LOOK THIS WAY: THE ROLE OF COLOR SATURATION IN ADVERTISEMENTS

A Senior Comprehensive Project
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Table of Contents

1. Abstract. 4
2. Artist's Statement. 5
3. Introduction. 6
3.1 Project Intention and overview……. 6
3.2 Color Studies…..……. 7
3.3 Color Theory….. 7
3.4 Rembrandt and Caravaggio….. 9
3.5 Complementary Colors….. 10
3.6 Monet, Van Gogh, and Seurat….. 11
3.7 Mixing Colors and the Color Wheel….. 12
3.8 Albers and Rothko….. . . . . .……13
3.9 Munsell Color System……. . . . . .……14
3.10 Color Print Advertisements 15
3.11 Eye Tracking and Art….. 17
3.12 Eye tracking and color….. 18
3.13 Hypotheses….. 19
4. Methods 19
4.1 Review of Working Process. 19
4.2 Research Design 21
4.3 Participants……..... 22
4.4 Materials……..... . . . . …22
4.5 Procedure……24
5. Results 26
5.1 Average Duration of Fixations. . . ……... 27
5.2 Average Number of Fixations. . . . . ……. 27
5.3 Attractiveness of Advertisement. . . . ……. ……. 28
5.4 Likelihood of Buying Product After Viewing Advertisement . . . . . ……. . . .28
5.5 Correlation between Attractiveness of Advertisement and Likelihood to Buy Product After Viewing Advertisement……. ……. 29
6. Discussion 30
6.1 Eye Drawings…….. 30
6.2 Science as Art……. 33

6.3 Results Summary….. 35
6.4 Interpretation of Results... 36
6.5 Limitations…… 38
6.6 Impact of Work on Self……... 39
6.7 Further Research 41
7. Works Cited 43
8. Works Consulted. 45
9. Works Created. . . . . …. 52
10. Appendices 64

Abstract

The main goal of this research was to examine how color saturation of print advertisements affects viewer attitudes and eye fixation patterns. A one-way ANOVA eye-tracking design was used with the level of color saturation (low, control, high) as the between-subjects variable. Thirty-five participants viewed a set of five advertisements. The results were examined in terms of how saturation affect an individual's mean duration of fixation, mean number of fixations, average attractiveness of advertisement, and average probability of buying the product presented after viewing the advertisement. Results indicated that color saturation has an effect on both average fixation duration and average number of fixations, where low saturation conditions had higher numbers of fixations for longer periods of time. Saturation did not have an effect upon advertisement attractiveness ratings or likelihood of buying the presented product, but attractiveness of advertisement and likelihood of purchasing the product were found to be positively correlated. These results shed light on how the individual components of color affect viewing of advertisements and open up paths for further research.

Artist's Statement

Color shapes every aspect of our perception of the world around us, subtly yet profoundly influencing the way we think, act, and feel. The effect of color in influencing human emotion can be observed even in conversational metaphors; for example, it is common to describe someone who is feeling sad as feeling blue or someone who is mad as seeing red. Even when color is broken into the three components of hue, value, and saturation, each piece still has a significantly observable impact upon the viewer. Advertising companies are well aware of how colors can influence consumers and purposely use heavily saturated colors such as red and blue in logos to signal attractiveness and competency. I became interested in the impact of color during the course of my studies as a double major and investigated the influence of color saturation in print advertisements upon the viewer by using an eye tracking machine; I was specifically interested in seeing how increasing and decreasing color saturation would affect the duration and location of viewer fixations as well as the rating of attractiveness and willingness to buy the advertised product. The works presented here are an exploration of merging art and science together as well as a commentary on how different people have different yet similar ways of looking at the same images. The impact that color saturation has on an individual cannot be overestimated, yet it often goes unexamined. Through prints made by staring at blank screens and videos compiled from eye tracking sessions, I invite to viewer to explore this dynamic relationship through art and science combined.

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Look this way: The role of color saturation in advertisements

The intention behind this project was to combine the disciplines of psychology and studio art in such a way that the final product would be a thorough and cohesive examination of color saturation in advertisements. While the execution of the psychological study was straightforward from the beginning, the path to creating a solid body of art work that echoed my findings was decidedly not. What began as an examination of the pervasive advertising culture and media over-saturation of society transformed into a commentary on the different ways of seeing the same object and the use of computer-driven technology to create works of art. The journey in researching color saturation and creating a body of work that intertwines art and science has given me a greater appreciation for how seemingly different disciplines can inform one another in unexpected ways. My aim was to share this journey with the audience in such a way that they themselves become more aware of the use of color in their lives.

The use of color to purposely direct the viewer's gaze has been part of the standard practice of making art for hundreds, if not thousands, of years; from the use of varied minerals and charcoal to make varied colors for cave paintings to the careful glazing of brilliant pigments in baroque and renaissance paintings. Throughout history several styles of painting have arisen that specifically highlight color saturation. Caravaggio and Rembrandt are two painters from the 16th and 17th centuries whose styles have been critiqued countless times over as using the saturation of colors to purposely direct the eye. The late 19th century saw the rise of Impressionism, followed by Post-Impressionism and Pointillism. These styles of painting relied on the heavy layering of saturated colors to create visual movement and attitude within a piece. Pointillism in particular heavily relies on the primary colors but keeps them unblended; it is the application of layers over layers of dots of paint that tricks the viewer's eye into perceiving

secondary colors. Artists such as Claude Monet, and Georges Seurat are notable for their paintings that use bold, saturated colors in thickly applied layers. In the 1950's, color saturation again came to the forefront of the art world as American Expressionist painters experimented with Color Field paintings. These oversize canvases typically feature highly saturated colors laid in strips next to their secondary or triadic color complement. Mark Rothko and Josef Albers' works are excellent examples of this style. The juxtaposition of hues allows the colors to boldly stand out, even if they are only a few value levels apart.

Color shapes every aspect of our perception of the world around us, subtly yet profoundly influencing the way we think, act, and feel. The affect of color in influencing human emotion can be observed even in conversational metaphors; for example, it is common to describe someone who is feeling sad as feeling blue or someone who is mad as seeing red. Individual preference for some colors and aversion to others varies across age ranges (Crozier 1999), genders (Eysenck 1941), ethnic groups (Birren 1997), and even personality types (Crozier 1999). Marketing and branding companies are cognizant of color associations and preferences when designing advertisements and logos, purposely using colors to influence consumer choice (Gorn, Chattopadhyay, Yi & Dahl, 1997; Labrecque and Milne, 2012; Lichtle, 2007; Lohse and Rosen, 2001). In recent years there has been an increase in research focused on the impact of color and its component pieces of hue, value, and saturation on visual attention and saliency, including tracking eye fixations when viewing color (Stuart, Barsdell and Day, 2013; Jost, Ouerhani, von Wartburg, Müri and Hügli, 2005; Frey, Honey and König, 2008). There are numerous eyetracking studies that examine print advertisements and the relationships between advertisement likeability, eye fixation location and duration (Lohse, 1997; Pieters and Wedel, 2004), and consumer motivation (Rayner, Miller and Rotello, 2008). However, there are few eyetracking studies that examine the impact of color saturation in print advertisements upon eye fixation location and duration, and how it relates to consumer perception of advertisements. The present study aims to combine these conditions.

In art and advertising, color is a fundamental aspect that is used for a variety of purposes: to divert viewer attention from one spot to another, to cue importance and information, and to give the illusion of shape, space, and depth. Color is also used to convey temperature and emotion within a piece. When viewing a piece of art, a person generally does not stop and consciously consider what they are supposed to feel; more often the viewer has an immediate emotional reaction followed by a rationalization of the reaction. Color can be broken down for discussion in many ways, be it in terms of additive and subtractive color; an overview of the color wheel and the various complementary, analogous, triadic, and tetradic relationships formed therein; or an examination of the physical properties such as pigmentation and hue, value, and saturation. For an example of a color wheel, please refer to Appendix A. For the purposes of this project, I will focus on color saturation. In their 1994 treatise *Art fundamentals: Theory and practice,* authors Ocvirk, Stintson, Wigg, Bone, and Clayton provide the following definitions for the abovementioned terms. Additive color is created by superimposing rays of light over one another-the overlapping projection of the primary colors red, green, and blue will result in the production of the secondary colors of cyan, yellow, and magenta. When all three primaries are combined, it creates a cancellation of color and produces white. Essentially, it is a reversal of the process where white light is refracted through a prism to break into the full color spectrum. Subtractive color is the application of the same theory to physical items rather than beams of light. An object's pigmentation is what allows us to perceive it as a certain color. "…The sensation of color is created when the surface absorbs all the wavelengths except those of the color experienced" (p. 141). When the pigment primaries are mixed together, they produce a color that appears as black, or the absence of light. Mixing pigments together allows for an expression of the full spectrum of light and color. A color wheel is the concept that all colors can be categorized within a spiraling pattern based on scaled increments of hue, value, and saturation. When any two of the primary colors (red, yellow, blue) are added together, they result in the secondary colors of orange, green, or purple. The mixing of a secondary color with

a neighboring primary color gives us intermediate colors, otherwise known as tertiary colors. For example, mixing the primary colors of yellow and blue gives us the secondary color green; subsequently mixing green with more of the primary color yellow would give us a tertiary yellow-green. The proportion of primary color affects the resultant hue such that the range of intermediate colors becomes near infinite, but the outermost ring standard color wheel representing pure hues is represented by twelve colors- the three primaries, the three secondaries, and the intermediary colors between each. Analogous colors are those placed directly next to one another on the color wheel such as red and red-orange, while complementary colors like purple-yellow and blue-orange are pairs located directly opposite from one another on the wheel. When two complementary colors are mixed together, they result in a neutralized grayish-tan color.

Rembrandt van Rijn and Michelangelo Merisi da Caravaggio are two painters whose use of color and saturation to compose attractive works of art are highly renowned. In *Caravaggio: A life sacred and profane*, Andrew Graham-Dixon credits Caravaggio for the introduction of a new style of handling the gradient changes from light to dark; this style, known as tenebrism, arose from the chiaroscuro style of transitioning between intense bright and intense dark with little medium values used (p. 184). Please see Item 1 under List of Works Consulted for the painting *Portrait of Fra Antonio Martelli* by Caravaggio. This painting contains all the hallmarks of dynamic color usage within a limited palette, and is often described as one of the most impressive portraits finished in the seventeenth century. The piece is dominated by warm earthen tones with enhanced tonality given by white, red, and yellow. The heavy, somber mood of the piece is weighted by the use of intensely saturated colors such as brown-black and extremely dark blue; a subtle gradation of the background tempers the piece and notes the extreme low light of the environment. To achieve such vivacity in a severely neutral-toned palette, Caravaggio relies on the optical illusion created by the use of a triadic scheme where

one saturated color is placed next to a complementary color so that both appear brighter in relation to the background. Graham-Dixon describes the piece as a forerunner to the sober portraiture of Rembrandt (p. 372), and it is easy to see why. Consult Item 2 from the List of Works Consulted to view the Rembrandt portrait *Herman Doomer*.

Whereas Caravaggio's palette consisted almost exclusively of pools of warm red and yellow light laid against the darkness formed by accents of cooler blue tonal colors, Rembrandt used a wider range of colors to denote areas of light and dark. His cinematic use of shadow evokes Caravaggio's tenebrous style, but draws in more ambient light such that the subject does not appear so starkly lit. Both the lit portions of the subject and the background exhibit the use of warm saturated colors; the pinks and yellows in the skin tone of the subject's face are identifiable in the colors used to paint the wall. In his 1957 biography and critical study *Rembrandt*, author Otto Benesch sums up this harmonious use of color and why Rembrandt's handling of color stood out from his contemporaries thusly:

> "Figures stand no longer as separate entities, distinct from the space around them, but are intimately bound up with that space which, like an undulating mist or fluid, washes over them in a ceaseless crescendo of light, so that they stand out like a crystallization of that fluid. This is why their pictorial reality is conveyed far more positively and palpably than is the case with other artists who set out from the idea of an abstract plastic volume which they proceed to clothe in colors" (p. 35).

Where Caravaggio's heavy use of saturated colors and chiaroscuro lighting was revolutionary, Rembrandt's subsequent expansion upon these themes paved the way for the subsequent exploration of color pairings in later centuries. Although neither Caravaggio nor Rembrandt left any notes as to their conscious decision to use complementary color tetrads in their works, we see that their legacy of the resplendent handling of colors continues to be utilized and explored through this day.

Complementary colors are incredibly important in art, advertising, and design because they are capable of increasing perceived visual intensity when they are placed beside one another. This is why red and green are such a startling combination, but blue and green is not. Most company logos are comprised of a primary color paired with a neutral, or two primary colors. Coca-Cola's iconic red and white and McDonald's red and yellow are two examples of this. While one might believe that a logo comprised of a complementary color pair would be the most effective in catching attention, the pairs can look uncomfortable or outright ugly unless moderated by an additional color. Mozilla Firefox's logo is an example of a complementary pair moderated by an additional color pairing, where the simultaneous color contrast between the orange fox and the blue planet is moderated by the yellow of the tail. This effectively harmonizes the relationship and makes for an attractive logo. This is also known as a triadic color interval.

The Industrial Revolution of the 19th century revolutionized not only manufacturing, technology and society, but also left a significant impact upon the art world. The advances in chemical engineering allowed for paint to be mass-manufactured with reliable consistency in color and texture. No longer bound to the confines of the studio, artists began moving outdoors and painting scenes with the purpose of capturing the appearance as well as the sensation and feeling of light. Painters such as Claude Monet painted with loose, visible brush strokes and became less concerned with the realistic rendering so much as they focused on capturing the immediate impression and feeling of the scene. This style of art, known as Impressionism, was the first notable instance where art focused more on the implications of color than on form or value. For an example of Monet's Impressionist paintings, please see Items 4 and 5 from the List of Works Consulted. The two paintings chosen depict the same subject from a near-identical vantage point; the only difference is the time of day when each was painted. *The Portal of Rouen Cathedral in Morning Light* captures the Cathedral front at dawn, when the tops of the spires are just beginning to catch the sun's golden rays. On the other hand, *Rouen Cathedral:*

The Portal(in Sun) shows the building in the full glare of the sun's light, turning the white marble façade a variety of oranges, yellows, and whites. Both paintings make little to no use of black for creating a range of values, but instead rely on blue and violet in a range of saturation intensities to create variety and mood. The darker, cooler tones of morning light imply a quiet, restful mood while the high-key whites and yellows of *The Portal of Rouen Cathedral in Morning Light* imparts an energetic, bustling feel. When the blues and violets used for the shadows are placed next to and directly over top of the whites, oranges and yellows used for the high ranges, it is primarily the color complement juxtaposition that creates visual space and depth for the viewer. When the paint is handled in such a free way, the movement of the brushstrokes themselves add visual motion to the piece; this artist-directed movement of the eyes is also responsible for the perception of middle tones when viewed at a distance. The Benzold effect (Ocvirk et al, 1994), as this is known, was a primary component in both Impressionist and pointillist styles of painting and is why color saturation is so effective at replacing value when used in this way. Pointillism arose from Impressionism; it took the loose, free brushwork and transformed it into short, purposeful strokes and dots. Georges Seurat's painting, *Farm Women at Work*, is an excellent example of this style; please refer to item 3 in the List of Works Consulted to review it. Here, we see chaos and order balanced- where the angles of the brushstrokes bound in every direction and give the piece incredible energy, the length of the brushstrokes is tightly controlled. Additionally, we see that Seurat's use of color is more liberal and dependant upon the Benzold effect than Monet's. Though the purple skirts of the women are in fact covered with dashes of orange, red, and yellow, when this painting is viewed from a distance the distinction between dashes disappears and the viewer perceives only a purple skirt with form and shadow. Seurat depends exclusively on the receding nature of intensely saturated colors like deep blue, violet and emerald green to define shadow and space in his work; though no leaves or plants are defined in detail, we still immediately perceive these dots of color as a scene of a farm.

While the 12-step color wheel is integral to understanding color, it deals primarily with hue rather than value or saturation. The range of colors achievable for an artist multiplies many times over when white and black pigments are added to a color; value increases the range of colors and can play a moderating influence in the saturation of a hue as well. The primary color blue is now far more flexible and useful, able to cover a range from the palest, delicate powder blue to the deepest blue-black of the ocean when viewed at night. The addition of white increases the amount of light reflected, making a color appear brighter, whereas the addition of black decreases the amount of light reflected, making it appear duller. However, the increase of white or black pigment in the hue composition has a corresponding decrease in color saturation. As previously mentioned, another way to adjust a color's saturation is to add it to its complementary color; the color held in dominant proportion will appear more neutralized but will retain a vividness that stands out from the dullness of a grey-toned hue. If a complex color such as blue-green is placed alongside a pure green, the color appears to be bluer, yet if it is placed next to blue it appears more greenish. This effect is known as simultaneous contrast, "According to this rule, whenever two different color tones come into direct contact, the contrast intensifies the difference between them" (p. 151). Both artists and advertisers recognize that no single color should be used without consideration for the other colors in the palette used for the whole piece.

