COLOR. LIGHT. PERCEPTION.

COLOR. LIGHT. PERCEPTION.

How color and light affect our understanding of visual and spatial perception, and how can color perception be used as a design tool within architectural education?

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TABLE OF CONTENTS

THESIS ABSTRACT

01

Color goes beyond our understanding of color theory (blue + red = purple, yellow + red = orange, etc.). When we begin to focus more in depth on how we visually perceive colors, as well as begin to isolate characteristics of colors, our subconscious understanding of color and visual perception may change. This is not something that is typically noticeable immediately, but when we become consumed within an experience that transforms our visual perception, this becomes more apparent. Now, how does this affect spatial perception? How does this affect individual human comfort levels and human behavior?

Our visual and spatial perception are tied very closely together and have a direct influence on one another. The way in which we experience a space may alter depending on the transformation of specific spatial variables, as well as the manipulations of color and light. Once our understanding of color perception becomes heightened, these core concepts can then be introduced within architectural education, which will ultimately lead to alternative design approaches and methods.

THESIS STATEMENT

02

This thesis will explore how the concepts of color and light become key elements in our visual and spatial perception. In fact, without the variables of color and light, visual and spatial transformations would not be present. These variables become significant when creating different experiences, which ultimately affect the way we perceive a space; therefore affecting an individual's human comfort levels and behaviors.

A variety of experiments have been conducted which explore the concepts of light, color, space, and human behavior in both a two-dimensional setting, as well as a three-dimensional setting. By understanding how these concepts differ depending on the dimensional qualities, allows for a more in depth and narrow focus of research to be present. The purpose of this thesis is to educate and make individuals aware of their own color perception, and explain how this knowledge can then be introduced as a design tool within architectural education.

"It's what's behind the eye that forms this reality we create. We like to think that this is the rational world we're receiving through our senses, but that isn't the way it works. We form our reality" (James Turrell).

Since these concepts are subjective to everyone, this thesis will focus on the different experiences each individual participant has. Comparing these experiences on an individual basis will be essential, rather than grouping individual experiences into specific categories.

DEFINITIONS

03

Color Contrast: Is the difference in visual properties that make an object (or its representation in an image) distinguishable from other objects and the background.

Depth Perception: Is the ability to see objects/ characteristics in a room in three dimensions (including the size and distance) and being able to judge how far that object/room characteristic is from the participant.

Experience: Is a physical and/or mental individualized knowledge/ understanding, that is obtained through direct participation or observation of an activity/ event.

Human Behavior: Is the range of actions and mannerisms exhibited by humans in conjunction with their environment.

Human Comfort: Is defined as the state of mind that expresses satisfaction with the surrounding environment. It provides a sense of ease and relaxation for an individual.

Objective: Is an individual understanding of a specific thing, that is not influenced by personal feelings or opinions. If something is "objective," it typically is based off of factual information.

Sensory Isolation: Occurs when one or more of our natural senses is reduced or eliminated, allowing the individual to heighten the other sense(s).

Spatial Perception: Is our ability to sense the size, shape, movement, and orientation of objects and/ or environments.

Subjective: Is an individual's understanding of a specific thing, that is influenced by personal feelings, tastes, or opinions.

Time: Is the measured or measurable period during which an action, process, or condition exists or continues. It is an instance of something happening and/or being done.

Visual Perception: Is our ability to see, organize, and interpret the surrounding environment through the sense of sight.

LITERATURE REVIEW

04

Understanding key concepts and principles that govern the different variables within this thesis, become essential when trying to understand this topic from a more critical/knowledgeable level. Literature review becomes the foundation in which investigation is built off of, as well as the starting point for exploration. This chapter will focus on the core concepts and principles that affect color, light, perception, and human behavior.

The Dimensions of Color: All colors are made up of three dimensions. This is refered to as the “dimensions of color,” and includes the following three components: (1) Hue, which is the attribute by which we recognize and describe a color such as red and yellow. (2) Value, which is the degree of lightness or darkness of a color in relation to white and black. (3) Saturation, which is the brilliance or dullness of a color; this depends on the amount of hue in a color. All attributes are interconnected to one another, and constitute all visual colors.

Color and Space: Color can affect our perception of form, dimension, and the overall qualities of a space. The warmth and coolness of a color’s hue, along with its relative value and degree of saturation can determine the visual force with which it affects our attention, bring an object into focus, and/or create a sense of space.

Chromatic Distribution: Is divided into the following three categories: foreground, midground, and background. Within these categories, decisions regarding the major planes on an interior space must be made. Objects that are at a closer distance to the viewer will be considered to be in the foreground of a room, whereas objects located further away from the viewer can be categorized into the background of the room.

The Spatial Effects of Color: May depend on various components. In a color, we can detect depth. This is due to the contrast of light and dark, and the possibilities for changing the color saturation and distribution. This is directly dependent on color contrast, meaning the overall color of the background is just as important as the separate colors. (i.e, Yellow can fade into a white background, whereas purple can extrude).

Spatial Variables: Are specific characteristics within a space that could potentially affect the way in which a space may appear. In some cases, a space may appear smaller due to these variables, and in other cases, a space may appear larger due to these variables. Spatial variables may include the following: light color, light source, room borders, room shape, lighting intensity, shadows, physical position, reflectivity, materiality, and time.

COLOR CONTRAST

Color Contrast: Is the difference in visual properties that make an object (or its representation in an image) distinguishable from other objects and the background. This distinction between objects and the background, can be created through six types of contrast. Color contrast is a concept present daily, but often times, we are unaware of its impact. Without color contrast, distinguishing objects both two-dimensionally and three-dimensionally would be impossible. Although the way we subjectively perceive color may be different for everyone, color contrast is still something that affects all individuals.

History of Color Contrast: Color contrast dates back centuries upon centuries but was strongly implemented during the Renaissance era. In art, weak contrast does not arrest attention the same way that high contrast pieces do, affecting the way individuals may interact or interpret a specific piece. Knowing the benefits and tools that color contrast holds, multiple art styles began to adopt such concept.

Chiaroscuro (Chiaro – Light, Scuro – Dark): Is the use of strong contrast between lights and darks (usually bold contrasts) to affect a whole composition. This concept was used to achieve a sense of volume in modelling three-dimensional objects and figures. The term rests on five underlying principles which include the following: light source, highlights, core shadow, reflected light, and cast shadow.

An artist who first brought Chiaroscuro to its fullest potential was *Caravaggio,* within his painting "The Deposition of Christ, 1481." He used strong contrasts of light and dark in figurative compositions to heighten the dramatic effect. Within this piece, the figures are portrayed against a black background, but the figures themselves are illuminated by a bright, searching light that sets off their three-dimensional forms. By doing this, it creates a sense of three-dimensional space within the piece, and increases the visual interest of the overall composition.

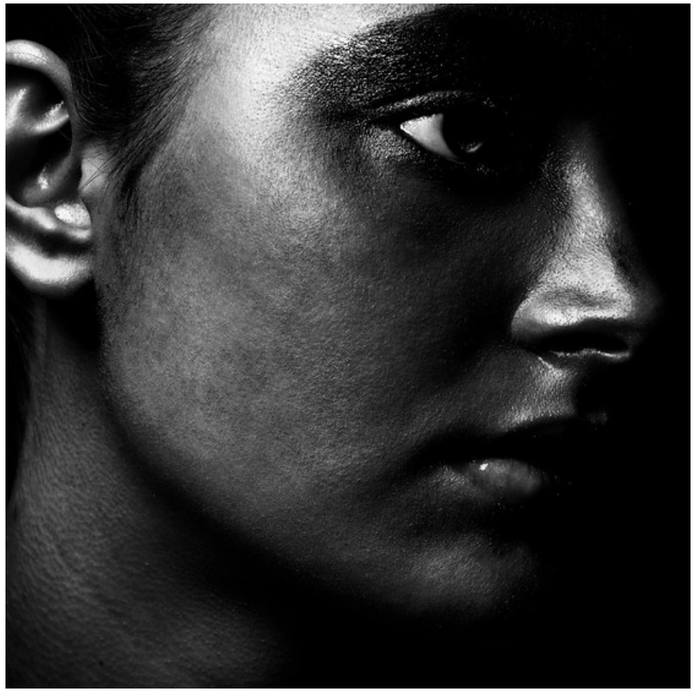

Figure 4.1
Modern Example of Chiaroscuro

Figure 4.2
The Deposition of Christ- Caravaggio (1481)

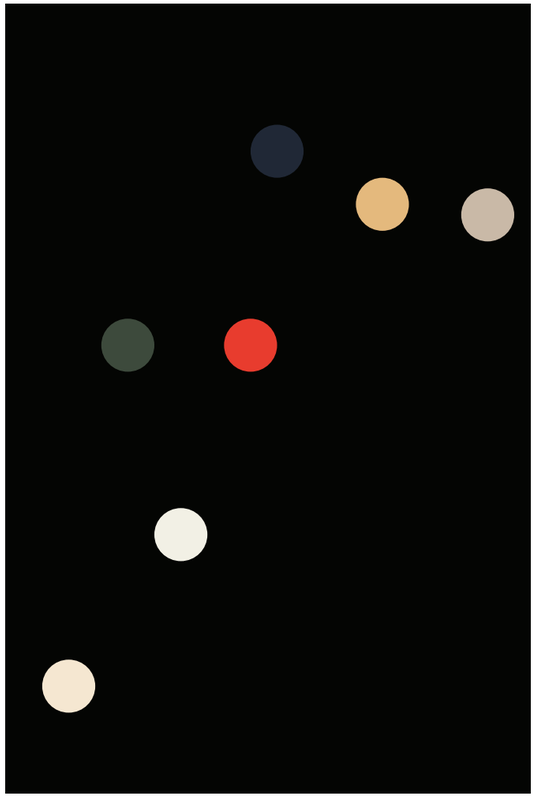

Figure 4.3
The Deposition of Christ- Color Isolation

CONTRAST TYPES

Color Contrast is the difference in visual properties that make an object (or its representation in an image) distinguishable from other objects and the background. This distinction between objects and the background, can be created through six types of contrast:

(1) Contrast Through Hue - Contrast through hue is created by two opposite colors on the color wheel (blue and orange).

(2) Contrast Through Value - Contrast through value is created when a 100% saturated color is present, and black and white is added to that color to alter the specific hue.

(3) Contrast Through Saturation - Contrast through saturation is created when a 100% saturated color is present, and another hue (not black or white) is added, which alters the specific hue.

(4) Triadic Contrast - Triadic contrast is created when three colors are evenly spaced on the color wheel (three primary colors).

(5) Contrast Through Temperature - Contrast through temperature is created when two colors from the same warmth or coolness is compared (yellow and red).

(6) Simultaneous Contrast - Simultaneous contrast is when a 100% saturated color is isolated within a neutral pallet.

Color contrast is a concept present daily, but often we are unaware of its impact. Without color contrast, distinguishing objects both two-dimensionally and three-dimensionally would be impossible. Although the way we subjectively perceive color may be different for everyone, the use of color contrast is still something that affects all individuals. In order to understand the effects color and light may have on our visual and spatial perception, understanding the six types of color contrast become significant.

