole design was attached completely to the background. The work was then covered with a black polythene bag to avoid the work trapping dirt.

**Inside Out**

This work used both echo and wave phenomena interchangeably and the colours of the cubes were deep blue, light green, pink, light green, and wine as seen in Figure 31. The sizes of the cubes started from 1.5” to 6” for each of the colours chosen. The first set was done with deep blue and just as the colours for the work had been stated, it continued in that manner. In this vein, the first lane started with 6” cubes through to 1.5”. It then started to rise from 1.5” to 6” cubes again giving a “valley” shape. The second set of the design using light green actually started from the smallest cube (1.5”) through to six inches (6”) the largest cube, and then started to diminish from 6” through to 1.5”, giving an “arc” shape. These rise and fall design was repeated interchangeably. The only difference was to change the colours to achieve the desired optical effects. Again, these cubes where arranged unglued until finally glued to the background after the final design had been arrived at.



Figure 5: *Infinity*, (photo by: Josephine Adu Boakyewaa )

*Cubic optical paradox*



Figure 6. Josephine Adu, *Reflections of Falsehood*, 2013, paper on wood (photo by: Josephine Adu Boakyewaa )



Figure 7. Josephine Adu, *Inside Out*, paper on wood (photo by: Josephine Adu Boakyewaa )

### **Results and Discussions**

The various works created were put together in exhibitions. For the exhibitions, wooden stands were designed and used for mounting the works. The stands were painted with white acrylic paint and the works screwed unto them, after which they were arranged for exhibition as seen in Figures 8.



Figure 8: Exhibition at KNUST museum (photo by: Josephine Adu Boakyewaa)

There were lots of ideas which were suggested by various observers who had their own ways of appreciating the works. Some observers thought that the works looked like play items for educational purposes. One observer actually said that the boxes for the works looked like Froebelian gifts. Indeed, they were not wrong in that assertion in that the Froebelian gifts consisted of various shapes for play with cubes being part of them. Some observers felt that they resembled textile designs, referring to the work titled 'The Weave' as resembling a table cloth. Some people felt that the works resembled fabric patterns which were represented three dimensionally.

From afar, the colours look joined diagonally, representing a diagonal network of cubes though all the cubes were arranged horizontally on the boards. The cubes behave this way because of the similarity in colours and not necessarily similarity in arrangement. This sends one's mind onto the plain weave in textiles which has a weave pattern of 'under-one-over-one'. Indeed, it was becoming evident that the exhibition could have passed for a textile exhibition however, the concentration this time was on optical effect. An observer saw the work titled 'Reflections of Falsehood' (Figure 6) and asked whether the pink boxes had the same colours or different shades. He commented that, the different background upon which they had been pasted made them look different. Indeed, it was that effect which was in mind while that particular work was being done. A careful observation of the work revealed that this work possesses some of the visual properties and theoretical positions in visual perception. The gestalt principle of similarity can easily be associated with this work. In the work, there are strips of cubes arranged in a zigzag form with varied cube sizes. Again, as the cubes move on the continual zigzag path, the colours change. Upon a glance at the work, an observer sees five (5) groups of boxes with different colours. This confirms the gestalt grouping principle which says that objects with similar characteristics are grouped together by the brain as it interprets the visual stimuli from the work.

Again, after another careful look, one realizes that the law of contiguity which Aristotle developed as part of his laws of association is inherent in the work. Though the zigzag strips change colour along the path, they are still seen as a continuous strip. However, one noticeable occurrence here is that the law of similarity seems to overpower the law of contiguity in the work. In other words one easily notices the groups because of the colour changes more than the fact that they move in continual strips. These notwithstanding, the gestalt law of proximity is also inherent in the work. This is because, though individual cubes have been joined to form the strips, they are considered not as individual boxes but as continuous strips. All these are exogenous factors that affect this particular work when it comes to its visual analyses. Interestingly in addition to all that said, there is a colour optical effect in the work as it is observed closely. Looking closely at the work, perhaps without blinking, one would realize that the colours

which meet at their boundaries sink into each other. This is to say that there is optical colour mixing in there which passes for an optical effect.

For instance, the small boxes at the boundary of the yellow group and the ones at the boundary of the orange group as I observed them, tend to mix into each other at the boundary where they meet. With this, the side of the orange group that meets with the yellow group looks hotter than the side that meets with the powder green group. This is because from a distance, the orange seems to absorb the colour yellow at the boundary where they meet, affecting at least the small boxes at that boundary. The significant aspect of this is that in reality, the colours do not mix into each other; however, by reason of the interpretation given by the brain based on what the eyes fed it, it looked quite different from what actually was. This optical effect was achieved by the manipulation of colour which is part of the first objective. It must be noted that, the entire work exists on networking since every cube identified in the piece could be connected to another. The second piece which was titled "Wisdom Knot" is made up of boxes which were arranged such that they portrayed individual cells of various colours, specifically, blue and green.

An observation of this piece reveals that the law of association is evident, specifically, contiguity plays a role in this piece. The top all-blue zigzag strip as well as the similar one down exhibits this principle much more than the others. Again, the law of association has naturally grouped some members of the network as one group. For instance, the inner green cells on the left side of the work appear grouped together, with the main reason being the principle of similarity. The green colour of the boxes in that area has resulted in that group. Again the Principle of proximity plays a role in the work too. Just like the green boxes on the left, the ones on the right also appear grouped however, the two groups of green boxes do not appear as one group and this is because of the law of proximity. That is because I realized there was a cell of blue boxes in between the two groups of green boxes and this caused the separation between the two groups. If this is so, then it is possible to discontinue connectivity with change of colour. Again, the principle of continuity could also be seen in the piece. One would realize that the eye is able to follow the strips of cubes which have been arranged even though there are some intersections at various points. A distinct feature about this piece is that the left part of the piece looks far away from the background whereas; the right part looks closer to the background. In other words, the left background looks receding because of its lightness (tint) making it move away from the cubes while the right background, because of its shade looks coming close to the cubes. This effect was achieved due to the way the background colour was treated moving from a shade of blue and gradually progressing into a tint of the same blue.