Color saturation as the focal point of an art piece again made a re-emergence in the 1960's and 70's with the emergence of Color Field painting. Artists like Mark Rothko and Josef Albers created works based solely around challenging the viewer's perception of one or two colors when placed over top or next to another hue. Color triads and tetrads are most common, though both artists created duo-tone works as well. For Albers' *Never Before j*, please see Item 6 under the List of Works Consulted. For Rothko's 1967 piece *Untitled*, please refer to Item 7 under the List of Works Consulted. Josef Albers was famous for his exploration with color and

published a book, *Interaction of Color*, that is still used as an artist's reference to this day. His screenprint *Never Before j* is a subtle exploration of the color red through four analogous saturation levels juxtaposed by a neutral tan. It is this neutralized tan that makes the other tones of red appear to be even more intense, as the tan is red mixed with yellow and lightened with white. In fact, the genius of the application of color theory is revealed in this piece when the tan is examined independent of the surrounding reds- it is in fact a desaturated orange. However, because it is placed in a field of deeply saturated blue-red, light desaturated white-red, and pure pigment red, the orange is perceived as tan. Where *Never Before j* explored the subtlety of perception of analogous color saturation, Mark Rothko's painting *Untitled* explored the bold contrast of complementary colors. This painting features a square of desaturated blue and a square of saturated red-orange over a background of medium yellow-orange. Again the ingenious application of color theory makes for interesting commentary on saturation; though the blue is very desaturated and is closer to pure grey than pure blue, the juxtaposition against two oranges intensifies a viewer's perception of blue. Even the edges of the blue tone reveal an interesting note, as the light application of grey-blue over yellow-orange presents a color that appears as a desaturated red. In this instance, when two complementary colors are laid over one another, the viewer perceives the creation of a third color. The collective works of both Rothko and Albers are exemplary for their intuitive use of saturation to direct the eye and force the viewer's perception of color.

Given the vast possibilities for mixing colors, difficulties quickly arose in naming and accurately reproducing the same color consistently time after time. It became clear that a standardization of color was necessary, especially for industrial purposes in dying, paint making, and graphic design. In 1913, Edward Munsell proposed a new way to systematically categorize color by increasing and decreasing these components on scales of equal value distances, as well as an attempt to name hues that resulted from primary-neutral mixes. The structure of

Munsell's system takes a rudimentary globe or tree-like form, where the white-black value scale forms the trunk and all the possible hues radiate out going from the dullest to the most saturated version of the hue. Color saturation, also commonly referred to as chroma, hue intensity, or brightness, is defined by Munsell as "… the quality that distinguishes a pure hue from a grey shade' (Munsell 35). For an example of Munsell's categorization of color saturation, please refer to Appendix B.

Color can also be described in terms of temperature, where colors such as red, orange, and yellow appear warm while hues like purple, blue, and green appear cool. When used appropriately, even unaltered primary colors can be used to delineate forms and special dimensions; "In general, warm colors advance while cool colors recede … a change of color on a form could serve the purpose of a change of value and not lose the effectiveness of the expression" (p. 156). These temperatures have corresponding tonalities that are often used in harmony to impart a certain mood to a piece. Ocvirk et al 1994 notes, "A wide value range (strongly contrasting light or dark hues) gives vitality and directness to a color scheme; closely related values and intensities suggest subtlety, calmness and repose" (p. 158). The colors used within a piece can also be utilized to purposefully solicit a direct emotional response from the viewer given the traditional societal color associations. "For example, blue is associated with loyalty and honesty, red with danger, yellow with cowardice, black with death, green with life or hope, white with purity, and purple with royalty and wealth" (p. 159). An artist's use of color often becomes consistent with a personal style or emotions on a subject. The temperature and emotional response that color can evoke has been documented in many psychological studies as well.

Humans have social and habitual tendencies to associate colors with words and emotions, as explored by Dorcus (1932). He found that when he showed participants color swatches and asked them to write down items that reminded them of the color, there was a high frequency of overlap in the words associated with the color (e.g., red and apple) and that this

association was only partially diminished when the test order was reversed and participants were asked to name colors they thought were associated with the item presented. Dorcus postulated that the diminished association was due to the human mind associating specific objects with specific colors, but generally associating specific colors with not only objects but also states of being and emotions. His theory was partially proven, sparking the link between color and emotion that has drawn researchers' and advertisers' attention alike in the recent decades (Duchowski, 2007; Piotrowski & Armstrong, 2012). The widely applicable nature and amount of information still unknown serve to make color association studies attractive to researchers in a wide array of fields.

For advertisers, the use of color compared to black and white printing continues to be a source of financial and philosophical debate. Black and white printing is much cheaper than color. A quarter page ad in a Midwestern metropolitan area telephone directory with a circulation of 1 million homes costs more than $10,000, and color printing can nearly double the cost (Lohse & Rosen, 2001). Furthermore, the studies that have examined the effectiveness of color advertisements compared to black and white advertisements have been inconsistent in their findings as advertisements vary greatly in their design. For example, the size, amount, and color of text can affect how advertisements are read and in what order information is interpreted (Rayner, Rotello, Keir & Duffy, 2001). Additionally, the context in which the ad is presented can affect viewing time and retention of advertisement material (Lichtle, 2007). There is strong evidence that color advertisements are viewed first, more often and for longer periods of time than black and white ads (Lohse, 1997), and that color advertisements can have a heavier impact on the target audience's emotions (Piotrowski & Armstrong, 2012) and opinions of companies and products alike (Duchowski, 2007; Warner & Franzen, 1946). However, there are mixed findings on whether consumers are actually more likely to remember and buy the product advertised in color compared to those advertised in black and white (Lee & Barnes, 1989).

Eye tracking studies based on advertisements are often privately funded and

consequently unpublished for public use. This can lead to gaps in research about how elements of advertisement design work and exactly what the recordings prove. It could potentially prove many theories about eye movements and multimodal memory pathways in the brain to be true, as Hiippala (2012) suggests. Great strides have been made over the past century in the research of eye movement, from the discovery of saccadic eye movement and perceptual span to the development of highly sophisticated, sensitive machines that can both track and interact with eye movement (Duchowski, 2007).

The art world is not wholly unfamiliar with the use of eye-tracking equipment to create works. There have been shows consisting of art prints produced with the assistance of an eye tracker, and even trackers being used to make pieces interact with the viewer. Jochem Hendricks is an artist who has created multiple pieces aided by an infrared eye tracking headset. For two examples of his work, please refer to items 8 and 9 in the List of Works Consulted. I found these two pieces in particular to be similar in concept and execution to my own, though the output is radically different. Both Hendricks and I place heavy focus on the eye's change of roles from sensory perception to sensory expression, and making a formerly invisible process visible. In *Hand*, Hendricks visually traced over his left hand twice, tracking first the movements of his left eye and then the movements of his right eye. When these two images are placed side by side, it becomes apparent to the viewer that eye movement is not a highly controllable event, even when used deliberately. As author Christiane Paul noted in her 2008 treatise *Digital Art* about Hendricks' works, "the artist's 'view of the world' is literally transcribed as an artwork… they offer a precise record of the root of artistic process and visual perception, the process of 'seeing' itself. The other piece by Hendricks that I found to be highly relatable to my own work was *Newspaper*. In this piece, Hendricks recorded his eye movement patterns as he read a newspaper and then printed the plots out as a newspaper. This transmogrification of a newspaper into scientific data and then back out again as a newspaper in a different form struck a chord with me. In my work, I turned the perception of printed

advertisements into both heat maps and fixation plots, and then turned them into printed works of art. In my work, this double conversion of the data resulted in a loss of resolution and a graininess in the prints, which left me concerned that my works would not be as visually powerful as they could be. At the conclusion of the chapter on Jochem Hendricks, Paul (2008) offers a particularly salient note on the issue of whether or not the creation of art on a computer obscures the relationship between maker and mark, and states that computer art is best compared to film and photography rather than the mark-making of drawing and painting. This is because technologically mediated design depends more on the effort behind the concept than the direct physical interaction of artist and mark. Essentially, "Concept, all elements of the composition process, the writing of software, and many other aspects of digital art's creation are still highly individual forms of expression that carry the aesthetic signature of an artist" (p. 60). Accepting the grainy nature of the pieces produced by the eye tracker allowed me to see them as more real, more representative of the message I wanted to send; "cleaning" up the lines and points to make it appear more polished in actuality only detracted from the impact of the works. The power and immediacy of both Jochem Hendricks' work and my own comes from the use of the eye tracking data, and the raw nature of the line work made by the computer program as it converts perception to expression adds to this factor exponentially.

Color can play a major effect in advertising, from conveying company image and product quality (Duchowski, 2007; Warner & Franzen, 1946) to influencing the mood and emotions of the viewer (Labrecque & Milne, 2012; Piotrowski & Armstrong, 2012). Early studies (Dorcus 1932, and Warner & Franzen 1947) relating color, marketing, and psychology together did not differentiate between the different components of color such as saturation and value. Instead, they primarily study hue, or the perceived color as described by one of the primary colors. Labrecque & Milne (2012) proposed a separation of value and saturation from hue in their study examining color interaction with brand personality perceptions. They define saturation as "… the amount of pigment in a color; it is measured on a scale from low (appearing gray and washed

out) to high (appearing vivid)" (717) and value as "… the amount of lightness or darkness relative to a scale that ranges from black (low) to white (high), so that a color with high value appears to contain a greater proportion of whites (pastels), and a color with a low value appears mixed with black (shades)" (717).

The purpose of the study was threefold. First, to add to the limited amount of studies that study color in its component parts in relation to advertising by focusing specifically on saturation. Second, to examine the eye fixation patterns as they related to saturation levels. Third, to explore the influence that color preference exerts on color advertisement perception. The present study believed that an increase in color saturation would have a positive affect on a participant's number of fixations. Specifically, the present study believed that high saturation would result in higher numbers of eye fixations than the control saturation condition, and that low saturation, no matter what advertisement it was paired with, would generate more eye movement with less fixations than the control condition. Additionally, it was hypothesized that an increase in color saturation would increase the average duration of participant fixations such that duration fixation would be longer in the high saturation condition than in the control saturation condition. The present study also predicted that the low saturation condition would have shorter fixation duration than control saturation. In terms of examining the relationship between participant ratings of advertisements and color saturation condition, the present study proposed that a participant's color favoritism would influence whether they rated the advertisements positively or negatively.

Method

I began working this semester by examining the products and labels that quietly invaded my everyday life by photographing not only the products and labels themselves but also the context in which they were set. However, I was disgruntled by what I found, and felt it to be fundamentally flawed. In an effort to express my concern, I rendered the photographs of the products in a computer graphics program to appear highly broken and color distorted. Glitch

computer art is a relatively unknown style of creation where photographs or drawings are purposely stretched and distorted in both shape and color. For an example of this, please refer to Item 1 under List of Works Created. My intention was to show that a materialistic approach to life was glitched and fundamentally corrupted. Shortly after, I began composing portraits of people using only the logos of the products they used in their daily lives. I was curious to see to what extent people allowed corporate products to define them; I was playing with the notion that a person was literally comprised of the products they consumed. Both of these styles of creation paralleled the actions I was taking to progress my eye tracking experiment as at the time I was coding my control program and was having a spot of trouble with coding errors and stimuli not showing up properly- the glitch in my psychology study was expressing through the art pieces. However, the works did not seem to tie together well enough, and the message I was trying to send did not effectively tie in color saturation at all which led to a change in stylistic direction.

I then began working directly with the company logos themselves, manipulating the color saturation and recognizable nature of the logos through digital glitching and reversing the associated colors used in a brand's identity. For example, the crisp lettering and red, white, and blue of Pepsi was switched with the stylized cursive white and red of Coca-Cola and vice-versa. Please refer to Item 2 under List of Items Created. I reworked many logos like this in an attempt to temporarily confuse the viewer, such that their habitual color associations for those logos would lead them to assume it was unaltered until they inspected the piece more closely. These works were interesting to me in that they invited the viewer to do a double-take and thus tied in with the eye-tracking study's concept of purposely directing the eye-movement of the viewer. I even coded a version of my eye-tracking study using the swapped and glitched logos I had created as stimuli, and recorded a tracking session so that the data from the experiment became part of the art. The creation of these works was helpful because it solidified for me the preference to create artwork digitally, and pointed me in the direction of integrating actual data

and fixation points from my study into my art. However, these pieces still fell short in really expressing any meaningful commentary to the viewer, and the overall concept felt disconnected.

The experimentation with eye tracking data as art became the turning point for my work. I enlisted the help of a friend and had them assist me in setting myself up in the eye-tracking headset; I then ran myself through my own experiment to see what it was like from the participant side. It took only a second to realize how temptingly easy it is to purposely look around rather than allow one's gaze to wander freely; it was a deep fear of mine that a participant would do this and end up distorting my data. Since I was not recording my track to be used in the analysis, I gave in and purposely stared for as long as I felt like at whatever random points I felt like choosing. When I ran the fixation plot analysis on my session data, I found that recognizable geometric shapes such as triangles and rectangles seemed to stand out far more than they did in normal participant analyses; the heat maps also revealed unusual patterns. Intrigued, I did it again viewing a different saturation level—and that's when the light bulb when off. What if I used the eye tracker to "draw" using only my eyes? I could use the heat maps as shading, and the lines between fixation points denoting saccades could be used to outline forms. I coded a basic E-prime program to appear as a blank white screen with program termination when the spacebar was pushed, re-enlisted the help of my friend, and gave it a shot by beginning to draw basic forms by staring fixedly at the blank screen. When compiled for analysis, I found a mix of success and failure. The fixation plot map very obviously showed a form of some dimension, but it was not at all clear and my eyes hurt from staring so intensely. Over the course of several more sessions I found that it was best to work in several sessions and compile the resulting fixation maps into one piece, rather than try to create a fixation based piece in one fell swoop.

Design

This study used a one way, between subjects design. The between subjects variable was the level of advertisement color saturation (high, low, and control). The control level was the unaltered version of the originally published ad, while high and low saturation conditions were altered in Photoshop to contain +50% and -50% of original color saturation respectively. Participants in all conditions were tested using the eyetracker to record the dependent variables of number of fixations on key product areas and the time duration of the fixations. A questionnaire was given after participants viewed the entire slideshow asking for information regarding the advertisements viewed.

Participants

35 Participants for this study were recruited from the undergraduate student body of Allegheny College, drawing from both the Psychology and Art Departments. There were 14 psychology majors, 6 art majors, and 15 participants who identified their major as other or undecided. Compensation for their time was given in the form of research participation credit or extra credit depending upon instructor policy, and a raffle ticket as entered into a drawing for one of three $15 gift cards to a local business of their choice. Of the 35 students recruited and tested, 10 were male and 25 were female. Participants ranged in age from 18-22. 7 participants were excluded from the study due to lack of recorded fixations or faulty eye tracking data as generated by a weak track. After those 7 sets of data were set aside, the analysis cohort consisted of 28 individuals distributed across three color saturation conditions. There were 9 participants in the low saturation group, 10 in the control group, and 9 in the high saturation group. No students were exempted from the study on the basis of colorblindness, and no students with corrected vision felt that they were unable to adequately view the advertisements. Participants were tested individually in Carnegie 217; testing sessions ran 12 minutes long on average. All participants were told that they were participating in a study about color print advertisements and that their eye movements would be recorded as they looked at the screen.

Materials

Eye Tracker- An Applied Science Laboratories (Bedford, MA) Eye-Trac 6 Control Unit with user interface software and H6 Head Mounted Optics headpiece was used to collect data on eye movement while E-Prime 2.0 software (Psychology Software Tools; Pittsburgh, PA) was utilized to control the presentation of stimuli and organize recorded data from the tracker. The headpiece consists of a plastic harness that fits over the head in a fashion similar to the adjustable rigging system of a baseball helmet, and has a small translucent glass eyepiece that drops down below the wearer's left eye. This equipment, available through the Allegheny College Psychology Department, enabled the researcher to track participants' eye movements as they viewed print advertisements on a digital computer screen. After all experimental data was collected, the data analysis software ASL Results was used to plot the number of times a participant fixated on the key product and the duration of the fixation.