Figure 4.4
Contrast Through Hue Diagram

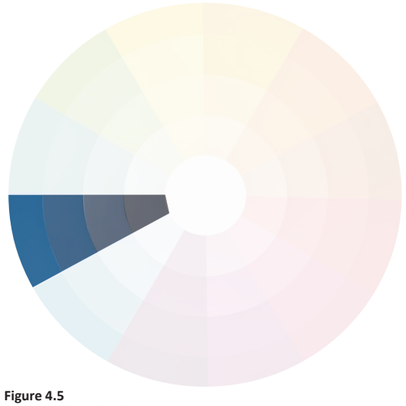

Figure 4.5
Contrast Through Value Diagram

Figure 4.6
Contrast Through Saturation Diagram

Figure 4.7
Triadic Contrast Diagram

Figure 4.8
Contrast Through Temperature Diagram

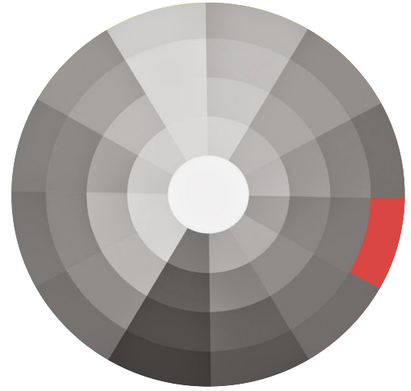

Figure 4.9
Simultaneous Contrast Diagram

DE STIJL MOVEMENT

The De Stijl Movement was founded in 1917 and lasted until 1931. This movement embraced an abstract, pared down aesthetic, centered in basic visual elements such as geometric forms and primary colors. The Rietveld-Schroder House in 1924, designed by Gerrit Rietveld is one example that showcases the essence of the De Stijl Movement. This house was originally made for Widow Truus Schroder-Schrader to have a house where she could mourn the death of her husband openly with her children and live in a way that broke with all the traditions of the time. She wanted simplicity and a space that was open.

The house used clean horizontal and vertical lines, primary colors, and non-colors (black and white). Inside the home, there was no static accumulation of rooms, but instead; the use of triadic contrast (refer to Figure 4.7) created zones for different programs within the house. The colors were chosen to strength the plasticity of the facades as well, while the surfaces were in white and shades of grey to create another form of color contrast. The Rietveld-Schroder house is a prime example of how color contrast can be used within architecture for both functionality and aesthetic purposes.

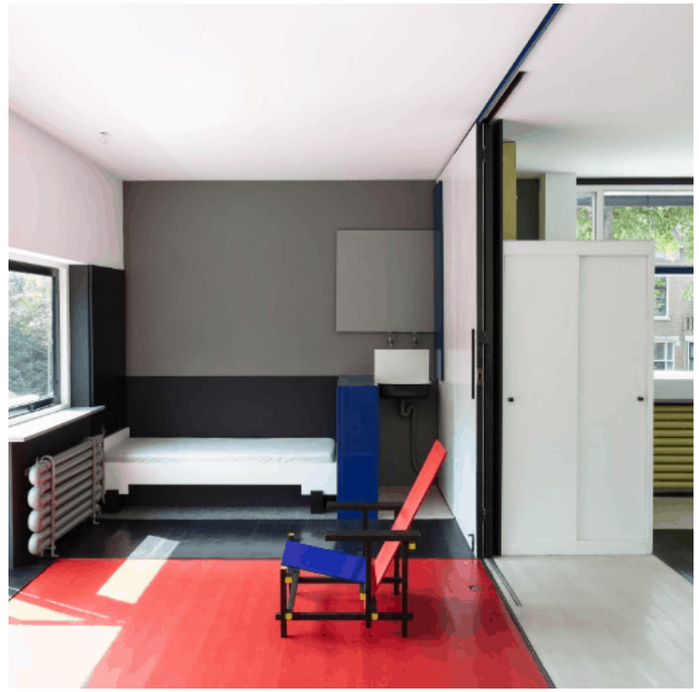

Figure 4.10
Rietveld-Schroder House (1924)

THESIS POSITION

05

Color and light are major factors that affect our visual and spatial perception. During these moments of transformation, components and concepts within the experience can alter and/or transform the way we perceive something. The way we may perceive a space can directly affect the way humans respond to that space; both in comfort levels and human behavior. This experience happens on an individual basis and cannot be categorized or grouped. Although similarities between experiences may arise, perception is a subjective concept affected by multiple other personal factors. This means that every transformation will be unique, personal, and the discovery or awareness of surrounding components will be individualized.

CASE STUDIES

06

This chapter discusses multiple artists and designers whose work focuses on the concepts of color, light, and perception. When reviewing these concepts, multiple perspectives and theories arise which become significant in the overall thesis understanding.

JAMES TURRELL

James Turrell, who is an American artist, explores the concepts of perception, color, light, and space, within multiple exhibitions and installations he creates. One of these installations being “Skyspace” in 2005.

“We actually give the sky its color as well as its shape. It’s what’s behind the eye that forms this reality we create. We like to think that this is the rational world we’re receiving through our senses, but that isn’t the way it works. We form our reality. All of the work I do is gentle reminders of how we do that. In fact, we de-form reality” (James Turrell).

Turrell explains how his work becomes a tactile experience as well. Due to the high contrast of colors and spatial qualities it creates within the interior, individuals often feel a tactile sensation when consumed in the space. James Turrell creates experiential art pieces that challenge the boundaries of our perception. When the viewer is engaged in the timeless and selfless perceiving, the viewer merges with the art piece.

“In working with light, what is really important to me is to create an experience of wordless thought, to make the quality and sensation of light itself something really quite tactile. It has a quality seemingly intangible, yet it is physically felt. Often people reach out and try to touch it” (James Turrell).

This installation consists of a small circular room, with a oculus located at the center of the ceiling. This oculus is directly connected to the exterior environment. The perimeter of the interior space is lined with artificial lighting, which is constantly changing at given moments of the day. As individuals enter this space, the interior walls are flooded with artificial colored light, allowing the viewer to feel completely consumed within the space. As the viewer looks through this center oculus, the contrast of the sky color and the artificial light, begins to alter our visual perception:

“As a dusk change in sky color develops, even a dull gray sky with only a slightly blue cast outside becomes a dark ultramarine when seen from inside” (James Turrell).

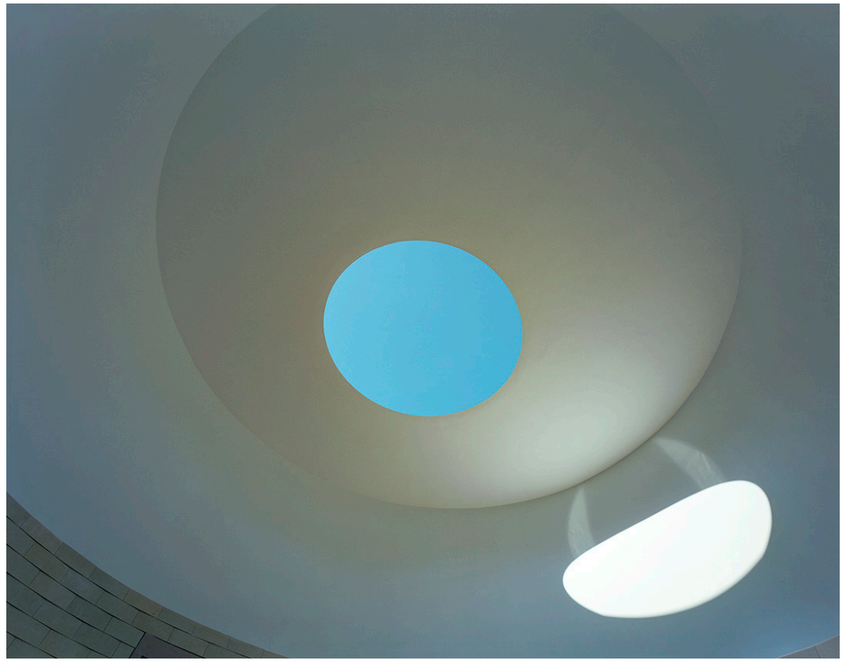

Figure 6.1
James Turrell- Skyspace Installation (2005)

All Turrell's work focuses on transforming our visual perception and challenging what we think is the reality of the world. His work makes the audience aware of certain characteristics, that we otherwise would not notice on a daily basis. One aspect of this installation that becomes essential to the human experience is the concept of time. Time becomes a prominent factor that plays a role in the way individuals visually and spatially perceive this space. Entering a Skyspace installation for only 30 seconds will not give that individual a long enough time to truly understand and capture the whole experience. In comparison, an individual who walks into a Skyspace installation for 5 minutes, may experience a larger shift and transformation of perception.

Figure 6.2
James Turrell - Skyspace Installation (2005)

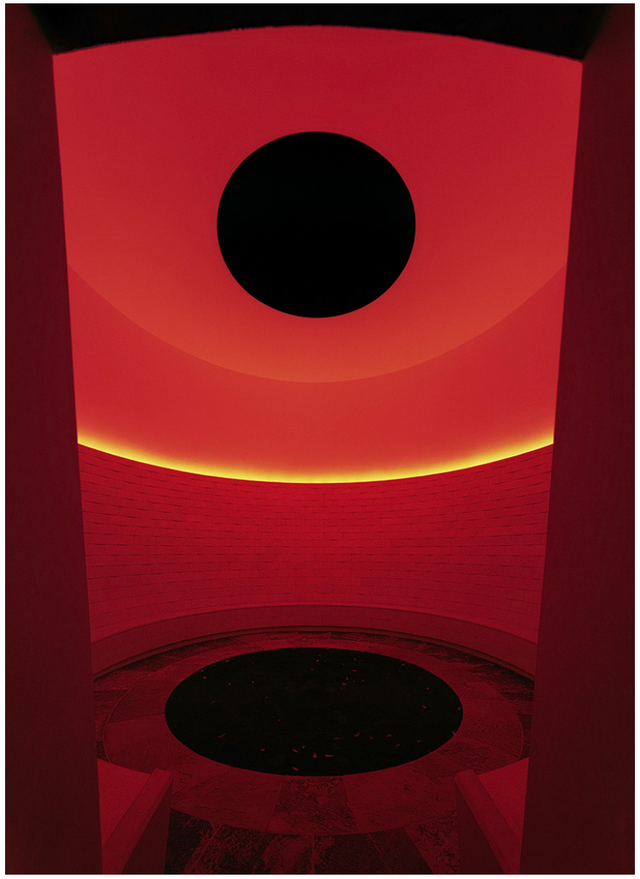

Figure 6.3
James Turrell - Skyspace Installation (2005)

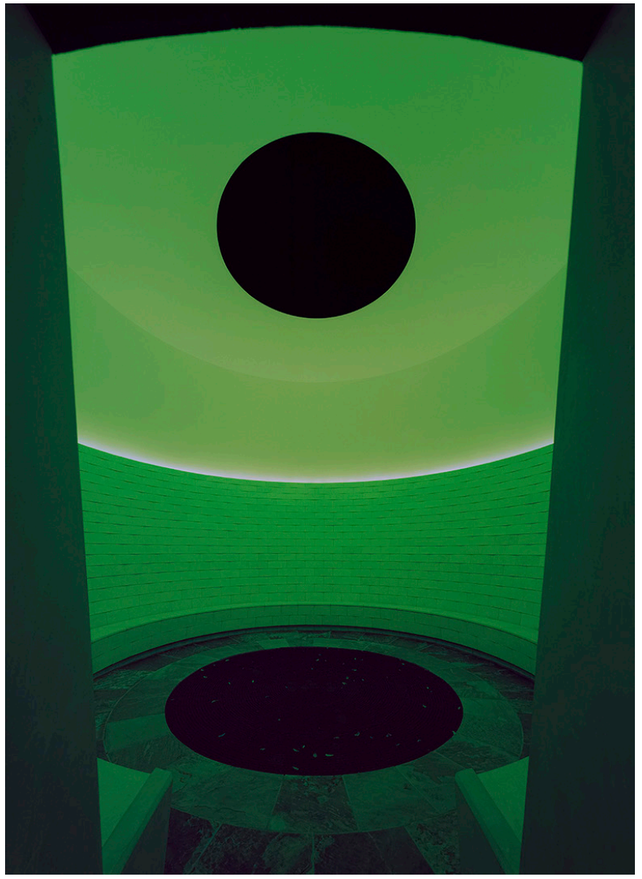

Figure 6.4
James Turrell - Skyspace Installation (2005)

OLAFUR ELIASON

Olafur Eliason, born is Denmark, is another artist who explores the concepts of color, light, and perception within his installation work. Eliason creates work that continually prompt viewers to think about the nature of perception. Many of his installations play with reflections, inversion, after-images and shifting colors, to challenge the way we navigate and perceive our environments.