The work which is titled "Inside Out" consists of cubes of various sizes which are arranged to possess a certain kind of harmony. This harmony portrayed perspective in various directions upon careful observation. This work also possesses the principle of proximity where objects which are close together are seen as one group. Carefully looking at the work, though all the boxes are not joined together, they are seen as a group of various colours which are basically in strips. Again, the principle of continuity plays a role in the work in that; there are strips of various colours which are close by each other however, the eyes follow each other without mixing them together. This is as a result of the principle of continuity. One would realize that, it is much easier and feels much comfortable to observe the work in the strips form than to mix them up. Also, the powder green cubes were arranged from small cubes to bigger cubes towards the middle and then back to small cubes towards the end. This gives a sense of two point perspective towards the ends. The other cubes by their arrangement were the opposite of the green cubes in that they were arranged from big cubes through small cubes and back to big cubes. This also portrayed a sense of one point perspective at the middle. The first impression created by the colours is that the green cubes are not immediately noticed upon looking at the piece. In other words, the green cubes attract less attention upon first observation. The other cubes are quite conspicuous and slightly attract more attention than the green cubes. The irony about this whole effect is that the green cubes are more than all other cubes in terms of number however, it attracts the least of attention. After I looked at the piece at a closer proximity and then at a much further one, I realized there was an interesting visual perception going on in the work. Though none of the cubes were physically joined together, they behaved as if they were, and their disjointedness was not

easily noticeable at all. This made me aware that, networking could exist by physical connectivity (physical attachment) or by 'false' visual connectivity (perceptual attachment).

This piece upon careful observation has similar characteristics as Patrick Hughes' Reverspective works. This is because his works are basically to do with exploration on pyramidal surfaces which has a connection with perspective. His compositions are usually pictorial with forms which depict perspective. The most fascinating quality about his work is that the parts which are farther away in the composition are really the parts that are really closer to the viewer in reality. That is how come the name 'Reverspective' in that the perspective, though represented perfectly, is in reverse. A typical example is his work titled 'Vanishing Venice' which shows high rise buildings arranged linearly with spaces between them.

The "Reflections of falsehood", also exhibited optical colour effects. With this, the design and colours on the left side of the work is the same as the ones on the right however, the colours look quite different when observed carefully. Specifically, the pink cubes on the left look quite deeper (greater colour Intensity) than the ones on the right side even though they are made up of the same colours. This was due to the fact that the pink cubes on the left were pasted on a light purple background which was darker than the pink background on which the pink boxes on the right were pasted. The pink background absorbed the pink cubes on them making them look less intense as compared to the ones on the left side of the work though the colours of the cube are the same. This created a colour optical effect where observers were not so sure whether the colours they were looking at were the same colours or different ones (Figure 6). This piece was given the title 'Reflections of falsehood' because the expected reflection on the left is not the same as that on the right though the designs are the same, and this is where falsehood comes in. Again, the work exhibits the principle of proximity, in that, the cubes appear in groups mainly due to the fact that they have similar colours close to them. For instance one pink cube has other pink cube quite close to it therefore, the brain interprets them as a group other than as individual cubes. Additionally, the work exhibits principles of continuity since the elements of the work are seen in a particular direction and are observed as such without interference from the other groups of boxes.

The work "Infinity" was composed of orange and powder green on a yellow background as seen in Figure 5. From an observation from a distance, the green appears slightly more conspicuous than the orange basically because the yellow background absorbs part of the intensity of the orange since orange is made up of yellow and red. Again, when an observer moves the head towards the shoulder on the left side, the curves at the ends rotate in a clockwise direction and vice versa. This effect is also caused by the positioning of the cubes. With regard to the principles, the principle of continuity is seen in this work since the cubes are easier seen as continuous strips of elements other than just a cluster of boxes. The visual perception induced is a group of continuing strips of cubes, which make it easier to understand. Again, though the cubes are not physically joined together, they are still seen as together, and this is by the principle of proximity.

### **Conclusion**

The entire project was pivoted on the objective of exploring some exogenous principles that affect how we see what we see, how both optical and tactile connectivity affect how we see what we see by using cubic compositions. Following completion of the four relief pieces, various observations and interpretations were drawn from them. First, it could be concluded that, the position of an object has an effect on how it is seen and every change in position can cause a change in the visual perception of that object. For this reason, it is recommended that artists who desire to employ optical effects in their works practice a lot on object positioning and its resultant effect on observation. Additionally, the environment of an object has an effect on how it is seen. The environment here refers to the immediate surroundings of the object being looked at. By reason of the positioning of some of the cubes, they looked tilted while they were straight in actual sense (Optical deception). Others showed two (2) different colours which were actually the same colour but were seen as different due to the interplay of the different background colours they were pasted on. In conclusion, I succeeded in exploring optical effects and how we see what we see, through the use of coloured cubes to achieve and represent various optical effects. It all started with the conception of an idea

which was developed and refined later into an exploration of optical effects in art and how we see what we see. Several investigations were made into various literature and various artistes whose works were similar to the idea which was yet to be expanded. Likewise, various works with similar characteristics were examined to critically study their techniques and adopt the styles appropriate for this project and perhaps, identify gaps in their way of exploration to address some of these issues.

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