Manipulated Advertisements- The slide show of advertising stimuli was set on a timer of 10 seconds per slide to avoid participant favoritism or over recording of visual trails. Using the materials of Lee & Barnes, 1989, as a model the advertisements in the present study that were manipulated into the given conditions and used as visual stimuli were selected from publications popularly subscribed to by the undergraduate student body, such as Rolling Stone, Vogue, The Wall Street Journal, et cetera. See Appendix C for full set of stimuli. Only advertisements that took up a quarter of a page or more were selected; this ensured that image resolution and clarity would remain high even when resized. All images were scaled to a controlled 768 pixels tall by 1024 wide, which was the same size as the monitor on the research computer. This resizing was to avoid sizing bias where a participant might remember one ad more than the other or look at an ad differently because of size incongruence. The stimuli set was comprised of 5 advertisements featuring a car, a camera, a cell phone, a taco, and airline seating. Research has suggested that people tend to fixate on blocks of text more than images in advertisements (Rayner et al., 2001), so the selected advertisements were controlled for amount of text by word count and size of text in proportion to total size of advertisement.

Advertisements were scanned from original print format to digital format with the aid of an electronic scanner. The images were then digitally manipulated using Adobe Creative Suite 6 (Adobe Systems, Inc.; San Jose, CA) imaging software to generate high and low saturation conditions. The advertisements were edited using Adobe's Saturate/Desaturate tools to retain +50% and -50% of original color saturation respectively. Average intensity is the control level for each group, where no color saturation adjustments were made by the investigator and the advertisement was reproduced from the magazine with as little alteration as possible. High saturation is marked by vivid colors and low saturation is represented by a dulling of color. The presentation of the sideshow generally ran 2-3 minutes long, while the entire testing session from consent form to debriefing form ran 12 minutes long on average.

Post-test Questionnaire- This questionnaire contained 15 questions (3 questions per advertisement, 5 advertisements viewed) relevant to perception of advertised content, motivation to buy products after viewing and likeability of the advertisements shown. For the full questionnaire, please refer to Appendix F. The two questions regarding participant motivation to buy products and attractiveness of advertisements were based on a 6 point Likert Scale. The question about perception of advertised content one was free response where participants were asked to identify where they believed they looked first when viewing the advertisement. There were also 3 additional questions which were used to collect demographic information about the major, minor, and favorite color of participants. Questions were based off of those used by Labrecque and Milne, 2012; Rayner et al., 2001; and Dorcus, 1926.

Procedure

Participants were individually scheduled for 15 minute testing slots using the Allegheny College Psychology Department Research Participation System (SONA). Upon arriving at 217 Carnegie, they were randomly assigned to one of three possible conditions and asked to sit down at the testing terminal. Participants were asked to sit a comfortable distance away from the testing terminal such that the keyboard was still within easy reach. Individuals were then

presented with a research participation consent form and given a brief outline of the study. Please see the consent form in Appendix D. After the consent form had been signed by the participant, the researcher then gave a brief overview of the eye tracking lab and familiarized the participant with how the headset of the eyetracker operated. Once settled, the researcher placed the eye tracker headset on the participant and adjusted it to fit comfortably. The headset was lightweight, and had a small glass mirror that dropped down below the participant's left eye. The mirror was clear so as to not obstruct viewing, and did not pose any danger to the eye as the mirror did not touch the participant's face. Participants were then given the opportunity to ask further questions. Following that, the lights in the room were turned off to allow for more consistent tracking as the headset tracks eye movement by picking up on light reflections from the eye itself.

The eye tracking unit required calibration to adjust to each individual participant. This was a simple procedure whereby the participant was asked to look at nine different labeled points on a neutral background while the researcher checked to make sure that the E-Prime software was corresponding with the headset correctly. Calibration reduces the average error in gaze position. E-Prime was the program that controls the presentation of stimuli as well as records the data feedback.

In order to avoid participant bias and erroneous eye movement, participants were told that they were taking part in a study on general ad effectiveness. This avoided the potential confound of participants fixating intentionally on one area as compared to another. Participants were instructed to press the space key on the keyboard in front of them when they were ready to begin, which began the slideshow and cued E-prime to begin recording data. The advertisements presented depended on the condition the participant was sorted into- a person in the high saturation condition viewed a 5- slide presentation lasting 2-3 minutes of advertisements that had been manipulated to reflect the experimental condition. Each slide was presented individually on the full computer screen for 10 seconds before flipping to a white

screen with the text prompt “Please press space to continue”. A white fixation screen would then flash for 1 second before the next ad was presented, in order to re-focus participant gaze to the center of the advertisement. The advertisement slide order was the same for each participant. When the slideshow was over, the experimenter stopped the data recording session and turned the lights back on after first warning the participant. The headset was then loosened and gently removed, with care given to moving the mirror away from the eye before lifting the headset. The participant was then asked to fill out a short survey comprised of 15 questions. On average, the questionnaire took no more than 10 minutes to complete.

Finally, the participant was presented with a debriefing form and a brief explanation of the reasoning behind the research question. Debriefing form is located in Appendix E. SONA research participation credit was granted online at this point. The study took 12 minutes on average.

Results

Differences between the number of fixations on the key product and the average duration of fixations on the key product in the saturation conditions were compared using a one-way between subjects ANOVA with planned mean comparisons between the three levels of saturation. Levels of color saturation were coded such that low saturation = 1, control saturation= 2, and high saturation = 3. Fixation duration was measured by E-Prime in seconds; there are 100 milliseconds in one second. The data presented below is in seconds, but most literature discusses fixation duration in milliseconds. To convert to the average fixation duration on product from seconds to milliseconds, move the decimal point three space to the right (i.e., .256 seconds becomes 256 milliseconds).

A participant’s total average fixation duration on key product was calculated in two steps. First, the average fixation duration on key product was calculated for each advertisement individually by adding together the durations of fixations on the key product and dividing by the number of fixations on the key product. Then, the individual advertisement fixation duration

averages were added together and divided by the number of ads viewed, 5, to give the total average duration of fixation on the key product.

The total average number of fixations on key product was calculated in a similar manner for each participant. First, the number of fixations on key product was identified for each advertisement. Then, these scores were added together and divided by the number of advertisements viewed, 5, to give the participant's total average number of fixations on key product.

The questionnaire collected participant ratings on a 6-point Likert scale for the attractiveness of each advertisement as well as the likelihood of purchasing the product after viewing the advertisement. A participant's average likelihood of purchasing advertised product score was the sum of purchase likelihood scores divided by number of advertisements rated, 5. The average of advertisement attractiveness was calculated through the summation of advertisement attractiveness scores divided by number of advertisements rated, 5. Academic major and favorite color of participant were both dropped from further analysis due to unequal group distribution.

Total Average Fixation Duration on Key Product

A one-way ANOVA with the level of color saturation (low, control, high) as the between subjects variable was run on the total average fixation duration on key product. The main effect of level of saturation was significant, $F(2, 25)= 5.173$, $p=0.013$, $\eta_p^2=0.293$. A series of planned mean comparisons were calculated and found that participants fixated longer on the key product in low saturation *(M*= .256*, SD*=0.034) than in the control saturation (*M*= .222, *SD*=0.019), *F(*1, 17)= 7.26, $p = .015$, $\eta_p^2=0.299$. Total average fixation duration on key product was also significantly different between low saturation (*M*= .256, *SD*=0.034) and high saturation conditions (*M*= .213, *SD*=0.035), $F(1, 16)= 6.9$, $p = .018$, $\eta_p^2=0.304$. There was no difference in the total average fixation duration on key product between control saturation (*M*= .222, *SD*

=0.019) and high saturation (*M*=.213; *SD*=.035), *F*<1.

Total Average Number of Fixations on Key Product

A second one-way ANOVA with the level of color saturation (low, control, high) as the between subjects variable was run on the total average number of fixations on key product. The main effect of level of saturation was not significant, $F(2, 25)= 2.707$, $p=0.086$, $\eta_p^2=0.178$. A series of planned mean comparisons were calculated and found that there was no statistically significant difference in the total average number of fixations on key product between low saturation (*M*= 10.86, *SD* =4.48) and control saturation (*M*=8.9; *SD*=2.659), $F(1,17)= 1.3$, $p= .27$, $\eta_p^2=0.071$. Additionally, there was no difference in the total average number of fixations on key product between control saturation (*M*= 8.96, *SD* =2.65) and high saturation (*M*=7.5; *SD*=1.22), $F(1,17)= 2.26$, $p= .15$, $\eta_p^2=0.118$. However, there was a significant interaction between low saturation (*M*= 10.86, *SD* =4.48) and high saturation (*M*=7.5; *SD*=1.22), $F(1, 16)= 4.7$, $p =.045$, $\eta^2=.227$.

Average Attractiveness of Advertisement

A one-way ANOVA with the level of color saturation (low, control, high) as the between subjects variable was run on the average attractiveness of the advertisements. The main effect of level of saturation was not significant, $F(2, 25)= .317$, $p=0.731$, $\eta_p^2=0.250$. A series of planned mean comparisons were calculated and found that participants did not significantly rate the attractiveness of low saturation advertisements (*M*= 3.911*, SD*=0.686) differently than in the control saturation (*M*= 4.06, *SD*=0.499*), F(*1, 17)= .297, $p = .593$*,* $\eta_p^2=0.017$. The average attractiveness of low saturation advertisements (*M*= 3.911, *SD*=0.686) was not statistically significant from high saturation advertisements (*M*= 3.844, *SD*=0.630), $F(1, 16)= .046$, $p = .833$, $\eta_p^2=0.003$. There was no statistically significant difference between the average attractiveness of control saturation advertisements (*M*= 4.06, *SD*=0.499) and the average rating of high

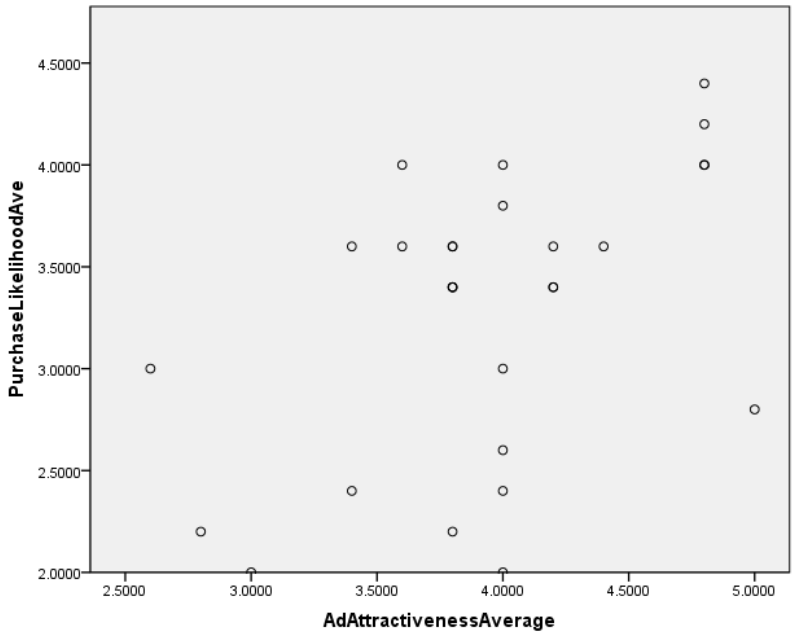
saturation advertisements (*M*= 3.844, *SD*=0.630), *F*(1, 17)= .690, *p* = .418, η_p^2=0.039.

Average Likelihood of Purchasing Advertised Product

A one-way ANOVA with the level of color saturation (low, control, high) as the between subjects variable was run on the average likelihood of purchasing advertised product. The main effect of level of saturation was not significant, *F*(2, 25)= .720, *p*=0.497, η_p^2=0.054. A series of planned mean comparisons were calculated and found that participants did not significantly rate the likelihood of purchasing products presented in low saturation advertisements (*M*= 3.42, *SD*=0.703) differently than in the control saturation (*M*= 3.34, *SD*=0.660), *F*(1, 17)= .069, *p* = .796, η_p^2=0.004. The average likelihood of purchasing products presented in low saturation advertisements (*M*= 3.42, *SD*=0.703) was not statistically significant from purchase intent ratings of high saturation advertisements (*M*= 3.04, *SD*=0.753), *F*(1,16)= 1.2, *p* = .288, η_p^2=0.070. There was no statistically significant difference between the average likelihood of purchasing products presented in control saturation advertisements (*M*= 3.34, *SD*=0.660) and the average rating of purchase intent of high saturation advertisements (*M*= 3.04, *SD*=0.753), *F(*1, 17)= .831, *p* = .375, η_p^2=0.047.

Pearson Product-Moment Correlation Coefficient Between Average Attractiveness of Advertisement and Average Likelihood of Purchasing Advertised Product

A Pearson product-moment correlation coefficient was calculated to assess the correlation between the average attractiveness of advertisements and the average likelihood of purchasing the advertised product. There was a positive correlation between the two variables, *r* = .488, *n* = 28, *p* = .008. A scatterplot below summarizes the results (Figure 1).



Discussion

While I found the eye drawings to be immensely interesting and downright fun to create, I found that without any context they simply did not make any sense to a naïve viewer. They were an interesting marriage of art and science, but when viewed objectively on a wall they conveyed nothing about color saturation, advertising, and little about eyes. Concurrent to the exploration of using the eye tracker to draw, I began photographing people's eyes. Eyes are powerfully engaging to any audience, without exception. I wanted to incorporate eye imagery into the final show, but I did not want to simply submit blasé pictures of eyes. Given the exploration of the eye tracker as a tool for creating art, I began attempting to draw eyes using my eyes. I found mixed success in unprompted drawing sessions, but hit upon a winning idea when I coded a photograph of an eye into the E-prime program and attempted a tracery of the image with purposeful fixations. When combined, the resulting heat maps and fixation plots created a piece that was highly abstracted, yet still clearly recognizable as an eye. Please refer to Items 3, 4, and 5 under List of Works Created. I found that I when I laid the original image back over the eye tracker-generated drawing, a visually fascinating interaction took place such

that the eye seemed to emerge out of the chaos of the data points. At the suggestion of Professor Sue Buck, I began experimenting with video and showing the emergence of the eye at different levels of opacity. The pieces *Eyes Only, Different Way of Seeing,* and *Look Here* are the presentation of the transformative combination of science and art, as the three- step increase in the photograph's visibility is evocative of the three levels of saturation used in the present study. Later, I returned to this concept to create a video, *The Eyes Have It.*

I began attempting to trace images advertisements with my eyes, leading to duplicates or interpretations in fixation plot form and the creation of two pieces that form part of my final show. For one, *Staring at Sorrento*, I did exactly as the name implies; please refer to Item 6 under List of Works Created. I found an advertisement for Sorrento-brand dairy products and was attracted to the use of saturated complementary colors red and green in the packaging. I scanned it into a digital format, imported it into my eye tracking art program, and began attempting to copy it using my eyes only. After many sessions of jittery tracks that jumped off the screen, a compilation of multiple sessions showed some success in defining forms in the space. I was pleased by the fixation plot map, and when the many sessions were again laid over the initial advertisement, and interesting dialogue arose between the natural pattern of movement suggested by the design of the advertisement and my artificial, purposeful fixation patterns. The careful control of my eye movements and the exactitude in the placement seemed at odds to the more gentle viewing pattern suggested by the centered circular nature of the advertisement design, and when the two were brought together I found that I could only follow my fixation plot drawing. The lines of the fixation plot force the eye of the viewer to travel a different pattern. The juxtaposition of the two ways of viewing (i.e., my structured viewing versus the unstructured viewing of the unedited advertisement) echoed what the results of my eye tracking study seemed to be reporting: every individual has a slightly different way of looking at the same object. There will be overlaps in similar fixation points stark differences in the location

of other points, but no two people will share the exact same fixation pattern.

I found that I wanted to share this finding in the context of my study but also in the form of works of art, which led to the creation of the two series *Saturation* and *Just The Facts, Please.* These six pieces are presented in a three by two grid format, and are comprised of stimuli and data taken directly from my study. When referring to the List of Works created, please note that 7 and 10, 8 and 11, and 9 and 12 are the correct pairings of plots to stimuli. Across the top row, the Honda Civic advertisement is shown in all three saturation conditions with the Area of Interest (AOI) marked and the tracking results of three different participants superimposed over the advertisement. The bottom row is comprised of the same AOI and compiled fixation plots that correspond to the saturation level of the piece above, but in this instance they are shown on a white background and the colors of the plots have been changed to a trio of highly intense analogous colors. I wanted to show the plots within the context of the advertisements and show that there were three distinct levels of saturation viewed by participants, but I also wanted to clearly show the viewer the similarities and differences between individuals in a condition so that the viewer could make their own conclusions about fixation patterns, rather than simply being told in the form of a written label. The highly intense colors that I chose for the plots are all relatively close on the color wheel in terms of hue, but are different in saturation level. When the compiled plot piece for low saturation is viewed in comparison to the compiled plot piece for high saturation, the differences in viewing pattern becomes rapidly apparent and is consistent with the numerical analysis of the data run through SPSS. This presentation of stand-alone data as a work of art also reinforces the theme of science as art; while this theme is evident through the use of eye tracking equipment and data in all of my pieces, it becomes solidified when the plots themselves are showcased and allowed to speak directly to the audience rather than interpreted as a dry set of numbers and analyzed in a standard scientific way. The inverse is also true- art is a science, especially when the exactitude of color relationships and their psychological responses are taken into consideration.