Within his "Room for One Color" installation in 1994, participants enter a completely saturated yellow lit room. Due to the intensity of this light, all colors, and surfaces (regardless of the shade, hue, tone, or value within it) become monochromatic. The participants who enter the room, immediately experience a shift in their visual perception.

"The experience of monochromatic light offers us an opportunity of imagining another perspective, of viewing the world with a recalibrated perceptual apparatus. It makes us aware of the limits of our senses and helps us to see the reality of our color perception" (Olafur Eliason).

"Understanding how we see color can make us reconsider how we constitute the world. By reducing experience to a minimum, the monochrome allows us to reflect on what is happening when we perceive something, on how perception is also a type of world making. For a moment, we can imagine what it might be like to become colour-blind" (Olafur Eliason).

"Over the years, in making art, I have constantly explored issues dealing with space, time, light, and society. I am particularly interested in how the light of a space determines how we see that space and similarly, in how light and color are actually phenomena within us, within our own eyes" (Olafur Eliason).

When individuals exit this completely yellow saturated room, there is a specific time frame that our eyes need to readjust to the different lighting and exterior environment. During this time of readjustment, the participants may experience the concept of *after-image*. One individual who explains this concept of after-image is Josef Albers within his "Interactions of Color" in 2013.

Figure 6.5
Olafur Eliason- A Room For One Color (1994)

JOSEF ALBERS

Josef Albers was born in 1888 in Bottrop, Germany. Albers enrolled in the Bauhaus in 1920. Five years later, he became the first student to be invited to join the Bauhaus as a Master's Instructor. He was an educator before he was a professional artist. From here, Josef pursued a passion of art and went on to write a book titled, "The Interaction of Color."

Within Josef Albers book, "The Interaction of Color" in 2013, he discusses the concept of after-image. The human retina is tuned to receive any of the three primary colors (red, blue, and yellow), which constitutes all colors. When we begin to stare at a specific color (yellow for example), that color will begin to fatigue the yellow-sensitive parts of the eye. This means with a sudden shift to white, only the mixture of red and blue will occur, creating the complementary color of yellow, being purple.

This process is called after-image and is how Olafur Eliason extends this experience of his installation. Josef Albers uses an example of two circles. If we were to stare at the center of a red circle for 30 seconds, then quickly look at the center of a white circle, the white circle may appear green. The phenomenon of seeing green (in this case) instead of white is called after-image. This concept, "proves that not even the most trained eye is foolproof against color deception."

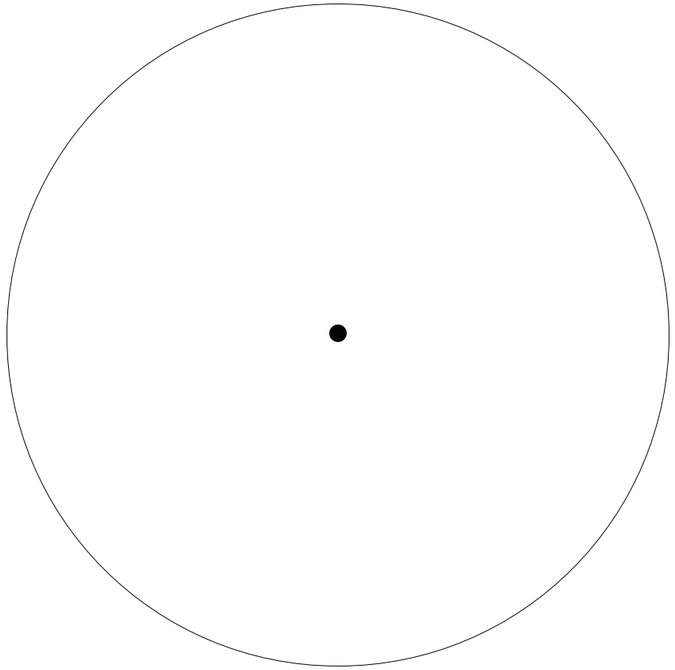

Figure 6.6
Josef Albers- After-Image Example

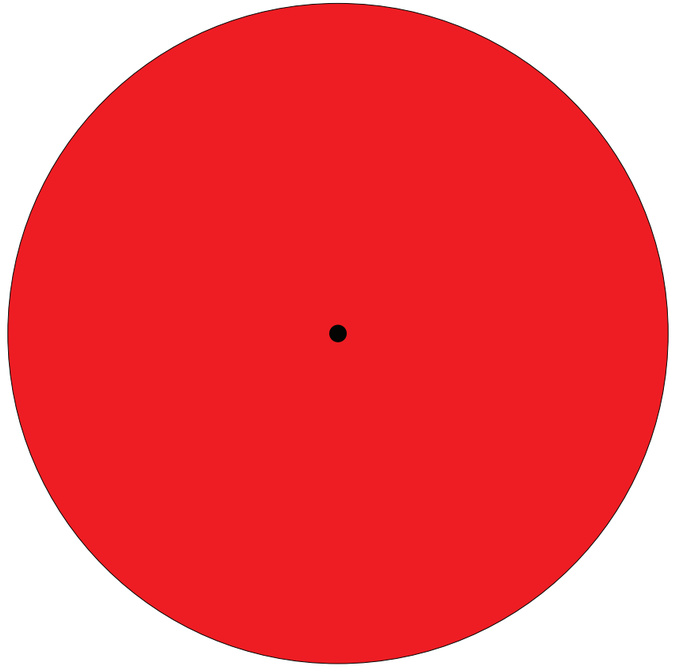

Figure 6.7
Josef Albers- After-Image Example

PERSONAL INVESTIGATION

07

This chapter focuses on the personal exploration that was conducted in relation to this thesis. Multiple experiments were conducted that explored the concepts of color, light, and perception, as well as the interconnected relationships present between each concept.

EXPERIMENT I - SWATCHES

To explore the concepts of light, color, and perception in greater detail, a video that explores the use of colored light to alter our visual perception of specific color swatches was produced. These color swatches included red, blue, yellow, green, purple, orange, black, and white.

The video starts and ends by displaying the color swatches in natural daylight, which allows the viewer to experience the swatches without any color alterations. When the colored light is turned on, a shift within the color swatches will occur. In some cases, the colored light will enhance the swatches, and in other cases, the colored light will diminish the intensity of the swatches completely. Depending on the colored light, some swatches may appear completely different as well. By focusing on one key element, *"it makes us aware of the limits of our senses and helps us to see the reality of our color perception. Understanding how we see color can make us reconsider how we constitute the world" (Olafur Eliason).* This video was meant to be an experience for the viewer and challenge the participants' visual perception.

After conducting this experiment, understanding what the relationship between artificial colored light, and specific color swatches became significant. More specifically, understanding what the transformation of these swatches are and how they changed under artificial light. To gather these results, two categories were produced. The first category analyzed how I can subjectively organize my findings. I organized which color swatches appeared the same depending on the colored light present, while the second category organized a more objective result of the experiment (A calculated RGB intensity).

This analysis allowed for a comparison between a subjective guess, and an objective calculation to be present. In some cases, the subjective guess and objective average intensity calculation were relatively similar, but in other cases, the subjective guess and objective calculation were far off. This proves that color and light cannot be completely reliant on vision, and that these concepts go beyond our typical knowledge of color theory and challenge our perception.

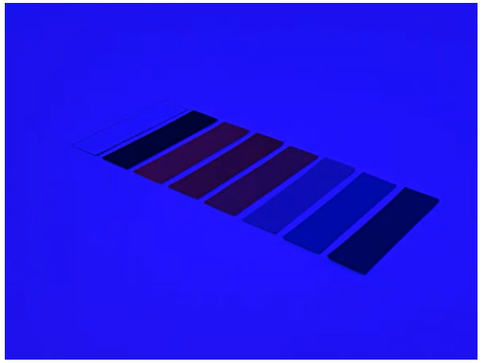

Figure 7.1
Experiment I
Swatch Analysis
Blue Lighting Condition

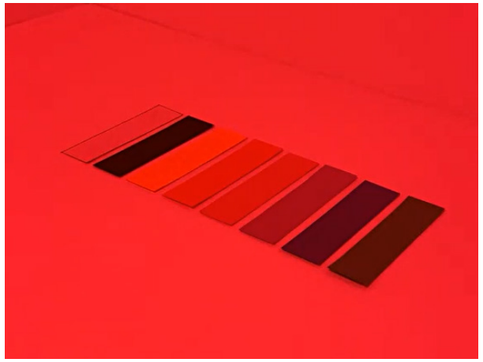

Figure 7.2
Experiment I
Swatch Analysis
Red Lighting Condition

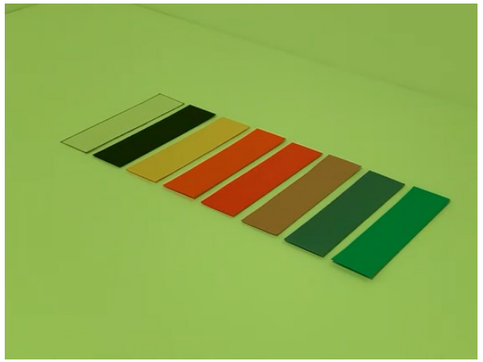

Figure 7.3
Experiment I
Swatch Analysis
Yellow Lighting Condition

WHITE LIGHT	WHITE	RED	BLUE	YELLOW	ORANGE	PURPLE	GREEN	BLACK
SIM. COLORS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
INTENSITY	255	100.3	82	156.3	122	132.6	65.3	0
RED LIGHT								
SIM. COLORS	1	1	2	N/A	1	N/A	2	N/A
INTENSITY	99	99.6	41.6	117.6	82.6	80.3	43	11.6
BLUE LIGHT								
SIM. COLORS	1	1	2	3	3	2	N/A	N/A
INTENSITY	100.6	90.3	59.6	36.6	36.6	68	33.3	20.6
YELLOW LIGHT								
SIM. COLORS	1	2	N/A	1	2	N/A	N/A	N/A
INTENSITY	125.6	79.6	51	116	83.3	87.6	52	16.3
PURPLE LIGHT								
SIM. COLORS	1	2	N/A	2	2	1	N/A	N/A
INTENSITY	147.3	94.6	80.3	97	89.3	108.6	60	37
GREEN LIGHT								
SIM. COLORS	1	2	3	1	2	3	N/A	N/A
INTENSITY	77.6	19.6	41.6	56.3	20.3	42.6	60	14

Figure 7.4
Experiment I
Swatch Analysis Results

WHITE LIGHT	WHITE	PINK	LIGHT BLUE	LIGHT YELLOW	LIGHT ORANGE	LIGHT PURPLE	LIGHT GREEN	BLACK
SIM. COLORS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
INTENSITY	255	185	208.3	212.3	145.6	147	130	0
RED LIGHT								
SIM. COLORS	1	2	2	N/A	N/A	2	1	N/A
INTENSITY	99	56.6	46	117.6	76	80.3	82.6	11.6
BLUE LIGHT								
SIM. COLORS	1	1	N/A	N/A	N/A	1	1	N/A
INTENSITY	100.6	74	73.3	62.3	103	83	86	20.6
YELLOW LIGHT								
SIM. COLORS	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
INTENSITY	125.6	105.3	149.6	200.6	173	133.3	215	16.3
PURPLE LIGHT								
SIM. COLORS	N/A	1	N/A	1	N/A	N/A	N/A	N/A
INTENSITY	147.3	163	136	170	149	146.3	205.6	37
GREEN LIGHT								
SIM. COLORS	1	2	1	1	2	N/A	1	N/A
INTENSITY	77.6	40.6	66	65	44.3	47.6	64	14

Figure 7.5
Experiment I
Swatch Analysis Results

EXPERIMENT II

When discussing how color and light affect our spatial perception, it is important to look at the multiple variables and components that could play a role in that transformation, in a three-dimensional setting. To understand what these spatial qualities were, a second experiment was conducted. This experiment consisted of an 8” x 8” x 8” box, with a light source located at the center of the ceiling. As the light filtered through this model, it began to highlight key variables of the box. These variables all playing a major role in the way we could potentially perceive a space.

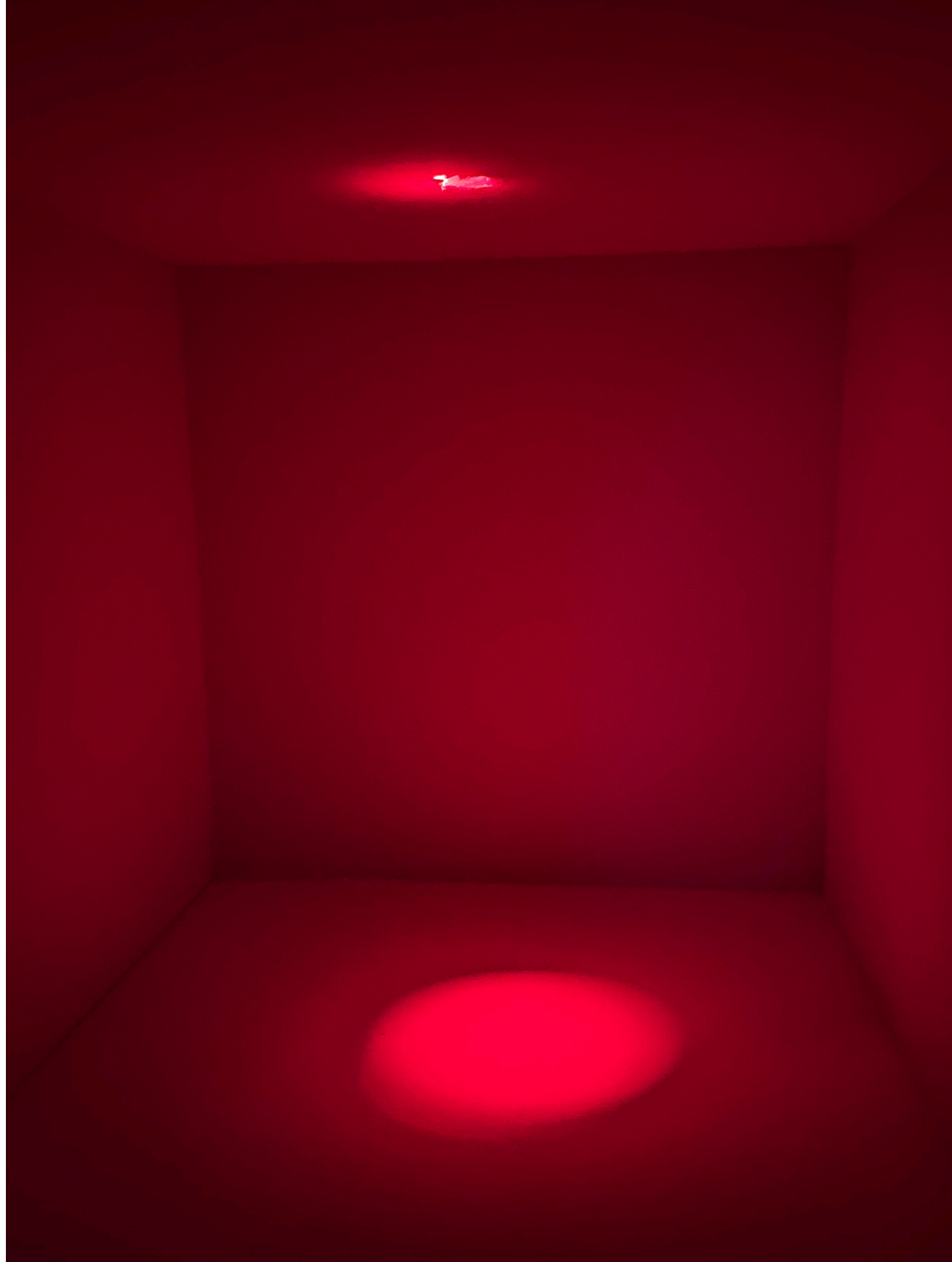

Figure 7.6
Experiment II
Spatial Variable Analysis

Form: The physical form of a space can create spatial qualities in itself. A room with curves can reflect light differently than a room that is rectilinear. As a result, this can affect the way we may visually and/or spatially perceive a space.

Light Color: Depending on the lighting, specific colors will begin to visually appear different (proved in Experiment 1 – Swatches). By changing the light color, it can alter our visual perception, which can affect our spatial perception of a space.

Light Intensity: Depending on the lighting intensity, this can affect the way we perceive specific colors. When light levels are extremely low, our eyes will need to adjust and adapt to the darkness. During this transformation, it can alter the way we perceive a space.

Light Source: The way a light source is positioned within a room can affect the way in which light diffuses into a space. Placing a light source in the corner of a room verses the center of a room will affect how that space can be perceived. The location of the light source can also affect the way a light will diffuse within a space, which can affect our spatial perception.

Materiality: The type of materials found within a space can have a large impact on the way light diffuses into a space. Materials with more texture will disrupt the alter light infiltration, while smoother materials will allow for more light to evenly distribute within a space.

Physical Position: The way in which we are physically positioned within a room can have a large impact on the way we perceive a space. Standing in the corner of a room can make a room appear larger, while standing in the center of the room can make a space appear smaller.

Room Borders: When two colors are next to one another, it allows our eyes to visually see the borders of a room. By using colors in a strategic way, we can use contrasting colors to challenge our visual perception, which can affect our spatial experience of the space.

Reflectivity: Colors that have a higher reflectivity allow more light to bounce off of them and into the space. The increase of light within the space allows for more open and spacious qualities. In comparison, colors with lower reflectivity absorb more light, which makes the room feel more intimate.

Shadows: For a space to feel three-dimensional, shadows must be present. Shadows become a way in which we can define borders, as well as give objects their dimension.

Time: The time in which an individual spends within a space can affect the way that individual visually and spatial perceives a space. A shorter amount of time spent within a space can make a space appear larger, while a longer amount of time spent within a space can make a space appear smaller.

Without the variables of color and light, visual and spatial transformations would not be present. These variables become significant when creating different experiences, which ultimately affect the way in which we choose to move within a space. To understand how these variables affect our spatial perception, understanding the relationship between color and light, and other spatial variables is essential.

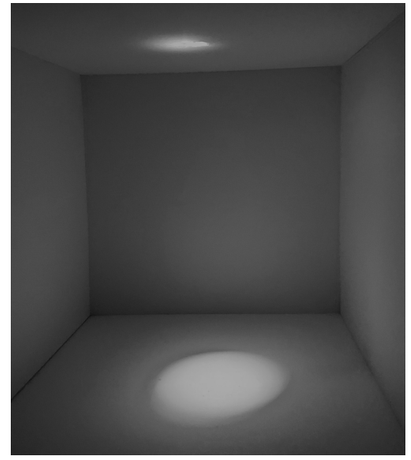

Figure 7.7
Experiment II
Spatial Variable Analysis

EXPERIMENT III - PERCEPTION

Depth perception is the ability to see objects and characteristics in a room three-dimensionally (including the size and distance) and being able to judge how far that object or room characteristic is from the participant. Depth perception mainly deals with the ability to judge the distance and size of objects, but there are many spatial factors that can affect the way we perceive that object as well. These factors were explored in Experiment 2- Spatial Variables and include the following: light color, light source, room borders, room shape, lighting intensity, shadows, physical position, reflectivity, materiality, and time. These outside spatial variables have a large impact that can change the way we visually perceive an object. This means that to understand how only the concepts of colored light affect our depth perception, sensory isolation and the creation of a uniform visual field must be present. To create a uniform visual field, finding ways to organize and structure specific spatial variables, while altering others is significant in understanding the relationship between colored light and depth perception.

Sensory Isolation: Occurs when one or more of our natural senses is reduced or eliminated, allowing individuals to heighten their other sense(s). This concept will also be a factor in how to create a uniform visual field. Reducing our senses to just sight will increase the participants visual sensitivity, leading to stronger changes in how they perceive the color, shape, size, and distance of an object.

To understand the interaction between color, light, and depth perception in greater detail, a three-dimensional experiment was conducted. I was curious on how the single spatial variable of colored light would change the appearance of the end of a hallway. This experiment took place at a residential home with a narrow hallway. This hallway was exactly 3' - 0" wide and spanned 12' - 0" long. All surfaces (apart from the dark grey hardwood flooring) were white surfaces. On the left-hand side of the hallway, there is a small closet with a single light source centered on the ceiling of the hallway.

By only having a single light, I was able to concentrate the colored light in one specific area. All other light sources in the area were eliminated to avoid any secondary light source interruptions. A camera was than set up on a tripod to keep all images captured at the same level and height. By doing this, it ensured that if differences in images occurred, it would be based off of our perception, and not error in the camera angle. This experiment was then tested under red, blue, and white light.

The three images that were captured were then compiled in a single document where participants could individually analyze and view the images. I then asked each participant to simple state:

In which image did the end of the hallway appear further away, and in which image did the end of the hallway appear closer?

It was interesting to see how individuals' (including myself) perception of the space changed based on the single spatial variable of light color. After reviewing all the participants' responses, I noticed that there were no distinct patterns or favored answers that stood out. In some cases, two of the participants may have had the same answer, but the other participants may have thought the complete opposite.