Art and technology are a pairing that has been widely explored across a plethora of themes and mediums, yet art and science as a pair where one is used to inform the other has only recently begun to be explored within the past two decades. I decided to include the poster that I designed for the Western Pennsylvania Undergraduate Psychology Conference (WPUPC) as an installation in the art show for multiple reasons. Please refer to Appendix J for the poster. Primarily, I was concerned with giving the audience more context for how the other art pieces were created, and why the saturated colors and fixation plots were important to the work. By presenting the poster as an art piece, I gave the audience an overview of the scientific side and explained how color saturation affected fixation duration, fixation location, and the relationships between color saturation, attractiveness of advertisement and motivation to buy the product presented in the advertisement. The design of the poster itself reflects the careful study of color saturation that I have made all year. I purposefully chose to work with a tonal yellow color palette- a bright, active color that is also flexible with a wide range of saturation intensities. I created the background as a gradient from light yellow to a de-saturated/neutralized yellow-grey in order to give some suggestion of motion to the poster and attract attention. I kept the default gold color for the section headers because it is a heavily saturated color and stands in bold contrast to the background without being visually disruptive the viewer. Then, I chose to present the three levels of saturation condition using an advertisement whose color scheme was complementary to the background, so as to create a bigger visual contrast and catch viewer attention. The IPhone advertisement's blue-red colors were perfect in this regard. I also included a picture of the eye tracking headset so that viewers would have a better understanding of the hardware used and the technical difficulties associated with its use. While labels underneath each art piece are helpful for explaining the body of work, I found that the inclusion of the poster strongly underscored the idea of science as art, and balanced the collection by explaining in straightforward terms the how and why of the creation of the other works.

The last two pieces that comprise my body of work are video based. As I was working on all of these pieces, it became clear that a project based off of eye movement really ought to have a moving component as part of the installation. The first piece, *The Eyes Have It,* has a running time of roughly 3 minutes but loops continuously. It is a complete fleshing-out of the digital print pieces *Eyes Only, Different Way of Seeing,* and *Look Here;* the video documents the increasing saturation of the photograph of the eye as the fixation points melt into the eye itself. It presents a documentation of the creation of the work as an incremental process by layering in each session of fixation drawing one by one until the first piece *Eyes Only* is clear, then proceeds by increasing the visibility and color saturation of the eye photo until the halfway mark *Different Way of Seeing* is reached. The animation then proceeds to a final end and loop back, where the eye photograph shown at full color intensity is both the beginning and end of the video. I wanted to show the viewer how the pieces were created rather than merely telling them, and I believe that I achieved this in the deliberate pacing of the frames and manipulation of color intensity. This video also serves as a good introduction to the rest of my show, as it prompts the viewer to the use of scientific-looking data, eyes, and color intensity as main themes running through the rest of the work. The other video piece included is *Finding & Fixating,* which is a documentation of an eye tracking session viewed via the feedback output from the tracker itself. The footage is in black and white, and begins in an abstract manner as the tracking mirror is adjusted to search for the reflection of the pupil. It is disorienting to watch, similar to the feeling of being lost and searching for a familiar landmark. The film steadies out a few minutes in when the pupil and corneal reflections are located; then it is only minorly adjusted to solidify the track. A moment later and the film shows us an inverted, black and white eye as it moves around searching and fixating. This continues for a moment longer before the film comes to a conclusion at roughly four and a half minutes in. I wanted to play with the viewer's awareness of their own eyes moving as they watch an abstracted but clearly recognizable eye search and stare at off screen stimuli, and I feel that this video provokes the audience to do so. It is also a

re-visitation to the creative theme of using the scientific equipment to create visually compelling works of art, but through a different medium in this instance. These videos neatly bookend the presentation of my work, presenting the how physical eye-movement is translated into 2-D data points, and how the data can subsequently be used to create new works of art.

Results Summary

The present study hypothesized that color saturation would have a significant effect on the mean duration of participant fixations on the key product. The results supported this. The present study also proposed that individuals in the high saturation condition would have longer duration fixations on identified key object areas than those in the low saturation condition. The results failed to support this hypothesis. Instead, the results show that that the inverse is true: individuals in the low color saturation condition had longer fixation times on key product areas than those in the high color saturation condition. To see the plot of fixations and heat map for low saturation condition, see Appendix G. The present study predicted that participants viewing low color saturation advertisements would have shorter fixation duration times on key product areas than those viewing control level saturation advertisements. The results failed to support this. Again, the results proved the inverse to be true, where participants in the low color saturation condition fixated longer on the key product than participants in the control group. To see the plot of fixations and heat map for the control saturation condition, see Appendix H. The present study predicted that participants in the low color saturation condition would have shorter average fixation duration times than those in the control saturation level. The results failed to support this hypothesis. Please refer to Appendix I to view the heat map and fixation plot for the high saturation condition.

The present study predicted that the level of color saturation in advertisements would have a significant overall effect on a participant's average number of fixations on the key product. The results did not support this. The present study proposed that individuals in the high

saturation condition would record a higher average number of fixations on identified key object areas than those in the low saturation condition. The results did not support this. Instead, the results showed the opposite to be true, where participants in the low color saturation condition had higher average number of fixations on key products than did those in the high color saturation condition. The present study also predicted that participants in the low color saturation condition would have lower average number of fixations on the key products than those in the control saturation level. The results failed to support this hypothesis as there was no significant difference between the mean averages. Finally, the present study predicted that participants in the high color saturation condition would have higher average number of fixations on the key products than those in the control saturation level. The results failed to support this hypothesis as there was no significant difference between the mean averages.

The present study hypothesized that an increase in color saturation would have a positive effect on how participants scored the attractiveness of each advertisement; however, the results failed to support this. There was no significant difference in ratings of advertisement attractiveness across the three color saturation conditions.

Following the previous hypothesis that increased saturation would increase the attractiveness of the advertisements, the present study also proposed that an increase in color saturation would increase the likelihood of purchasing the advertised product, given that previous research had indicated a positive correlation between the two scores (Lictle 2007). The results failed to support a significant affect of color saturation on purchasing intent. However, the results did support the existence of a positive correlation between advertisement attractiveness and purchasing intent. It is important to note that these two items are only casually correlated, and not causal.

Interpretation of Results

The present study found that color saturation exerted an influence on the mean duration of fixations on the key object, where participants in the low saturation condition fixated on the

key product for longer periods of time than did participants in both the control and high color saturation conditions. These findings seem contradictory to current study findings, as it was hypothesized that individuals viewing high saturation ads would fixate longer rather than those viewing low saturation advertisements. It is possible that there is a confounding variable of contrast here: advertisements that were low in color saturation still had spots and small areas of intense color which could have drawn the eye. It is possible that these areas of sharp contrast caused participants to fixate longer in the low color saturation condition, but it does not explain why participants in the control color saturation condition had longer fixation times than participants in the high color saturation condition.

The present study examined the relationship between color saturation level and the average number of times that a participant fixated on the key product presented in an advertisement, and the results supported that participants in the low color saturation condition had a higher number of fixations than did participants in control or high color saturation conditions. These findings again contradict the hypothesis originally proposed, where participants in a high color saturation condition were expected to have the highest number of fixations. This finding is unusual. It seems that as saturation levels increased, participants fixated on the key product less often and for shorter periods of time. It is possible that an explanation for this lies in the concentration of colors and overall design of the advertisement. However, it is more likely that as color saturation increased overall, more areas of the advertisement became vivid and attractive to the eye as opposed to just the key product. As the key area of interest stood out less, participants were less likely to fixate on it as well as less likely to spend time fixating on it. The reduction in contrast between key product and the rest of the advertisement is presumably why participants in the high color saturation condition had lower numbers of fixations and lower duration times of fixations on the key product.

The present study also examined the participant ratings of advertisement attractiveness and how the average rating is affected by color saturation level. The results did not have any

significance, which is contradictory to the studies that indicated that increases in color saturation are associated with increases in ratings of advertisement attractiveness. In fact, the mean average rating of attractiveness decreased both as color saturation increased and as color saturation decreased. Low saturation advertisements received an average score of 3.911, while high saturation advertisements scored an average 3.844. Participants rated control saturation advertisements as the most attractive, with an average score of 4.06. It is highly probable that the advertisements were overly saturated and overly de-saturated past ideal attractiveness levels. Presumably a published advertisement is already at an ideal level of attractiveness once it is published and while a smaller increase in color saturation may have yielded a positive increase in attractiveness rating, a 50% increase in color saturation was probably far too much.

The average likelihood of a participant buying the advertised product after viewing the advertisement was also compared to saturation level, though the results did not support any significant relationship. This provides evidence for future studies to expand upon, as there is little current research about consumer motivation to buy a product after viewing highly saturated or desaturated advertisement content. However, a Pearson's r test confirmed the existence of a positive correlation between average rating of advertisement attractiveness and average likelihood of buying the advertised product, which is consistent with current literature regarding consumer attitudes and print advertisements in general.

Limitations of the Present Study

While the present study was developed following standards of research integrity, there are limitations in the research design which may have affected the results. Lack of clarification within current literature regarding exactly what constitutes color saturation was an obstacle often encountered in the completion of the present study. As previously mentioned, color saturation or a construct defined in a strikingly similar way was often referred to under various other names such as intensity, brightness, shade, vividness, chroma, and color purity; this confusion where

the same color component was studied under multiple different names led to uncertainty on the validity of the color saturation construct. While it is clear from the results that color saturation was tested in the present study with some statistical significance, it is hard to say if that is true for other literature when hue and saturation are two separate components of color that are easily confused.

Aside from the difficulty of a standard for referencing saturation, there is the problem that each color reaches maximum saturation at different levels on the Munsell system, depending on how pure the original hue was to start with. Colors such as red, blue, and purple reach full saturation intensity at much higher chroma levels than colors such as yellow; this discrepancy could result in the faulty manipulation of advertisements leading to certain areas of an advertisement becoming over saturated despite a careful control of manipulation. A design that would negate this problem would be to test advertisements that all contain similar color palettes as groups, such as predominately green ads, predominately red ads, etc. This way, the effect of saturation level could be explored more thoroughly and with greater precision.

My journey in creating art through science was not without limitations either. Aside from the infuriatingly unpredictable program crashes and data-reading incompatibilities, there were significant challenges posed by the nature of combining two different disciplines into one succinct piece. Additionally, at times, my own anxieties and ideas blocked the forward progression of the project as a whole. Daunting as it was to begin, in retrospect it seems that all of the bumbling and failed attempts were necessary. The frustration of beginning down all of the wrong paths before finally finding a direct route that felt seamless was indescribably panic-inducing, but in some ways that pent up frenetic energy was helpful once I was headed in the right direction. What began as a personal examination of media saturation spiraled into a dialogue between the art and science regarding nearly every aspect of color saturation. I feel confident in the completed pieces and their ability to effectively convey this commentary without losing any of the directness of the data output or subtlety of color usage.

Personally, perhaps the most significant result from the entirety of this year's work comes not in the form of statistical significance or a highly successful show; but a recognizable and substantial shift in the way that I perceive what art and color are, and what they can be. That is not to discredit or elevate one portion of my senior comprehensive over another, but a commentary on how the combination of two distinct disciplines has broadened my views of both. I wrote my very first draft proposal for this project in the fall semester of my junior year, gamely and naively thinking that I had a fairly good grasp of what art was, how color was used in art and advertising, and what the scientific community had to say about all of it. It seemed straightforward enough: art was the production of something visually compelling, and historically featured bold color usage and naked women. While the preceding statement was made in a satirical manner, it is also a rough approximation of the truth. Everyone has their own personal definition for what art is and what it is not; I was quite firmly stuck in my own views up until February/ March of my senior year. I felt an intense need to produce a body of work that was crisp, classic, consistent with some kind of art history precedent, and that somehow tied in color saturation, advertising, and psychology. In creating work that examined the over-saturation of media and societal product consumption, I was attempting art as activism yet missing the fundamental psychology portion. When I then turned to inverted logos, I found the psychological research behind brand and color association to be fascinating, and artistic concept I was so mentally stuck on produced nothing more than a visually compelling one-trick pony. If I had been asked in January to guess what my final show would look like in April, I do not believe that I would have come anywhere close to describing a body of work comprised almost entirely of eye movement. The turning point in my re-definition of what art and color usage are came with the realization that the lines, numbers, and ways of looking, when recorded and compiled with the eye tracking unit, comprised a unique form of art that spoke directly to my perception of perception. The pre-conceived notions that I had set forth at the beginning of the process in the form of hypotheses about the impact that color saturation would have on perception were

disproven to the degree that not only was I wrong; I was in fact, completely and utterly wrong--and it was thrilling. High saturation did not cause people to fixate for a longer period of time; low saturation did! Why would someone spend a longer period of time examining a dull, lifeless advertisement than a resplendently colorful advertisement? It seemed so counter-intuitive! As conclusive data from testing sessions began adding up, I felt an increasing desire to somehow use eye tracking data in my art. I believe that it was the absolute acceptance of being wrong that led to a personal redefinition of understanding art and integration of the eye tracker into the creative process. Whereas I began this project with the narrow view that raw data had no business in an art show, I can see that it is the raw immediacy of the data and the power of allowing the audience to make their own analysis of the numbers that gives significant meaning to my work from this semester. When the gallery show opens on Tuesday, I will have the unique opportunity to challenge the preconceived notions of my viewers in much the same way that my project challenged and changed me. I believe that if the same lightbulb that clicked for me goes on for even just one other person, I will consider the show, and my comprehensive in its entirety, a success.

The implications of the present study and body of work show that color saturation level does play a part in influencing how people perceive advertisements, and that this relationship can be expressed through a variety of forms and mediums. Further study needs to be devoted to the challenges presented in separating saturation from value when testing advertisements, but given the interdependence of hue, value, and saturation, it is likely that future studies will need to devise a reliable system of calibration. Additionally, it is worth noting that colors displayed on a digital screen will always appear more intensely saturated than when they are printed or painted using pigment; this is due to the extra light emitted from the screen itself whereas paper and canvas are only externally lit. However color might be expressed, it will remain the crucial component in designing eye-catching compositions for art and advertising. Beauty may be in the eye of the beholder, but the level of saturation certainly affects how we

look at beauty.

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1. Michelangelo Merisi da Caravaggio, *Portrait of Fra Antonio Martelli*, 1607-1608, Oil on Canvas, 118.5 x 95.5 cm, Galleria Palatina, Retrieved from artStor.



2. Rembrandt van Rijn, *Herbert Doomer*, 1640, Oil on Wood, 75.2 x 55.2 cm, The Metropolitan Museum of Art, Retrieved from artStor.



3. Georges Seurat, *Farm Women at Work*, 1882-1883, Oil on Canvas, 38.5 x 46.2 cm, Solomon R. Guggenheim Museum, Retrieved from artSTOR database.



4. Claude Monet, *The Portal of Rouen Cathedral in Morning Light,* 1894, Oil on Canvas, 100 x 64.9 cm, J. Paul Getty Museum, Retrieved from artSTOR database.



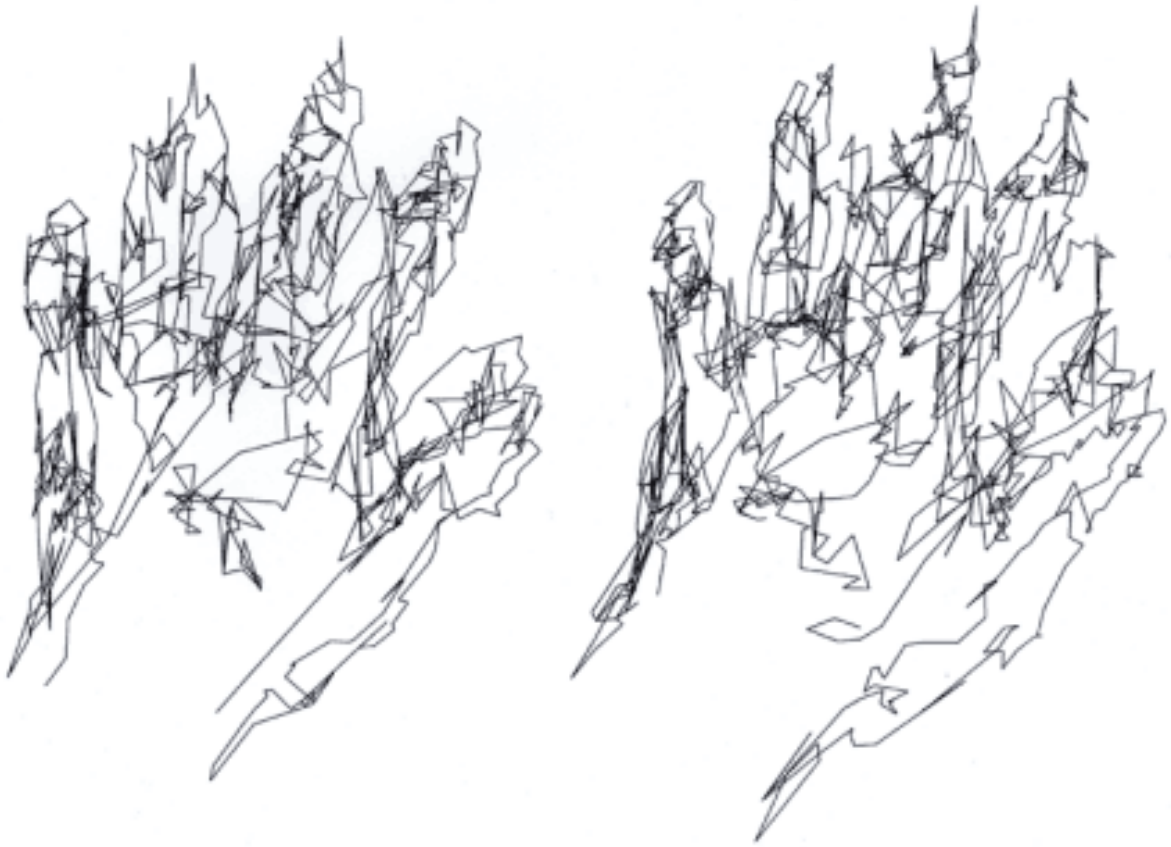
5. Claude Monet, *Rouen Cathedral: The Portal(in Sun),* 1894, Oil on Canvas, 88.7 x 65.7 cm, The Metropolitan Museum of Art, Retrieved from artSTOR database.