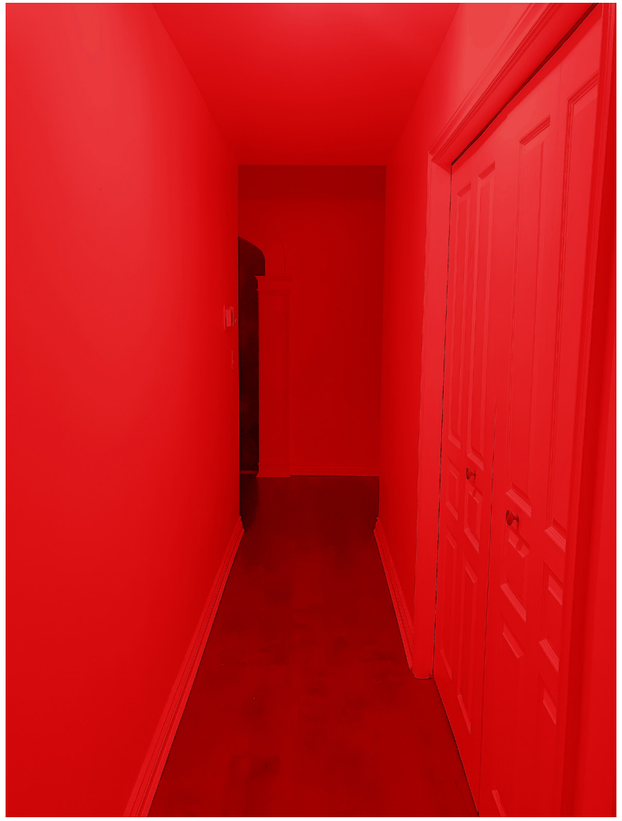

Figure 7.8
Experiment III
Hallway Analysis: Depth
Perception Red Lighting

Figure 7.9
Experiment III
Hallway Analysis: Depth
Perception Blue Lighting

EXPERIMENT IV

This experiment analyzed how the change of colored light can affect the way an individual visually and spatially perceives a space. In addition, the time spent in that space, as well as how the individual's human behavior and comfort levels may change depending on the light color that is present. Understanding the effects that colored light has on our visual and spatial perception and human behavior is significant to the understanding of human comfort levels and individual experiences. It also plays a role in the time an individual would want to spend within a space. Understanding these concepts can make individuals more aware of the influence lighting has on the human body as well as the sensitivities and triggers it can cause individuals.

The experiment was conducted within a closed off corner in a residential dwelling, where all wall surfaces were painted white. At the center of the ceiling, a single light source was located. This was the only light source in this area when the experiment was being conducted. By only having a single light, I was able to concentrate the colored light in one specific area. All other light sources in the area were eliminated, to avoid any secondary light source interruptions. On the floor, foot markers were present to indicate where participants would stand during the experiment. The following instructions were given to each participant:

(1) When you enter the space, stand on the foot markers looking towards the blank white wall.
(2) When you are in position, close your eyes. (Participant would close their eyes, and I would adjust the lighting to the colored light I am testing).
(3) When I say go, you can open your eyes and I want you to count to a minute.
(4) Once a minute is reached, say "done" and I will adjust the lights back to its natural white color.
(5) A series of questions were then asked to each participant.

Participant 1
Red Light - 1:05.40
Blue Light - 1:09.30 (Longest TIme)
Yellow Light - 1:00.16 (Quickest Time)
Best Lighting Condition - Red
Worst Lighting Condition - Yellow

Participant 2
Red Light - 1:08.40 (Longest TIme)
Blue Light - 1:06.47
Yellow Light - 55.30 (Quickest Time)
Best Lighting Condition - Yellow
Worst Lighting Condition - Red

Participant 3
Red light - 51.98 (Quickest Time)
Blue Light - 1:05.35
Yellow Light - 1:06.55 (Longest Time)
Best Lighting Condition - Blue
Worst Lighting Condition - Red

Participant 4
Red Light - 1:31.6 (Longest Time)
Blue Light - 1:19.27
Yellow Light - 1:08.48 (Quickest Time)
Best Lighting Condition - Red
Worst Lighting Condition - Yellow

Participant 5
Red Light - 59.83 (Quickest Time)
Blue Light - 1:19.92 (Longest Time)
Yellow Light - 1:16.96
Best Lighting Condition - Red
Worst Lighting Condition - Blue

Participant 6
Red Light - 55.82
Blue Light - 56.93 (Longest TIme)
Yellow Light - 53.17 (Quickest TIme)
Best Lighting Condition - Blue
Worst Lighting Condition - Yellow

After conducting this experiment, a series of questions regarding each individual's experience was made. These questions include the following: What was the human behavior of each participant with the colored light most disliked? What is the relationship between the most disliked color and time of each participant? Did the participant experience after-image? What is the relationship between room comfort and each participant's spatial perception? What is the relationship between time and each participant's spatial perception? What is the relationship between physical human behavior and each participant's spatial perception?

(1) What was the human behavior of each participant with the colored light most disliked?

Each participant experienced similar human behaviors when in a space with the lighting color least desired. There were four main movements and human behaviors that were seen throughout the participants. These include the following: fidgeting, heavy breathing, swaying back and forth, and an increase in blinking. The most common human behavior being fidgeting. In all six participants, fidgeting was the primary behavior seen when participants were under their least desired lighting color.

(2) What is the relationship between the most disliked color and time of each participant?

It was interesting to see if there was any relationship between the length of time spent under each colored light and the least favored lighting option for each participant. When analyzing the data collected, four of six participants' quickest times were counted under the lighting option they least desired. These same four participants also experienced similar emotional responses of uneasiness, anxiety, and stress. In terms of physical human behavior, there were strong urges to leave the space or move around. There was also a noticeable increase in fidgeting from each of these four participants when under the lighting option they least desired.

(3) Did the participant experience after-image?

Each participant did experience after-image (at least once) within the three lighting options. After analyzing the data and findings from this experiment, blue light had the largest response between participants. All six participants responded saying that once the blue colored light was turned back to white light, everything appeared to have a strong yellow/orange hue to it. When conducting the experiment with red light, four of the six participants experienced after-image. These four participants all responded saying that once the red colored light was turned back to white light, everything appeared to have a strong green hue to it. Finally, when this experiment was conducted with yellow light, four of the six participants did experience after-image. These four participants all responded saying that once the yellow colored light was turned back to white light, everything appeared to have a strong blue/purple hue to it. It was interesting to hear the responses of each participant because all the responses were very consistent both in the after-image color, and in the timing that the after-image occurred (5-10 seconds).

(4) What is the relationship between room comfort and each participant's spatial perception?

After conducting this experiment, a room that may appear larger and more spacious, does not necessarily mean that an increase in human comfort will be present. In multiple experiments conducted, the space that felt the most spacious, was the space that participants felt the most uncomfortable in. This was true for participant 1, participant 5, and participant 6. In comparison, other participants had the complete opposite feelings towards larger spaces. Participant 2, participant 3, and participant 4 all had an increase in comfort levels when in spaces that appeared larger.

(5) What is the relationship between time and each participant's spatial perception?

After conducting this experiment, I do not believe that there was a strong correlation between the amount of time an individual spends in a space (dependent on the lighting color) and the way an individual spaciously perceives that space. In some instances, participants stayed in more intimate feeling spaces longer, but the data collected does not show strong enough patterns or relationships to conclude this statement. There is not a strong relationship between an individual's spatial perception of a room's size, and the time each participant stayed in that space.

(6) What is the relationship between human behavior and each participant's spatial perception?

Although each participant's experience was on an individual basis, in all six participants' experiences, there was a common theme of little to no movement when in the space they felt was most intimate and small. In some cases, the space that appeared the smallest was the space participants felt the least comfortable. These participants described the space as if they could not move and felt restricted. In other situations, some participants felt the most comfortable within more intimate spaces and described the space as relaxing. Therefore, regardless of the reasoning behind why participants experienced little to no movement, the lack of physical human behavior happened when participants were in spaces that appeared more intimate and small.

(1) What was the human behavior of each participant with the colored light most disliked?

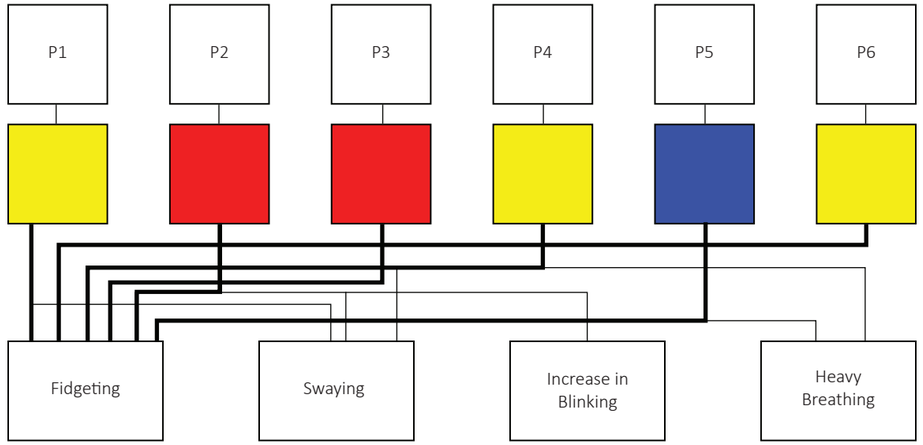

Figure 7.10
Experiment IV Diagram (1)

(2) What is the relationship between the most disliked color and time of each participant?

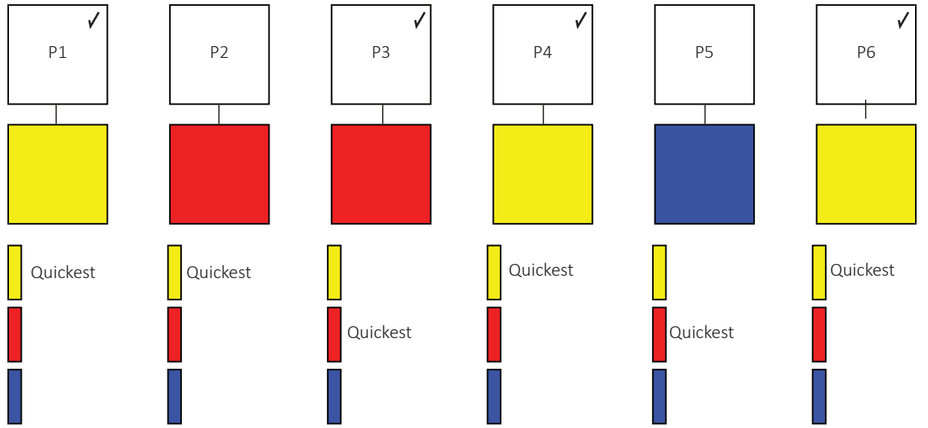

Figure 7.11
Experiment IV Diagram (2)

(3) Did the participant experience after-image?