6. Josef Albers, *Never Before j*, 1976, Screenprint, 48.26 x 50.8 cm, Josef and Anni Albers Foundation, Retrieved from artSTOR database.



7. Mark Rothko, *Untitled*, 1967, Acrylic on Paper, 64.77 x 49.2125 cm, Estate of Christopher Rothko, Retrieved from artSTOR.



8. Jochem Hendricks, *Hand (left eye / right eye),* Ink on Paper, 61 x 43 cm, Collection of the Artist, Retrieved from artist's website http://www.jochem-hendricks.de/



9. Jochem Hendricks, *Newspaper*, Rotary Print, 57 x 40 x 0.2 cm, Collection of the Artist, Retrieved from artist's website http://www.jochem-hendricks.de/

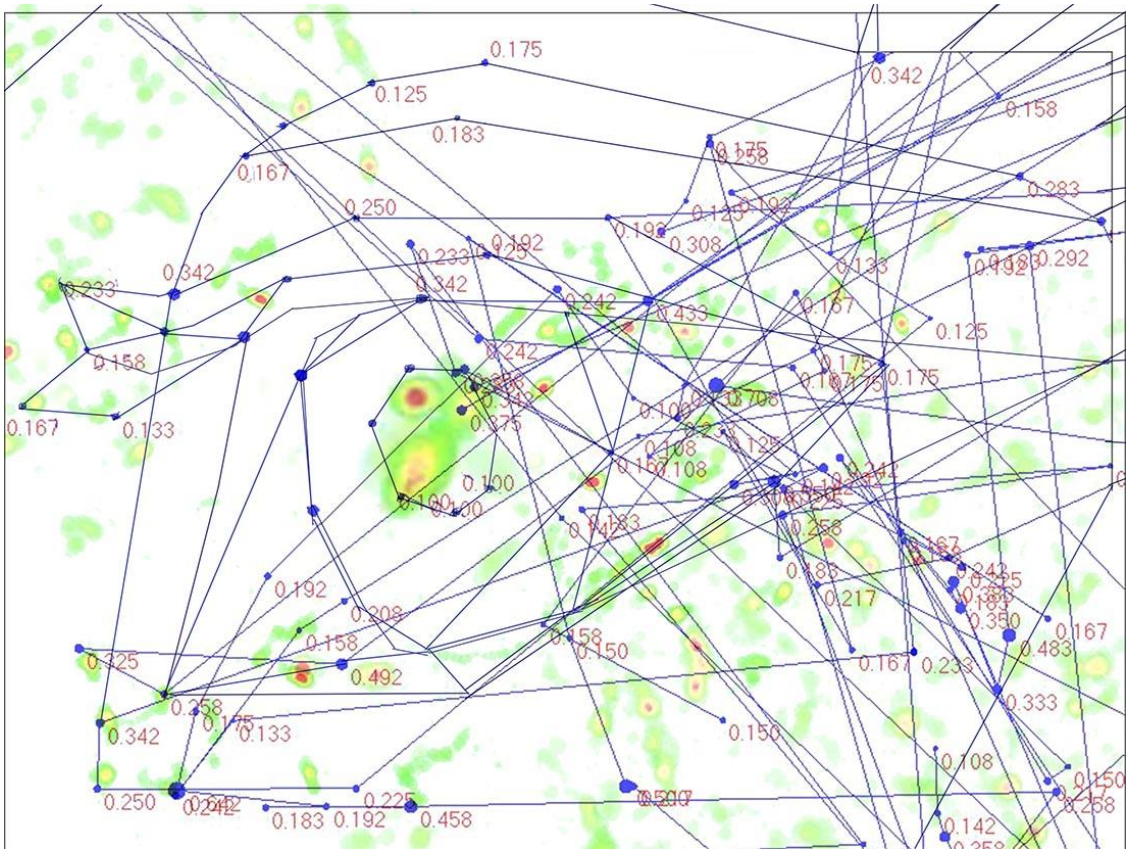
List of Works Created



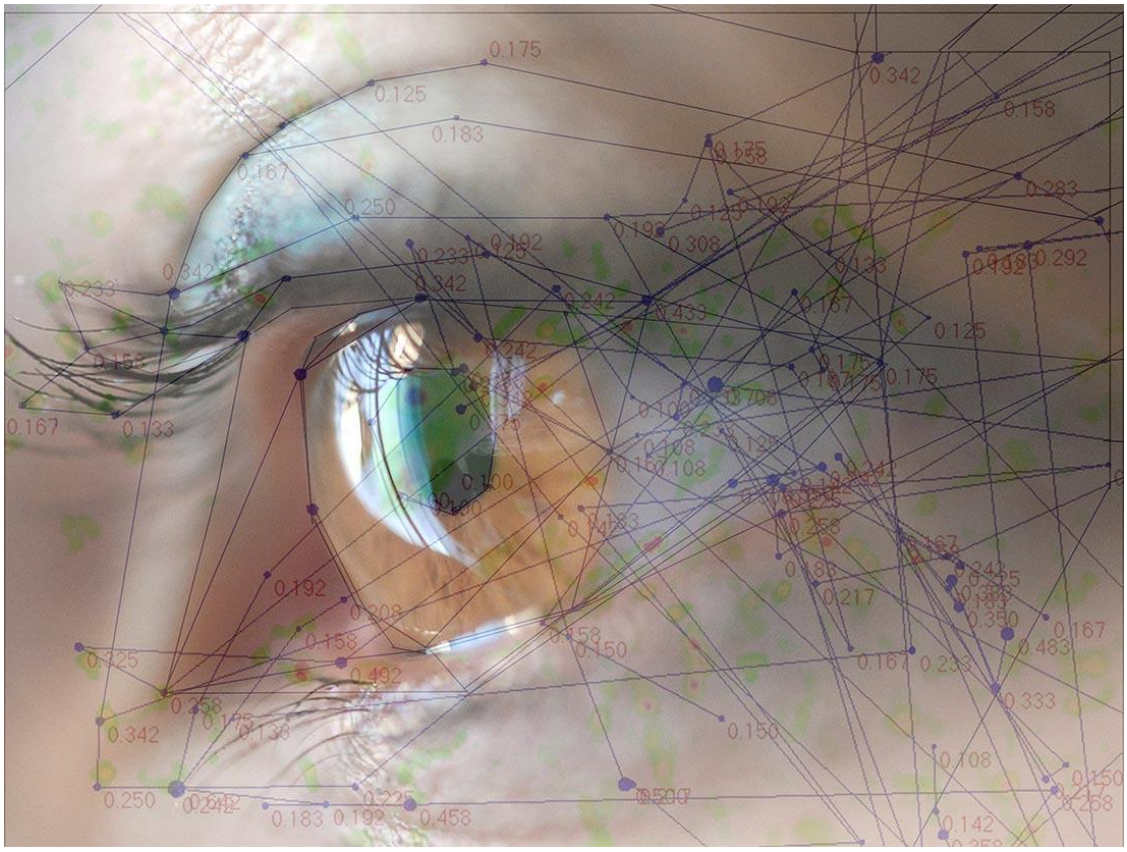
1. Jessica Duvall, *Untitled A*, 2014, Digital Print, 17” x 22”



2. Jessica Duvall, *Untitled B*, 2014, Digital Print, 17” x 22”



3. Jessica Duvall, *Eyes Only,* 2014, Digital Print, 17” x 22”



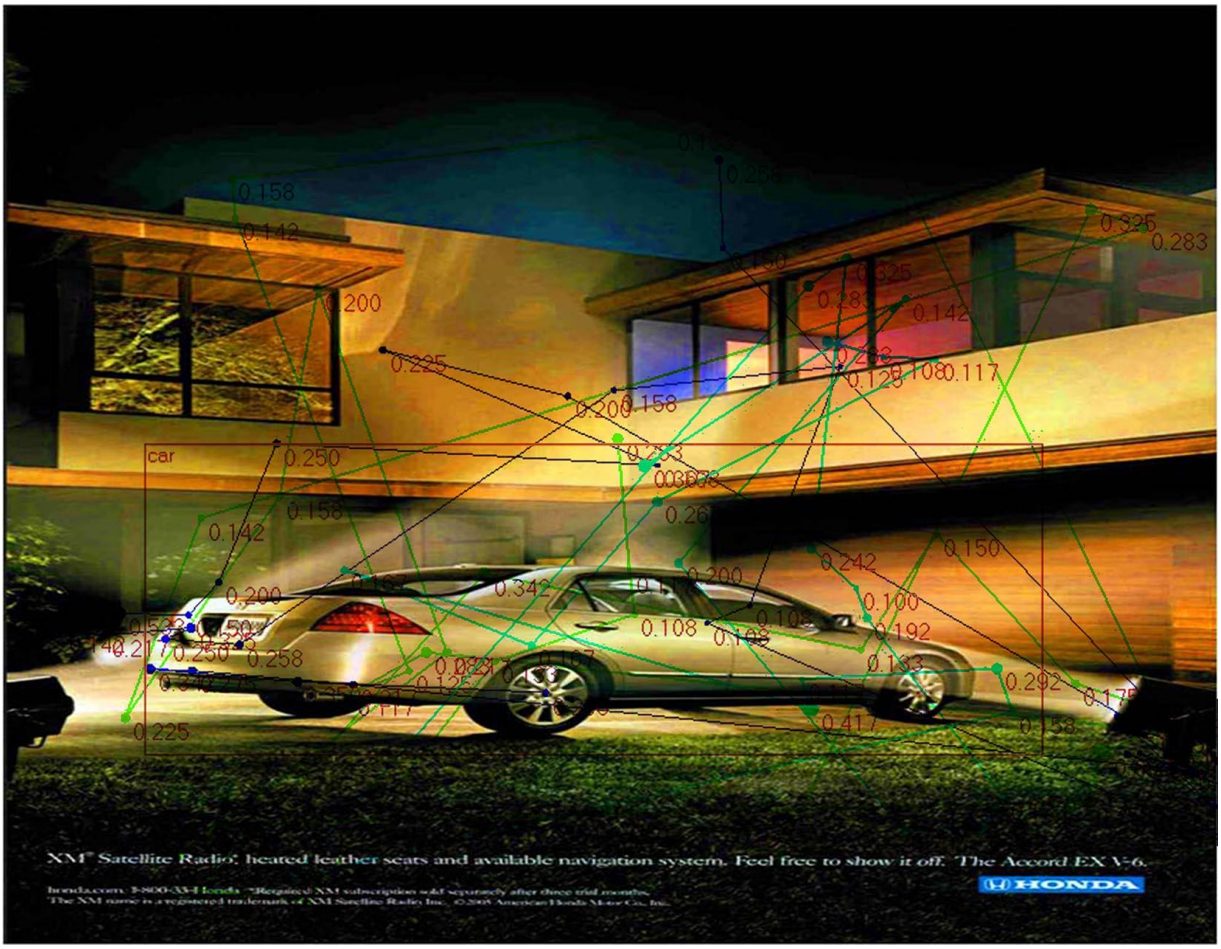
4. Jessica Duvall, *Different Way of Seeing,* 2014, Digital Print, 17” x 22”



5. Jessica Duvall*, Look Here,* 2014, Digital Print, 17” x 22”



6. Jessica Duvall, *Staring at Sorrento,* 2014, Digital Print, 22" x 17"



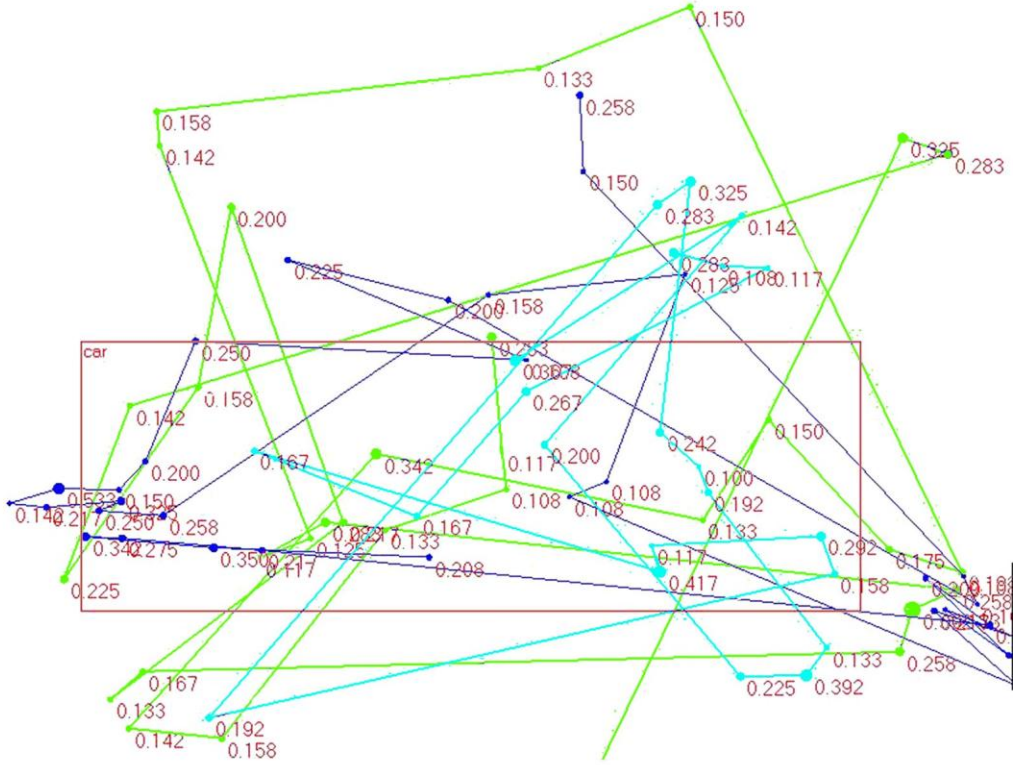
7. Jessica Duvall, *High Saturation,* 2014, Digital Print, 17” x 22”



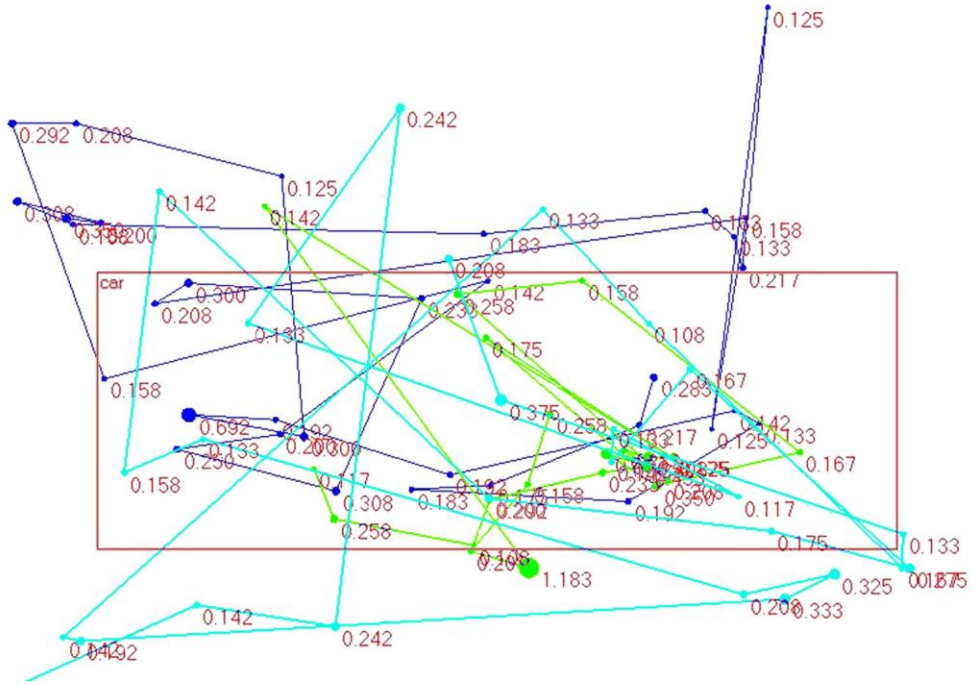
8. Jessica Duvall, *Control Saturation,* 2014, Digital Print, 17” x 22”



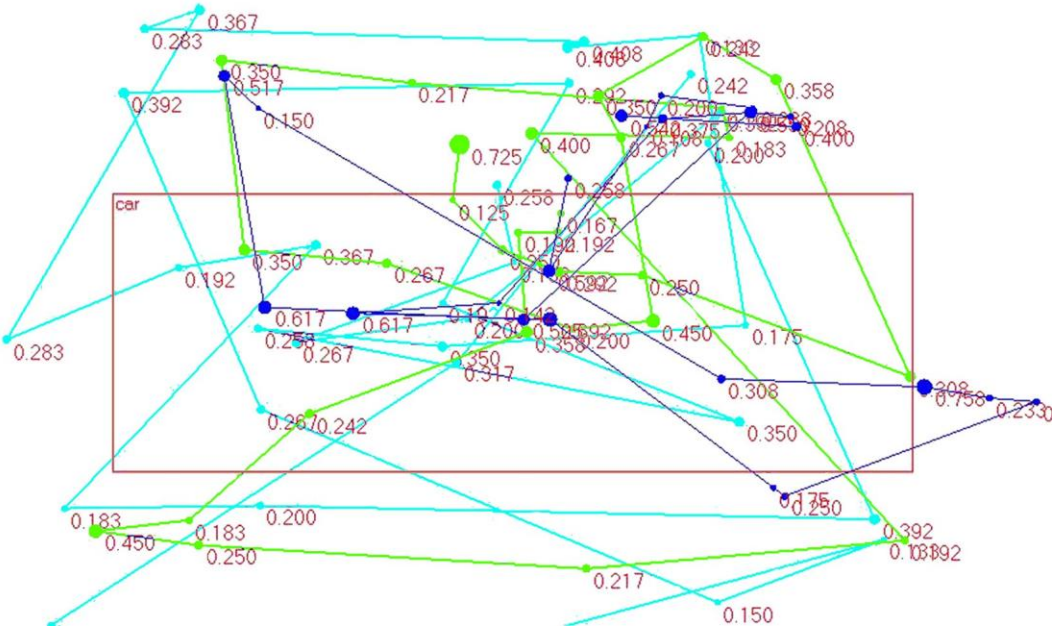
9. Jessica Duvall, *Low Saturation,* 2014, Digital Print, 17” x 22”



10. Jessica Duvall, *Just The Facts, Please,* 2014, Digital Print, 17” x 22”



11. Jessica Duvall, *Just The Facts, Please II,* 2014, Digital Print, 17” x 22”

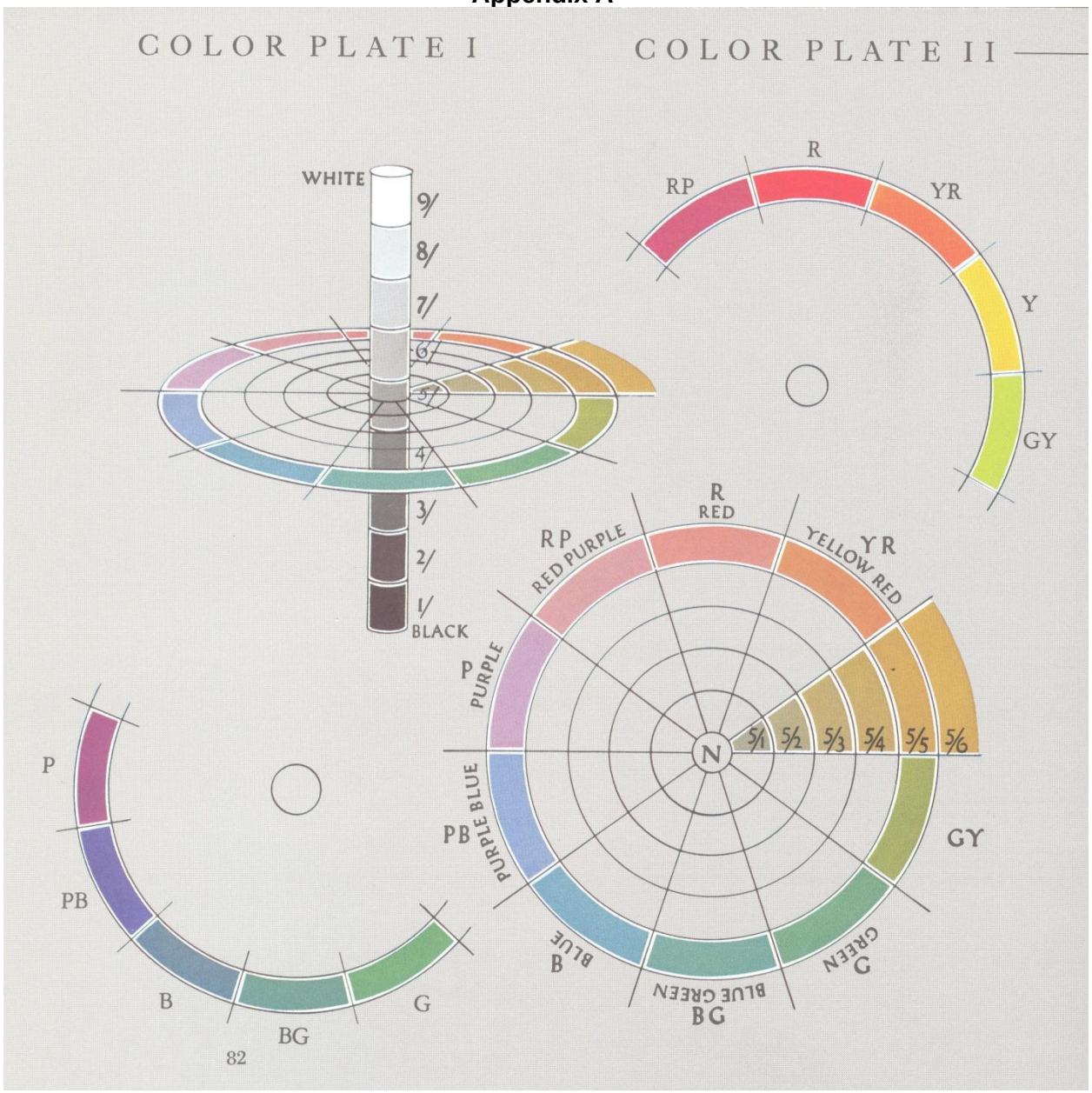


12. Jessica Duvall*, Just The Facts, Please III,* 2014, Digital Print, 17" x 22"

13. Jessica Duvall*, Finding & Fixating,* 2014, Digital Video

14. Jessica Duvall*, The Eyes Have It,* 2014, Digital Video

Appendix A



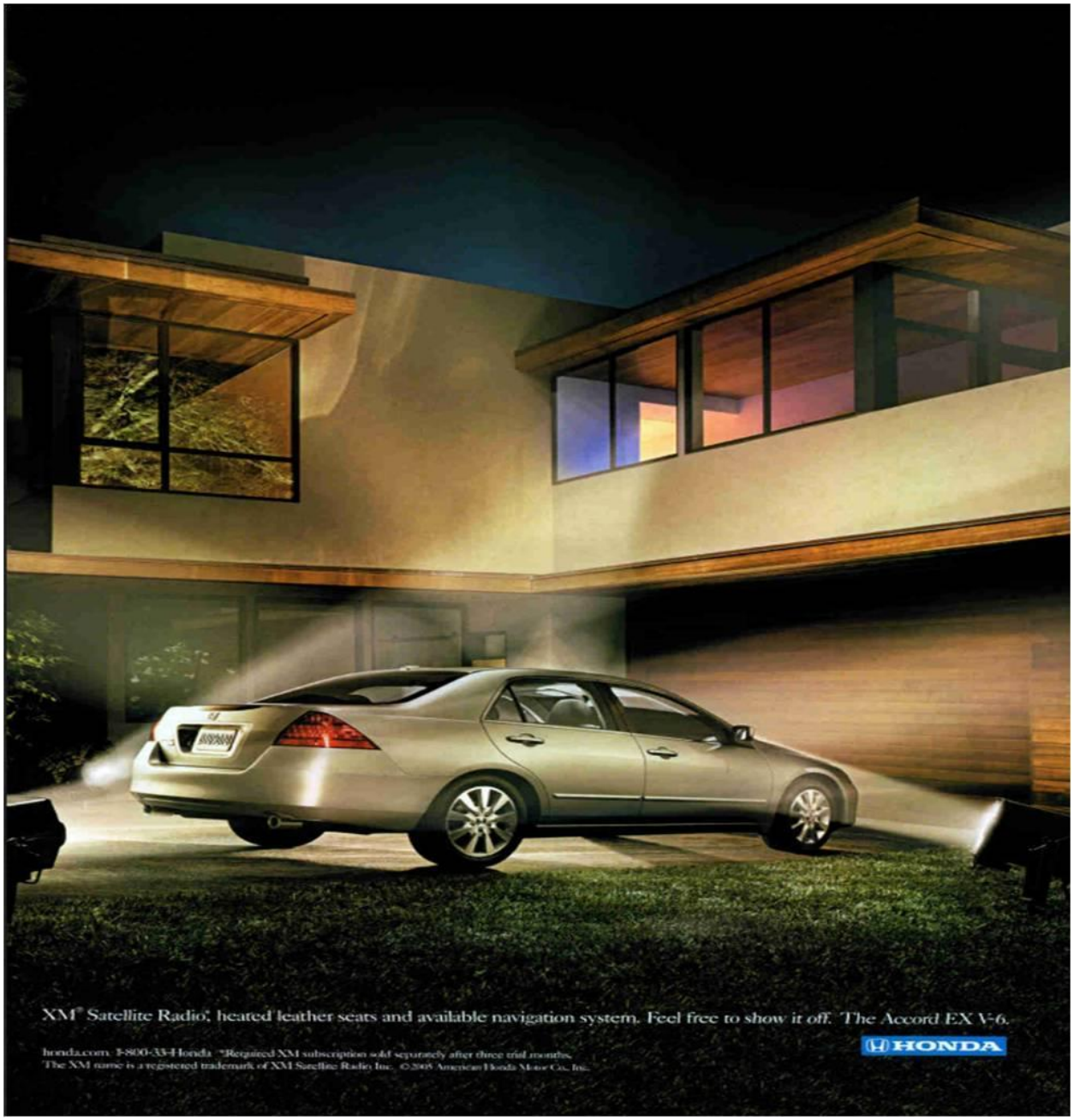
A color plate from *Munsell: A Grammar of Color*, displaying examples of color wheel sections.

Appendix B

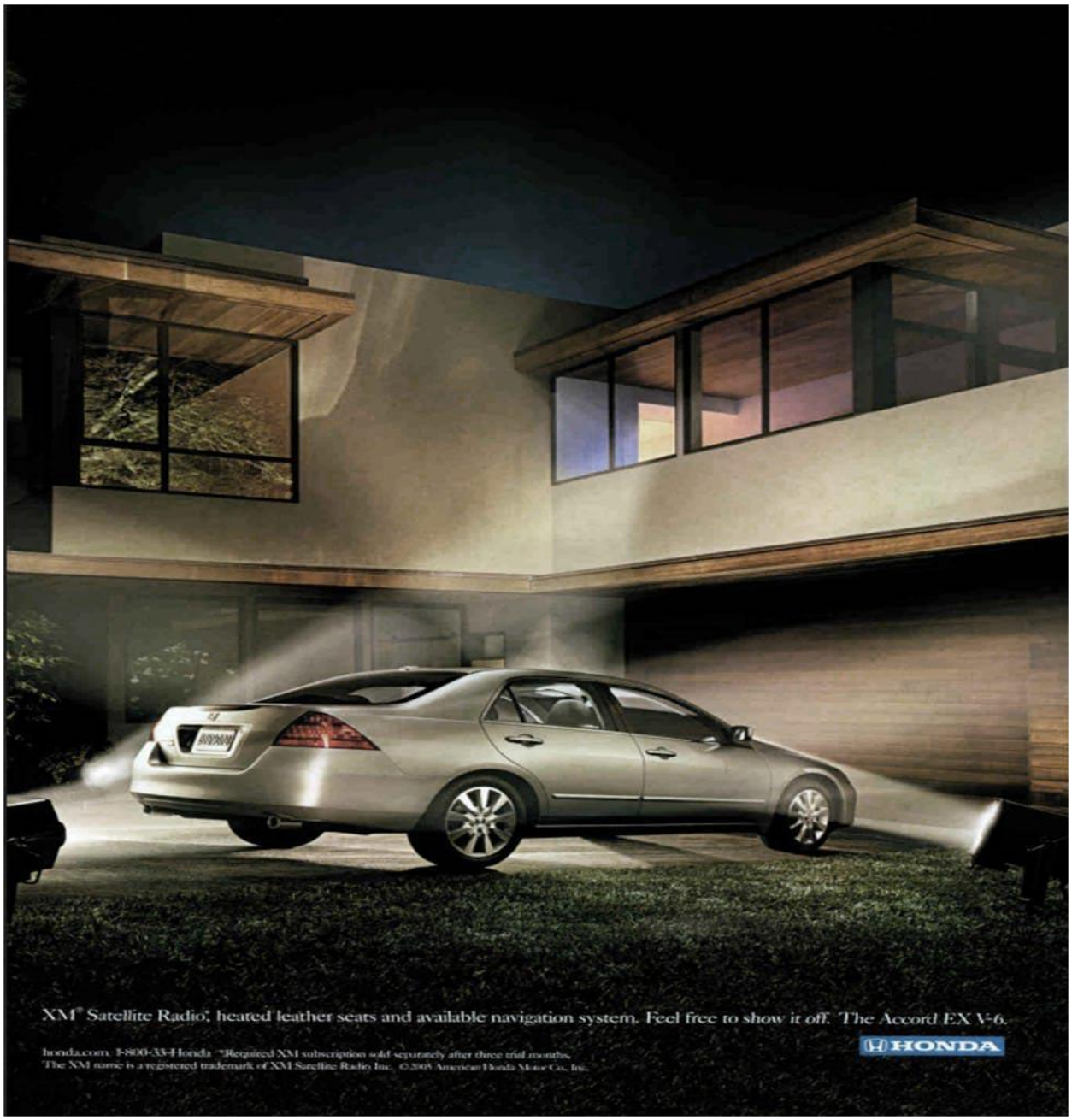


A color plate from *Munsell: A Grammar of Color*, displaying increasing saturation in the color yellow.