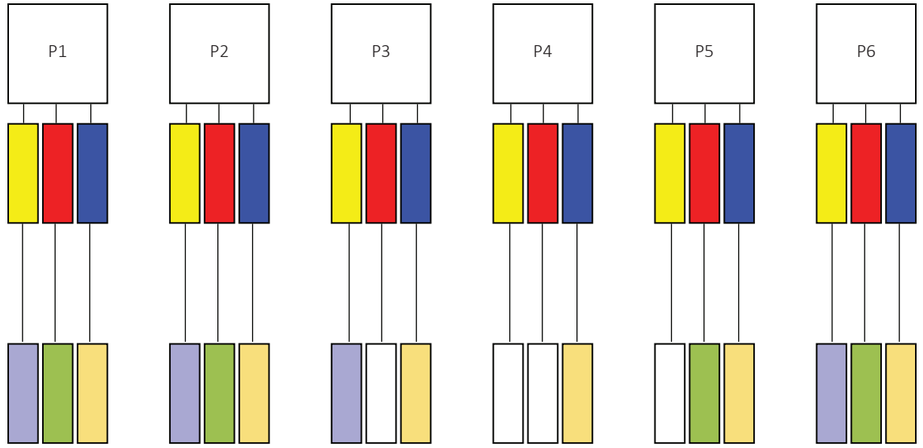

Figure 7.12
Experiment IV Diagram (3)

(4) What is the relationship between room comfort and each participant's spatial perception?

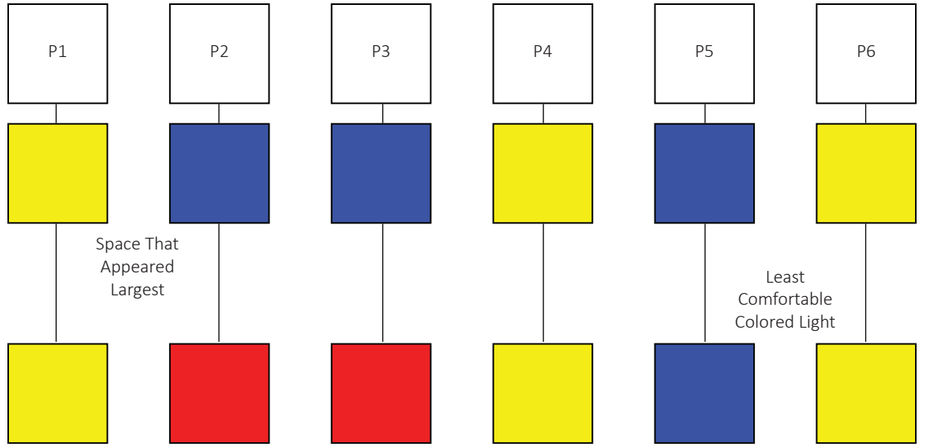

Figure 7.13
Experiment IV Diagram (4)

(5) What is the relationship between time and each participant's spatial perception?

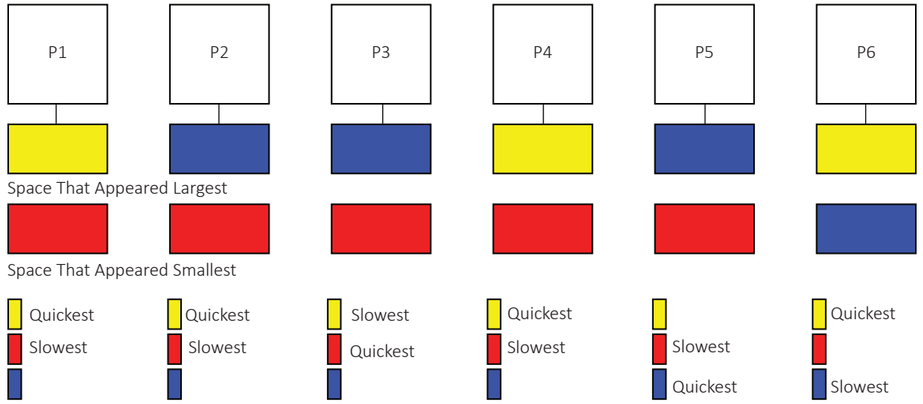

Figure 7.14
Experiment IV Diagram (5)

(6) What is the relationship between human behavior and each participant's spatial perception?

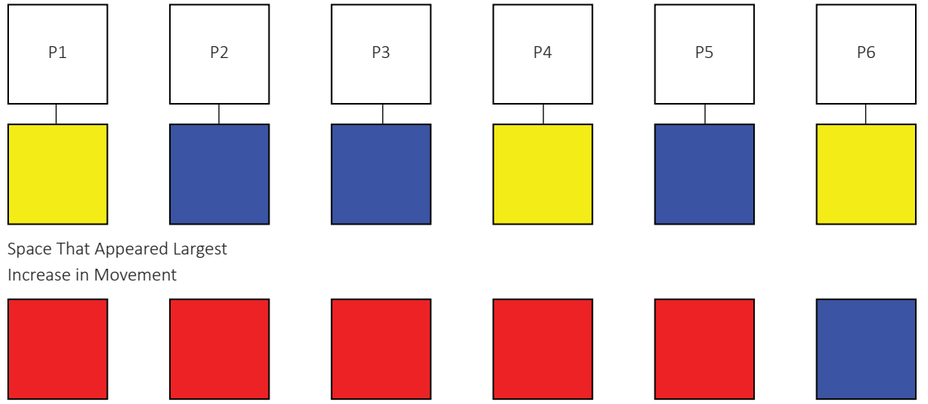

Figure 7.15
Experiment IV Diagram (6)

EXPERIMENT V

Up to this point, I have been studying how colored light affects that way I visually and spatially perceive a space, as well as how these concepts affect human comfort and behavior. For this next investigation, I wanted this process to be as organic as possible without having constraints or uniform variables unlike my pervious experiment that was tested. To do this, I simply altered the lighting of my room to the desired light color and situated myself in my room for a complete hour. During this hour, I did not have any set tasks to complete. It was up to myself to chose what to do within that space during this set time frame.

RED LIGHT

The first aspect I noticed was the scale of the space. Within seconds of the light changing from white to red, the room size appeared smaller. I also immediately noticed how all the objects in my room became monochromatic. This was something I have previously studied in Experiment I - Swatches. This idea of monochromatic spaces was also studied by Olafur Eliason in his installation titled, “A Room for One Color.” Since I have previously studied these relationships and concepts, I was able to anticipate these results. My main concern for this experiment was to look past what I already investigated and see what else my perception could uncover. While in my room, I noticed details that I have not noticed before about this space. Firstly, when the red light was present, my attention to detail strongly increased. Instead of seeing a singular object in my room, I noticed the details and patterns that made up that particular object instead.

This happened with any object I would look at. The objects’ physical features appeared stronger, and more contrast in shadows and highlights were present. The physical object borders became more distinct as well. For example, when I was looking at my bed linens, the red light enhanced my ability to focus on the folds of the sheet. Although the folds were organic, there was still a sense of uniformity to them, that I never noticed with white light. Although I could not see the true color of the objects due to the monochromatic feature of the light, these features of the objects were still more vivid. The original color of the object held no relevance when thinking of the objects’ values beyond the surface. The red light led my perception in noticing the details of an object regardless of its original color, which was something I have never noticed before.

Figure 7.16
Experiment V Diagram
Red Lighting Condition

BLUE LIGHT

The second light color that was tested was blue light. Similarly to the red light, the blue light made all objects and surfaces monochromatic. In this case, when the lighting was changed from white to blue light, the room appear much larger. The physical room borders, as well as the borders of objects, did not appear as distinct as they did under red light. The same happened when analyzing the patterns and details within the objects. It was much more difficult to notice the details and patterns within objects under this lighting condition. However, one aspect that was prevalent was the actual color blocking of each object. Color blocking is made up of the three dimensions of color (hue, value, and saturation).

For example, when staring at my tapestry, I was able to distinguish the tones and values of each color of the tapestry much easier than when under white light. The tapestry consists of three beige tones, making it hard to recognize which values are lighter and darker. When under blue light, it made the process of analyzing the color values much more identifiable. Since the details in the tapestry were not as visible as they were under red light, the colors of the tapestries looked very consistent. Due to the presence of the blue light, my perception of the object changed. I was able to identify and analyze the tapestry in a different way, allowing me to uncover information regarding a specific object, that I would not have noticed under a white lighting condition.

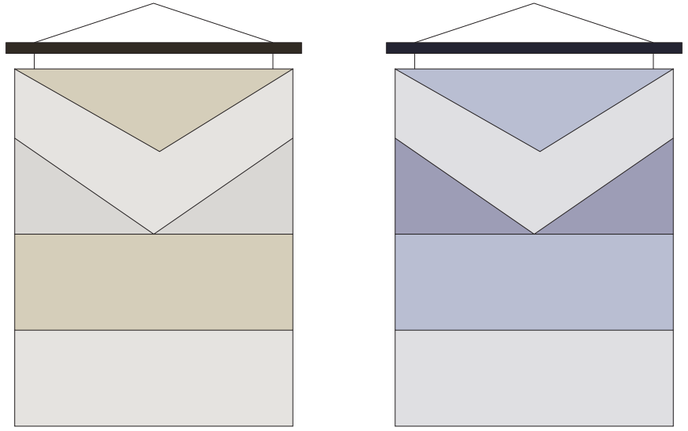

Figure 7.17
Experiment V Diagram
Blue Lighting Condition

YELLOW LIGHT

The final lighting condition that was tested was yellow light. Like the previous two lighting conditions, the yellow light made the space monochromatic. The size of the room appeared the largest out of the three conditions. This lighting condition in relation to the other two condition, triggered more human movement and discomfort. I found myself getting agitated and annoyed by the light, causing headaches relatively quickly. This made it much more difficult to concentrate on the space and analyze my surroundings. However, when the yellow light was on, I did find myself noticing the "imperfections" of the space.

These imperfections were exceedingly small and minor imperfections that were easily missed during the other lighting conditions. However, they were enhanced with the yellow light. For example, I was able to notice how my two art prints were slightly off in height, as well as how my tapestry was slightly on an angle. What made this most interesting to me was the fact that this lighting condition was the third lighting condition I tested. Meaning, that these imperfections were present under the red and blue lighting conditions as well, but I was unable to pick up on them until under the yellow lighting condition. This condition changed my perception of the space in a different way than the previous lighting conditions.

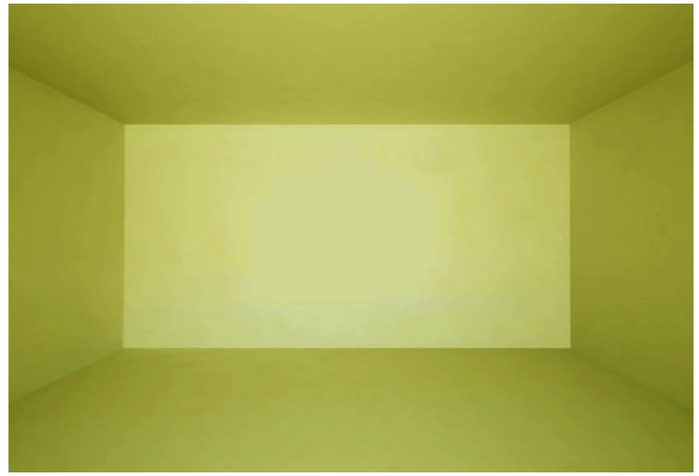

Figure 7.18
Experiment V Diagram
Yellow Lighting Condition

Colored light reduces our visual perception to a minimum. It makes the world monochromatic. This is not a bad thing. In fact, it makes us more aware of our surroundings and enhances the patterns, textures, and other elements that make up an object. It goes past our ability to notice obvious conclusions of an object and strengthens our connection to the built environment through a more authentic, critical, and knowledgeable way (maybe this is what makes James Turrell's Skyspace installation so successful).