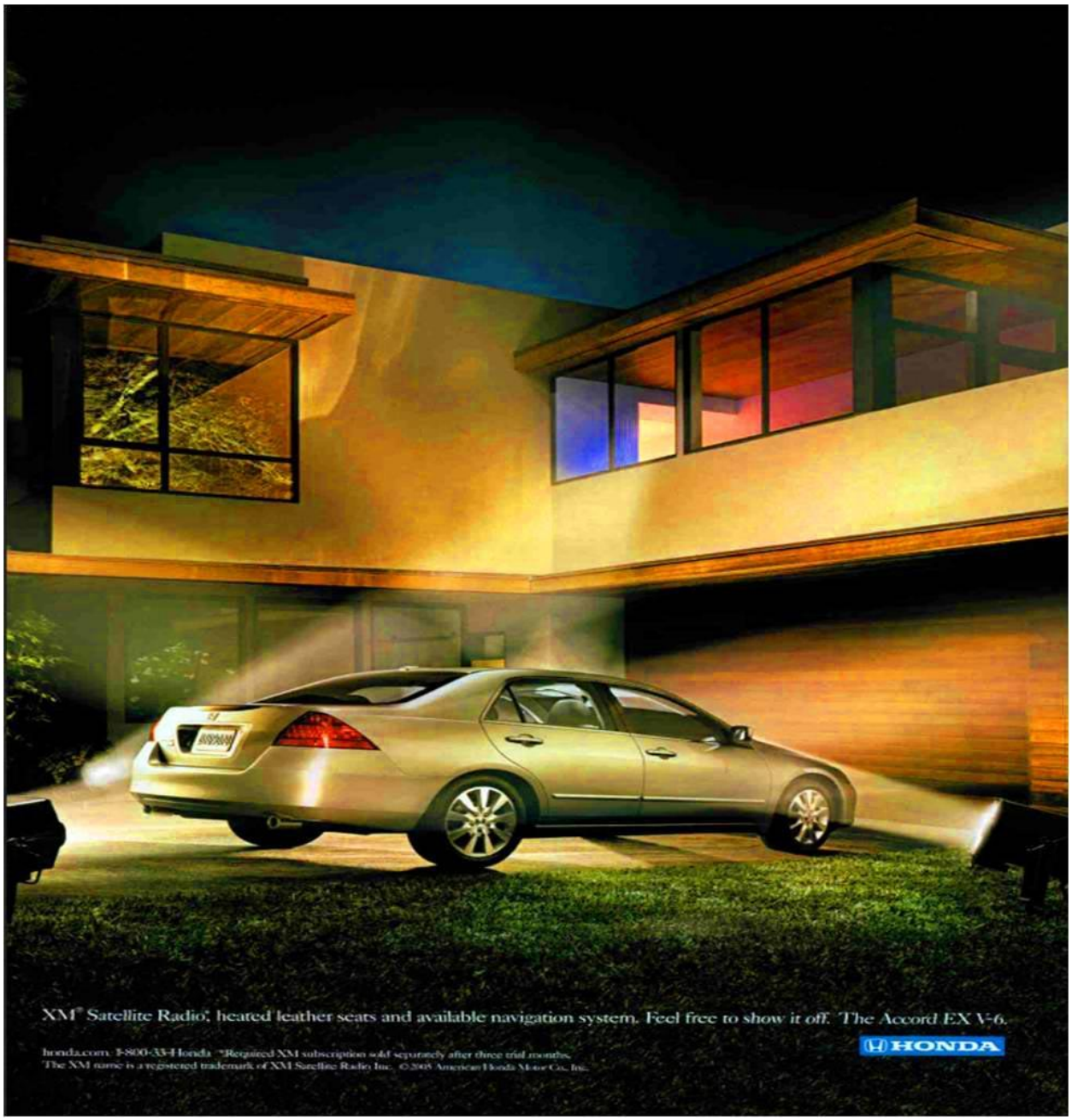
Appendix C



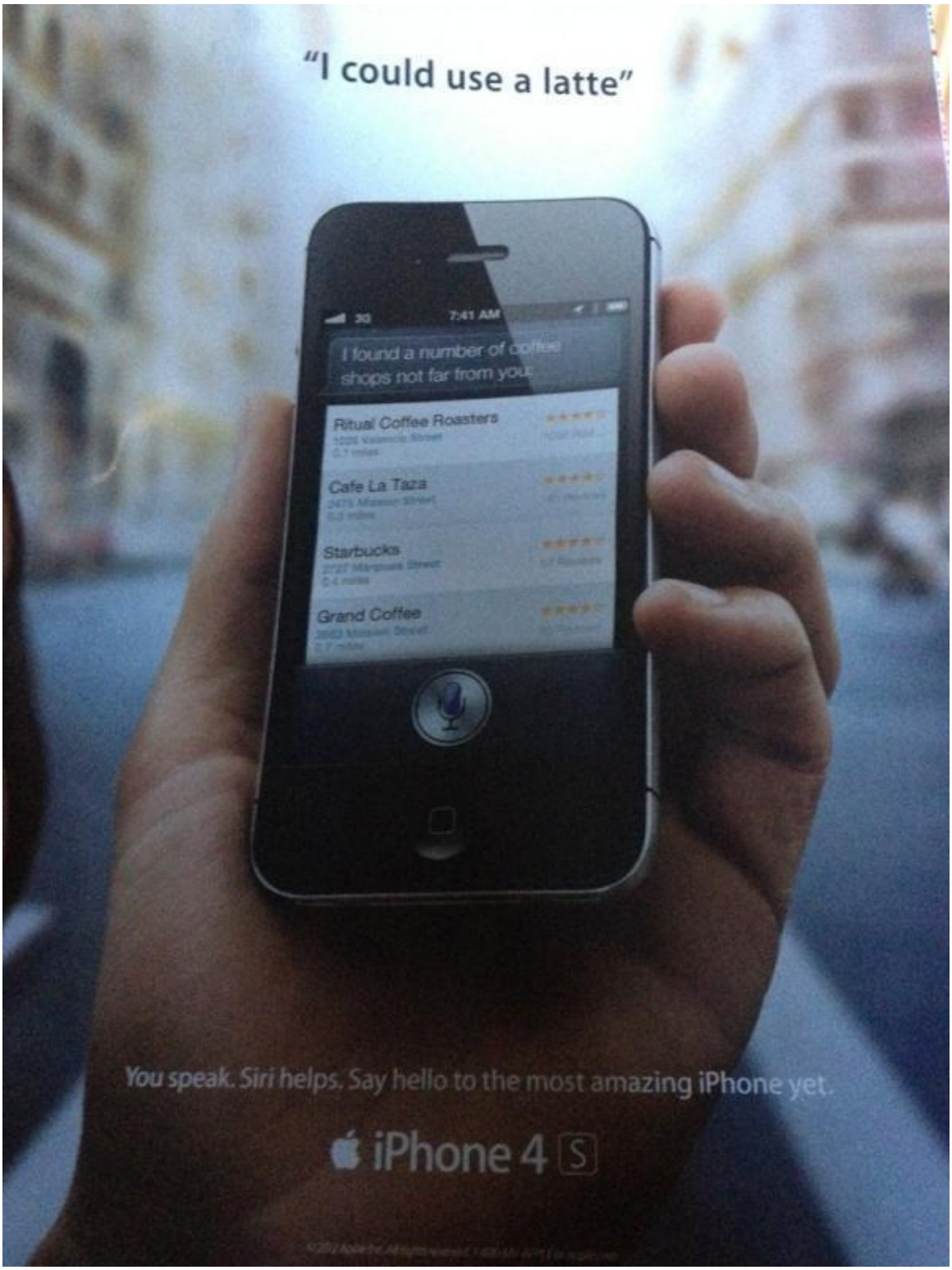
Honda advertisement for Accord sedan as printed in National Geographic magazine, April 2006. Control level saturation.



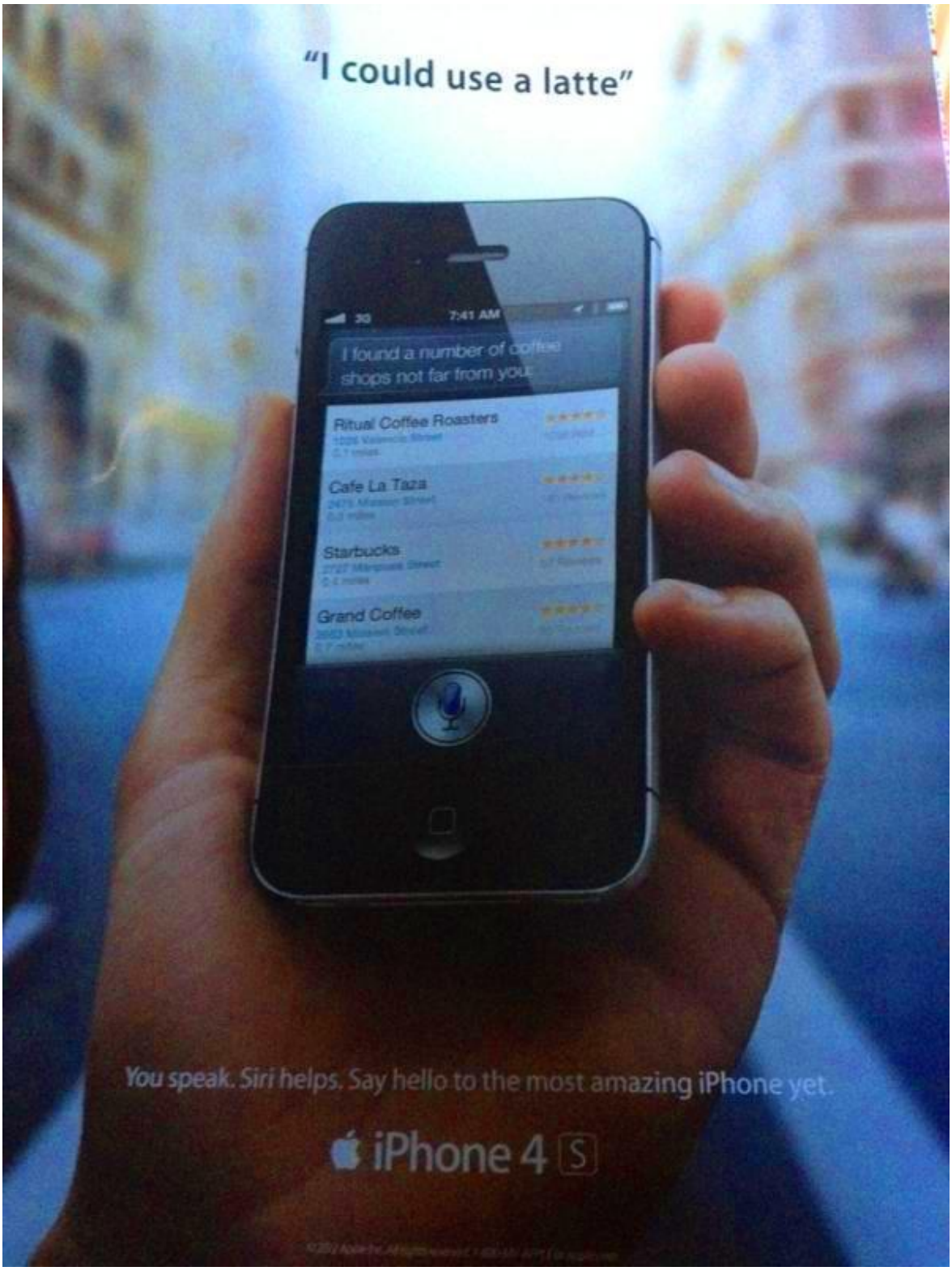
Honda advertisement for Accord sedan as printed in National Geographic magazine, April 2006. Low level saturation.



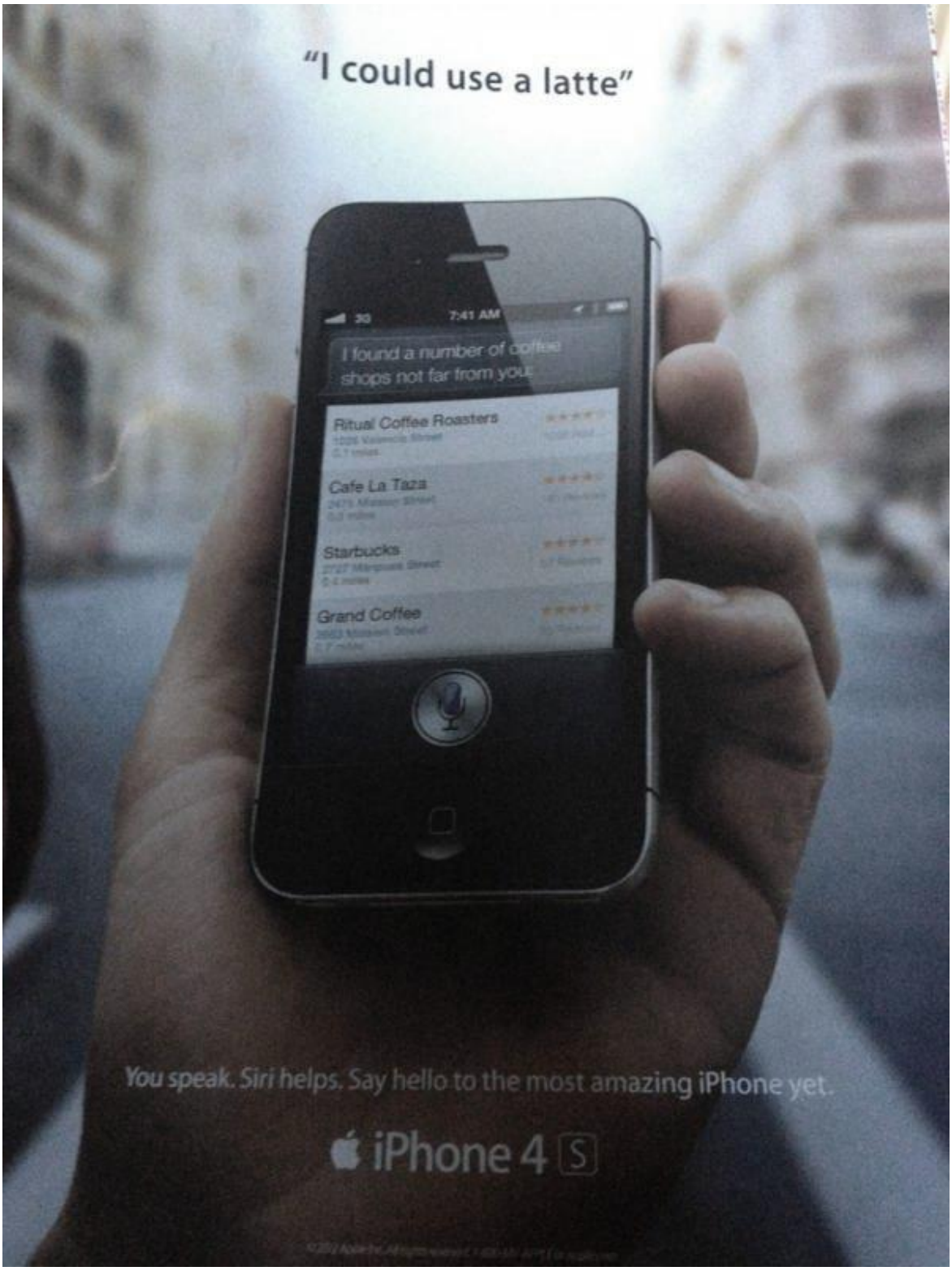
Honda advertisement for Accord sedan as printed in National Geographic magazine, April 2006. High level saturation.



Apple advertisement for IPhone 4S as printed in Rolling Stone magazine, Issue #1153, March 29 2012. Control level saturation.



Apple advertisement for IPhone 4S as printed in Rolling Stone Magazine, Issue #1153, March 29 2012. High level saturation.



Apple advertisement for IPhone 4S as printed in Rolling Stone magazine, Issue #1153, March 29 2012. Low level saturation.



Advertisement for Canon as printed in National Geographic, March 2010. Control level saturation.



Advertisement for Canon as printed in National Geographic, March 2010. High level saturation.



Advertisement for Canon as printed in National Geographic, March 2010. Low level saturation.



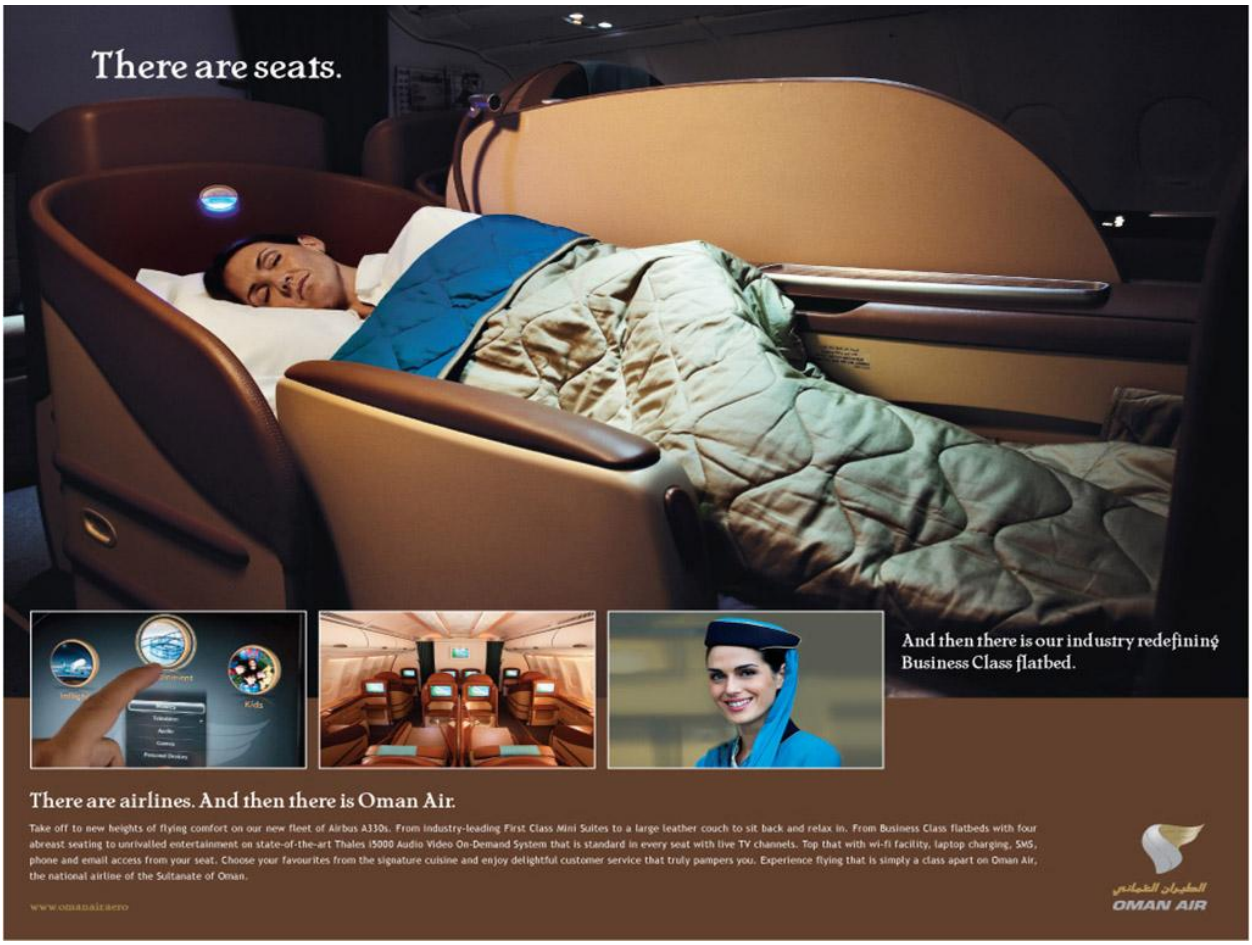
Taco Bell advertisement for Doritos Locos Tacos as printed in Sports Illustrated, May 2013. Control level saturation.