This experiment has led me to understand the significance our perception has on understanding the built environment around us. Each lighting condition has a different effect on the way we perceive the world, meaning that each lighting condition will uncover new characteristics of the physical built environment. The issue is that we are unaware of the ability that our own perception holds and the significance it has on the physical space around us. The only way to understand it is to experience it. I would argue that we as humans have not truly experienced and uncovered all aspects of a specific built environment, until we have experienced it under multiple light conditions.

CRITIQUE

08

This chapter discusses some of the critiques present when discussing the core concepts of this thesis. In fact, some individuals do not believe that an experience can be achieved through the concepts of color, light, and perception. This chapter is meant to shed some light on the opposing perspectives present in relation to my personal investigation.

DAN FLAVIN

Dan Flavin is an American artist who creates installations that feature fluorescence light tubes in geometric arrays. These lights emit rich ambient monochrome or multicolored light that subtly reshape the interior spaces in which they are displayed.

Dan Flavin sees light and color from a different perspective and goes against James Turrell's and Olafur Eliason's views regarding the topic. He states how the exhibitions that he creates are exactly what you see. It is light and color, and there is nothing else to it.

"It is what it is, and it isn't nothing' else.... There is no overwhelming spirituality you are supposed to come into contact with.... And it is very easy to understand. One might not think of light as a matter of fact, but I do... as plain and open and direct an art as you will ever find" (Dan Flavin).

Flavin does not see his work as an experience, but rather a physical object that participants can view. This perspective argues that art is strictly tied to sight and can not create physical transformations and/or challenge our visual and spatial perception.

Figure 8.1
Dan Flavin Ikon Gallery

Figure 8.2
Dan Flavin Ikon Gallery

CRITICAL DISCUSSION

09

This chapter focuses on the relationship between key concepts discussed and architectural education. More specifically, this chapter will discuss how the concept of color perception can used as a design tool within architectural education and how this tool can lead to alternative design approaches within a studio process.

Understanding color perception as a design tool can be very beneficial within architectural education for a studio process. From previous exploration, it has been proven that different lighting conditions can alter the way we spatially and visually perceive a space. When this shift in perception occurs, it begins to uncover new information regarding the space that would have gone unnoticed without altering the colored light. Reference Experiment V for more information regarding specific transformations that occurred under different lighting conditions.

For this thesis, there was a strong focus on implementing color perception as a design tool within the earlier stages of a studio process. This includes the following: site plan analysis, context plan analysis, sketching, hand drafting, major design consideration, form manipulation, and mass modelling. To illustrate how color perception can be implemented into the design process, a specific site was chosen in which this theory was tested on. This site was the hallway tested in Experiment III.

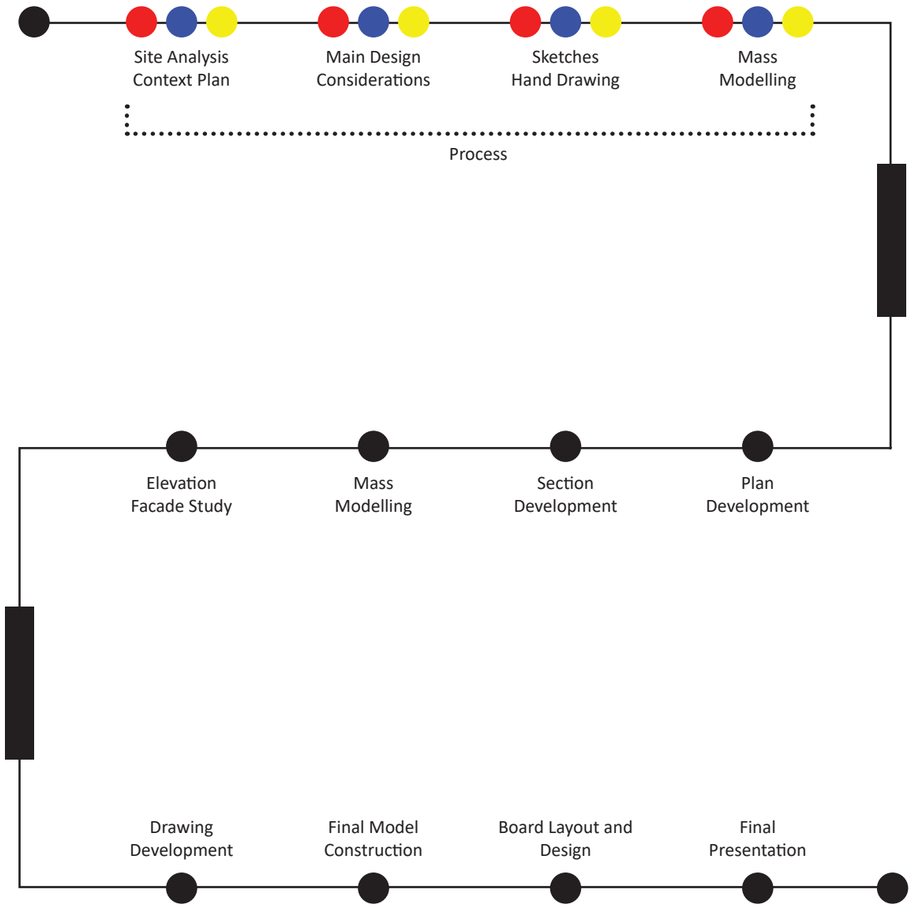

Figure 9.1
Typical Undergraduate
Studio Process

Viewing a site under a different light will begin to alter the way we perceive a space. These new discoveries will allow us to see the site in a new way and make hidden elements and characteristics about the site come to the forefront. This can then be translated into the way we sketch or represent the site. Instead of sketching the site as it visually is, begin to sketch the components of the site that came to the forefront when observed under a specific lighting condition. For example, when observing this site under red light, my attention to detail increased. Instead of seeing the site as a whole, each object was broken down into pattern, texture, and materiality. Under a blue lighting condition, my attention to color blocking and the values of color increased, meaning that my attention to the form and values that made up the site was most apparent. When observing the site under a yellow lighting condition, the edges and room borders of the site were enhanced. From this knowledge, a series of sketches were then produced that focus merely on the concepts and characteristics that each lighting condition enhanced in relation to the specific site.

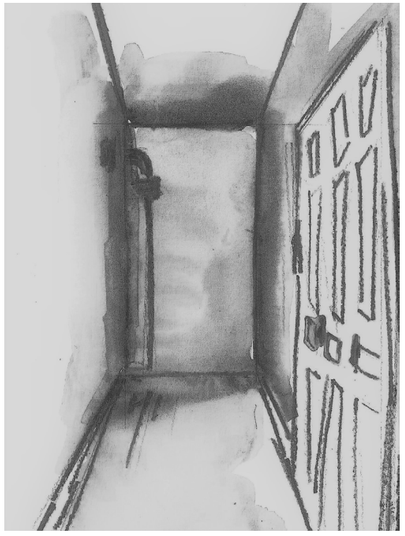

Figure 9.2
Color Perception as a
Design Tool - Red Lighting

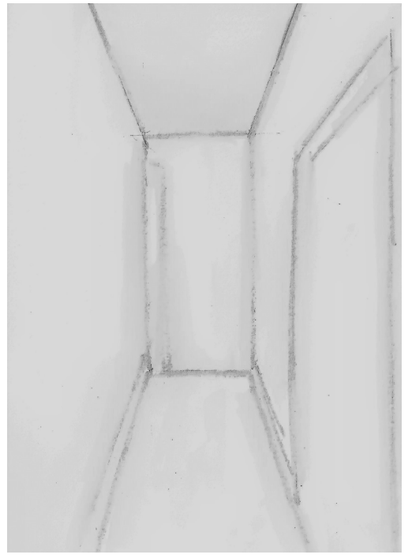

Figure 9.3
Color Perception as a
Design Tool - Blue Lighting

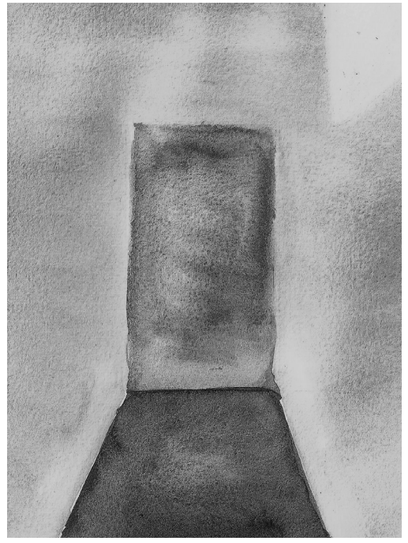

Figure 9.4
Color Perception as a Design
Tool - Yellow Lighting

By creating this series of sketches, it allows for three completely different design approaches to be present. Although these images represent the exact space site, each image focuses on just one main aspect from the space (detail, space alignment, and color blocking). To push this investigation further, a series of models were then created based on the sketches. Not only does this allow for these sketches to be represented three-dimensionally, but it represents the site in a physical form, which new design approaches and discoveries can be built from.

Figure 9.5
Color Perception as a
Design Tool - Red Lighting

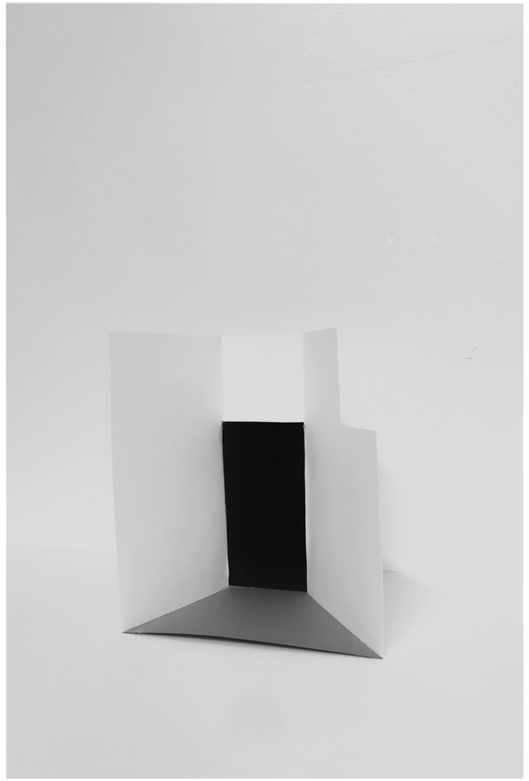

Figure 9.6
Color Perception as a
Design Tool - Blue Lighting

Figure 9.7
Color Perception as a Design
Tool - Yellow Lighting

Figure 9.8
Color Perception as a
Design Tool - Red Lighting

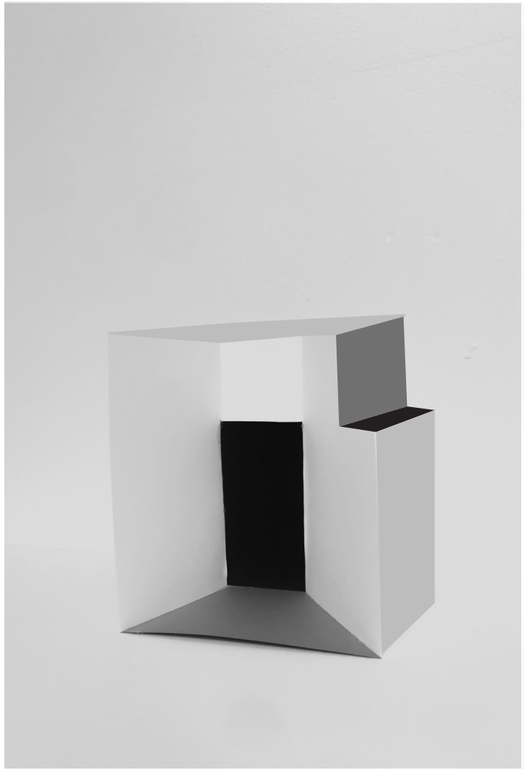

Figure 9.9
Color Perception as a
Design Tool - Blue Lighting

Figure 9.10
Color Perception as a Design Tool - Yellow Lighting

Colored light reduces our visual perception to a minimum. It makes the world monochromatic. It makes us look past our ability to notice obvious conclusions of an object and strengthens our connection to the built environment. Personal exploration has led me to understand the significance our perception has on understanding the built environment around us. Each lighting condition has a different effect on the way we perceive the world, meaning that each lighting condition will uncover new characteristics of the physical space we are consumed in.

This can become a powerful design tool within the field of architectural education. Using color perception within architectural education allows students to experience and uncover new knowledge regarding a space, which can lead to new innovative design approaches. What is intriguing about this design tool is the fact that each student would have their own individualized experience, meaning that each student's approach would be unique. It broadens the traditional methods of architectural education, and introduces a new, abstract way of thinking.

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10

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- Figure 4.3. The Deposition of Christ- Color Isolation - Original Image
- Figure 4.4. Contrast Through Hue Diagram: Color Wheel - Original Image
- Figure 4.5. Contrast Through Value Diagram: Color Wheel - Original Image
- Figure 4.6. Contrast Through Saturation Diagram: Color Wheel - Original Image
- Figure 4.7. Triadic Contrast Diagram: Color Wheel - Original Image
- Figure 4.8. Contrast Through Temperature Diagram: Color Wheel - Original Image
- Figure 4.9. Simultaneous Contrast Diagram: Color Wheel - Original Image
- Figure 4.10. Rietveld-Schroder House (1924) https://ettyandarchitecture.weebly.com/architecture-in-context-year-2.html
- Figure 6.1. James Turrell- Skyspace (2005) https://hirambutler.com/artists/james-turrell/crystal-bridges-museum-of-american-art
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APPENDIX A - EXPERIMENT IV - PARTICIPANT QUESTIONNAIRE

Participant 1

Red Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	Yes Movement: Swaying back and forth
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focusing on counting at first, then I zoned out for a few seconds Focused on sounds
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	I was looking mainly at the wall, but would turn my head to look around slightly
How did you feel? (tense, stressed, relaxed, tired)	Weird. It felt like I was in a different world. Kinda freaky at first.
Any other comments on the experience?	When I left the space, I saw green for a few seconds Eyes hurt for 10-15 seconds after
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	The size of the room felt smaller, more intimate
Blue Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	No – Stood Still
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on Counting
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Wall – Appeared to change from blue to purple
How did you feel? (tense, stressed, relaxed, tired)	Tired – Not as freaky as the red light
Any other comments on the experience?	Eyes hurt a bit When I left the space, I saw an orange/ yellow colour (very intense)
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	The size of the room felt taller
Yellow Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Meh – Not as comfortable as the other colors
Did you have an urge to move around? (yes or no)	Yes – I was swaying back and forth Fidgeting
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focusing on counting and wanting to leave the space
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking at the wall, looked at the other walls occasionally
How did you feel? (tense, stressed, relaxed, tired)	Tense – Felt painful
Any other comments on the experience?	Eyes were hurting the whole time Saw blue when the light turned back to white
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	The size of the room felt larger –much more spacious than blue and red

Participant 2

Red Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	Yes Movement: Swaying back and forth
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focusing on counting at first, then I zoned out for a few seconds Focused on sounds
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	I was looking mainly at the wall, but would turn my head to look around slightly
How did you feel? (tense, stressed, relaxed, tired)	Weird. It felt like I was in a different world. Kinda freaky at first.
Any other comments on the experience?	When I left the space, I saw green for a few seconds Eyes hurt for 10-15 seconds after
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	The size of the room felt smaller, more intimate
Blue Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	No – Stood Still
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on Counting
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Wall – Appeared to change from blue to purple
How did you feel? (tense, stressed, relaxed, tired)	Tired – Not as freaky as the red light
Any other comments on the experience?	Eyes hurt a bit When I left the space, I saw an orange/ yellow colour (very intense)
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	The size of the room felt taller
Yellow Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Meh – Not as comfortable as the other colors
Did you have an urge to move around? (yes or no)	Yes – I was swaying back and forth Fidgeting
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focusing on counting and wanting to leave the space
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking at the wall, looked at the other walls occasionally
How did you feel? (tense, stressed, relaxed, tired)	Tense – Felt painful
Any other comments on the experience?	Eyes were hurting the whole time Saw blue when the light turned back to white
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	The size of the room felt larger –much more spacious than blue and red

Participant 3

Red Light	
Questions	**Responses**
Did you feel claustrophobic in that space? (yes or no)	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	No – Because you were starring at red – Kinda scary
Did you have an urge to move around? (yes or no)	Yes – but stood still
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on Counting
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking at the wall in front of her Thought her heard a clock sound
How did you feel? (tense, stressed, relaxed, tired, etc.).	Nervous Uneasy
Any other comments on the experience?	Saw pinky orange Hurt when light changed to white
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Room felt small – felt restricted
Blue Light	
Questions	**Responses**
Did you feel claustrophobic in that space? (yes or no)	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	More comfortable than red
Did you have an urge to move around? (yes or no)	Not move – but rocking a bit
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focusing on counting at first, then zoned out Started to look at the cloth details
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Wall – The whole time
How did you feel? (tense, stressed, relaxed, tired, etc.).	Did not really feel anything – Felt neutral
Any other comments on the experience?	When I turned the light on, everything looked warm and yellow Did not hurt when I turned the light to white
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Room felt larger and taller
Yellow Light	
Questions	**Responses**
Did you feel claustrophobic in that space? (yes or no)	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes – Felt Normal More than Red and Same as Blue
Did you have an urge to move around? (yes or no)	No
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on Counting
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking straight at the wall
How did you feel? (tense, stressed, relaxed, tired)	Did not feel anything different
Any other comments on the experience?	When lights were turned back to white, she saw blue
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Did not notice a huge change in room size due to the colored light

Participant 4

Red Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	Counting on his figures and swagging back and forth Fidgeting
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on counted When first started, reminded him a movie (scary story to tell in the dark)
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Staring at the wall
How did you feel? (tense, stressed, relaxed, tired, etc.).	Started off: Anxious Then was neutral the rest of the time Heavy Breathing
Any other comments on the experience?	When light was turned to white, it stung a bit
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Room felt a bit smaller
Blue Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	A bit – Less than red
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focus on counting
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Starring at "blue" wall
How did you feel? (tense, stressed, relaxed, tired)	Tired
Any other comments on the experience?	The light looked yellow when changed Wall looked blue than purple, blue than purple, etc.
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Did not notice a dramatic size difference
Yellow Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	A bit
Were you comfortable standing still in that space? (yes or no) – if no – why?	No – Worst out of the red and blue by a lot
Did you have an urge to move around? (yes or no)	Yes – Strong urge Was moving his body around, a lot of fidgeting
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on Counting and how much you disliked the color
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking around The light started to look green
How did you feel? (tense, stressed, relaxed, tired, etc.).	Anxious Heavy Breathing
Any other comments on the experience?	When the lights were turned back to white, everything appear much brighter than normal
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Did not notice a dramatic size difference

Participant 5

Red Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	No – Stood Still
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Thinking of Counting Zoned Out Focused on Breathing
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking at the Wall – Focusing on one specific detail
How did you feel? (tense, stressed, relaxed, tired, etc.).	Relaxed
Any other comments on the experience?	Hurt eyes at the start, then eyes adjusted When the light turned white, it looked blue green for a second
Did you notice anything about the physical space? (size of room, height, where things moving?)	Room felt smaller and more intimate
Blue Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Meh – Red was more comfortable
Did you have an urge to move around? (yes or no)	A little bit
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on Counting
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Had to blink a lot, it was hurting his eyes Looking forward
How did you feel? (tense, stressed, relaxed, tired, etc.).	Relaxed at first, starting to get impatient and annoying closer to the end Heavy Beathing
Any other comments on the experience?	Eyes did not have to adjust as much as the red.
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Felt more spacious than red and yellow (not too much more than yellow)
Yellow Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes - More than the blue
Did you have an urge to move around? (yes or no)	No – little movement
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on counting
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Starring at the wall
How did you feel? (tense, stressed, relaxed, tired, etc.).	Relaxed and Comfortable
Any other comments on the experience?	Eyes did not hurt at all When the lights turned white nothing happened – but easier transition than the blue light
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Felt a bit larger than normal

Participant 6

Red Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes
Did you have an urge to move around? (yes or no)	Fidgeting and Swaying back and Forth
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focusing on counting, then felt like he was counting to slow
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking at the wall in front of him
How did you feel? (tense, stressed, relaxed, tired, etc.).	In his own world
Any other comments on the experience?	When light was turned back to white, he saw shades of yellow green When he blinked it was green
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Didn't notice a huge change in room size from the colored light
Blue Light	
Questions	**Responses**
Did you feel claustrophobic in that space? (yes or no)	No – but the space felt smaller – More intimate (like the walls were hugging him)
Were you comfortable standing still in that space? (yes or no) – if no – why?	Yes – More than red and yellow
Did you have an urge to move around? (yes or no)	No – Did not move at all
What were you thinking? (Focused on Counting? Thinking of Nothing? etc..)	Focusing on how the space felt smaller and how he was surrounded by the space
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looking in front of him Black dots" appeared red to him
How did you feel? (tense, stressed, relaxed, tired, etc.).	Relaxed
Any other comments on the experience?	When lights turned to white, it looked very orange/ yellow
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Small felt much smaller than the red or yellow room, felt much more intimate
Yellow Light	
Questions	**Responses**
Did you feel claustrophobic in that space?	No
Were you comfortable standing still in that space? (yes or no) – if no – why?	No – Felt Anxious because it was a "weird" color
Did you have an urge to move around? (yes or no)	Yes – Wanted to leave the same
What were you thinking? (Focused on Counting? Thinking of Nothing? etc.)	Focused on nothing
What were you looking at? (At the wall? Ceiling? Had your eyes closed, etc.)	Looked at the ceiling, then the walls, then back in front of him
How did you feel? (tense, stressed, relaxed, tired, etc.).	Tense and anxious
Any other comments on the experience?	When the light turned to white, saw a second of blue Really did not like that color of light
Did you notice anything about the physical space? (size of room, height of room, where things moving?)	Felt like there were no walls – A lot of space