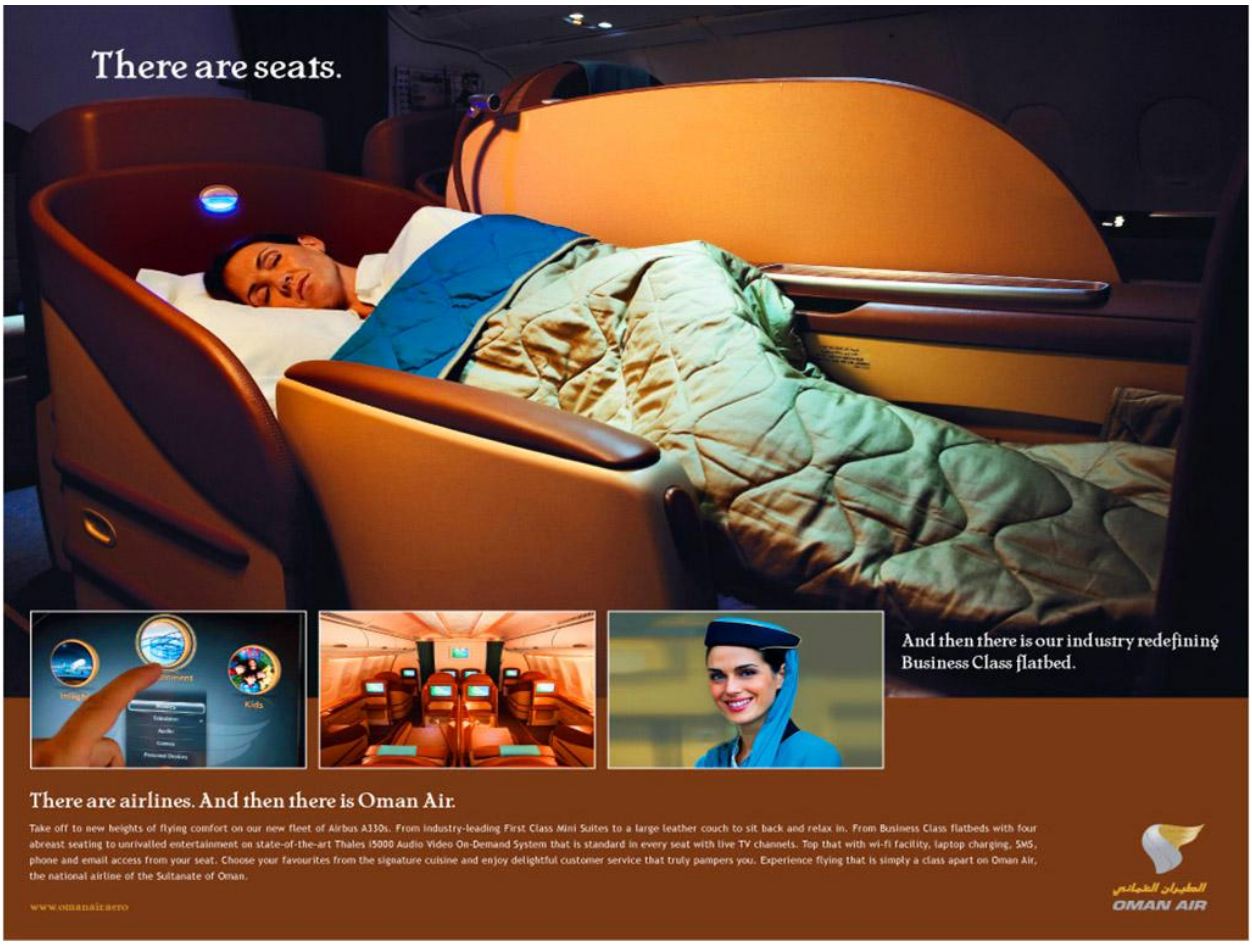
Taco Bell advertisement for Doritos Locos Tacos as printed in Sports Illustrated, May 2013. High level saturation.



Taco Bell advertisement for Doritos Locos Tacos as printed in Sports Illustrated, May 2013. Low level saturation.



Oman Airways advertisement for Business Class seating as printed in Business Insider, April 2013. Control level saturation.



Oman Airways advertisement for Business Class seating as printed in Business Insider, April 2013. High level saturation.



Oman Airways advertisement for Business Class seating as printed in Business Insider, April 2013. Low level saturation.

Appendix D

RESEARCH PARTICIPANT CONSENT FORM
Eyetracking and advertisements
Jessica Duvall
Allegheny College
Department of Psychology

PRINCIPAL INVESTIGATORS: Dr. Aimee Knupsky and Jessica Duvall

PURPOSE OF RESEARCH: The purpose of this research is to examine participant perception of advertisements.

DESCRIPTION/PROCEDURE: Each participant will view a slideshow of 5 images and will then be asked to fill out a questionnaire regarding the advertisements. This study should take about 15 minutes.

RISKS: There are no foreseen risks in participation.

BENEFITS: I understand that the main benefit of participating in this study is a general exposure to research designs at Allegheny College.

COMPENSATION: Students registered on the SONA system will receive 2 credits for 1 hour of participation, and all students will have the opportunity to enter a random drawing for one of three gift cards to local businesses.

ANONYMITY: I understand that the data I provide today are completely anonymous and that my name never will be associated with the data I provide. I understand that the researcher is not interested in any single person's data and will combine the data I provide with all other participants' data to look for general patterns. Any reports made based on this study's data will focus only on general patterns.

I understand that my data and consent form will be stored separately under lock and key in the Department of Psychology at Allegheny College. I understand that my entry in the drawing will never be connected with my data or consent form. I understand that the data I provide today will be destroyed when they are no longer needed.

RIGHT TO REFUSE OR END PARTICIPATION: I understand that at any point throughout the experiment I may choose to withdrawal. I also understand that I will not be penalized for doing so. If I choose to withdraw from this study, I will verbally inform the researcher so that she may stop the study.

If I have questions or concerns, I may contact Jessica Duvall at duvallj@allegheny.edu or Dr. Aimee Knupsky at aknupsky@allegheny.edu. Also, if I have any questions, comments, or concerns about the treatment of research participants in regards to this study I can contact Dr. Richard Bowden, Chair of the IRB, at richard.bowden@allegheny.edu.

I understand the description of the experiment and the procedures, and I have been provided a copy of this informed consent form. My questions have been answered, and I agree to participate in the study.

Name (printed): _____

Signature: _____

Date: _____

I wish to receive a summary of the results in my mailbox: Yes No (Circle)
Box # _____

Appendix E

RESEARCH PARTICIPANT DEBRIEFING FORM
Look this way: The role of saturation in advertisements
Jessica Duvall
Allegheny College
Department of Psychology

Thank you very much for your participation in this study!
Your participation is greatly appreciated!

PURPOSE OF RESEARCH: The purpose of this research was to determine what role saturation plays in the visual perception of print advertisements by using an eye tracking device to record participants' eye movements as they view a slideshow of preselected advertisements that had been altered to fit one of three intensity conditions (high, low, control). Although marketing and advertising firms have long employed color theory and carefully tailored advertisement tactics to increase revenue, not much scientific literature has been published or recently reviewed on eye motion and advertisement perception as functions of color. Much of the research is out of date or examines color as one condition rather than studying color independently through its component pieces.

COMPENSATION: Students currently registered in a psychology class will receive research participation credit through the SONA system. Students not in the SONA system will be entered in a random drawing for one of three gift cards to local businesses.

CONFIDENTIALITY: The data provided by all participants are completely anonymous and participants' names never will be associated with the data they provide. The data will be destroyed when they are no longer needed.

Additional Sources of Information:

Rayner, K., Rotello, C., Stewart, A., Keir, J., & Duffy, S. (2001). Integrating text and pictorial information: Eye movements when looking at print advertisements. *Journal of experimental psychology: Applied*, *7*(3), 219-226.

Labrecque, L., & Milne, G. (2012). Exciting red and competent blue: The importance of color in marketing. *Journal of the academy of marketing science*, *40*(2012), 711-727.

Contact Information:
Please feel free to contact any of the following people.

For any questions or concerns about this research project, please email Jessica Duvall at duvallj@allegheny.edu. You also may contact Dr. Aimee Knupsky at aknupsky@allegheny.edu.

For any psychological concerns, please visit or call the Allegheny College Counseling Center at 814-332-4368.

For any questions or concerns about the treatment of research participants, including yourself, please call Dr. Richard Bowden, Chair of the Allegheny College Institutional Review Board (IRB), at (814) 332-2975 or email him at richard.bowden@allegheny.edu. For any health concerns, please visit or call the Allegheny College Health Center (Winslow Health Center) at 814-332-4355 or visit your personal physician.

THANK YOU AGAIN FOR YOUR PARTICIPATION.

Appendix F

Post- Test Questionnaire

Slide 1- Honda

1. After viewing the advertisement, I am more likely to buy this product.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

2. I found the advertisement to be pleasing to the eye.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

3. What part of the advertisement do you think you looked at first?

_____
_____
_____
_____

Slide 2- Canon

1. After viewing the advertisement, I am more likely to buy this product.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

2. I found the advertisement to be pleasing to the eye.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

3. What part of the advertisement do you think you looked at first?

_____
_____
_____
_____

Slide 3- Iphone

1. After viewing the advertisement, I am more likely to buy this product.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

2. I found the advertisement to be pleasing to the eye.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

3. What part of the advertisement do you think you looked at first?

_____
_____
_____
_____

Slide 4- Taco Bell

1. After viewing the advertisement, I am more likely to buy this product.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

2. I found the advertisement to be pleasing to the eye.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

3. What part of the advertisement do you think you looked at first?

_____
_____
_____
_____

Slide 5- Oman Airlines

1. After viewing the advertisement, I am more likely to buy this product.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

2. I found the advertisement to be pleasing to the eye.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

3. What part of the advertisement do you think you looked at first?

_____
_____
_____
_____

Demographic Questions

1. What is your major? _____

2. What is your minor? _____

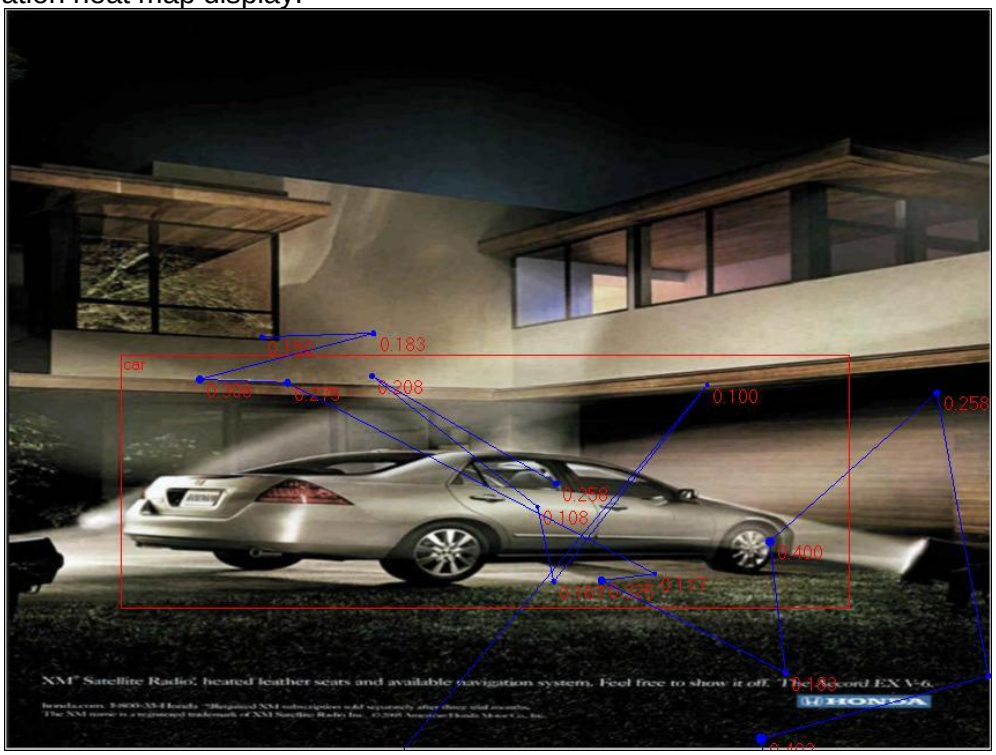
3. Rank in order your three favorite colors.

_____
_____
_____

Appendix G



Low saturation heat map display.



Low saturation plot of fixations.

Appendix H

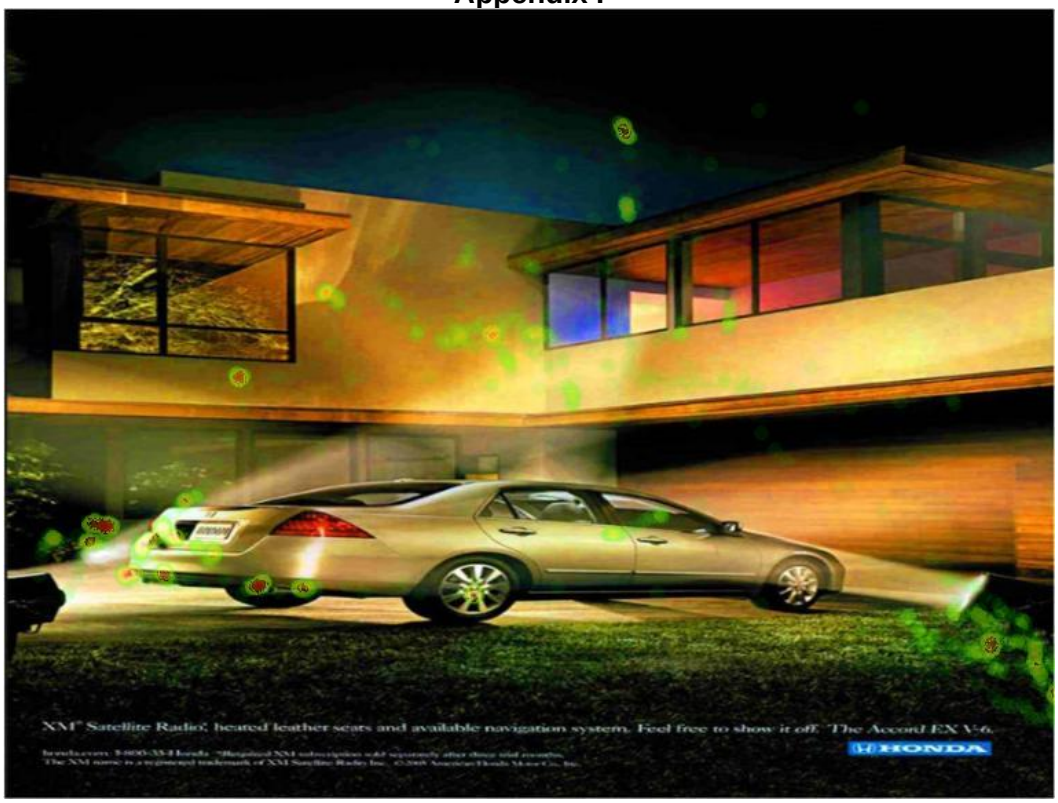


Control saturation heat map display.

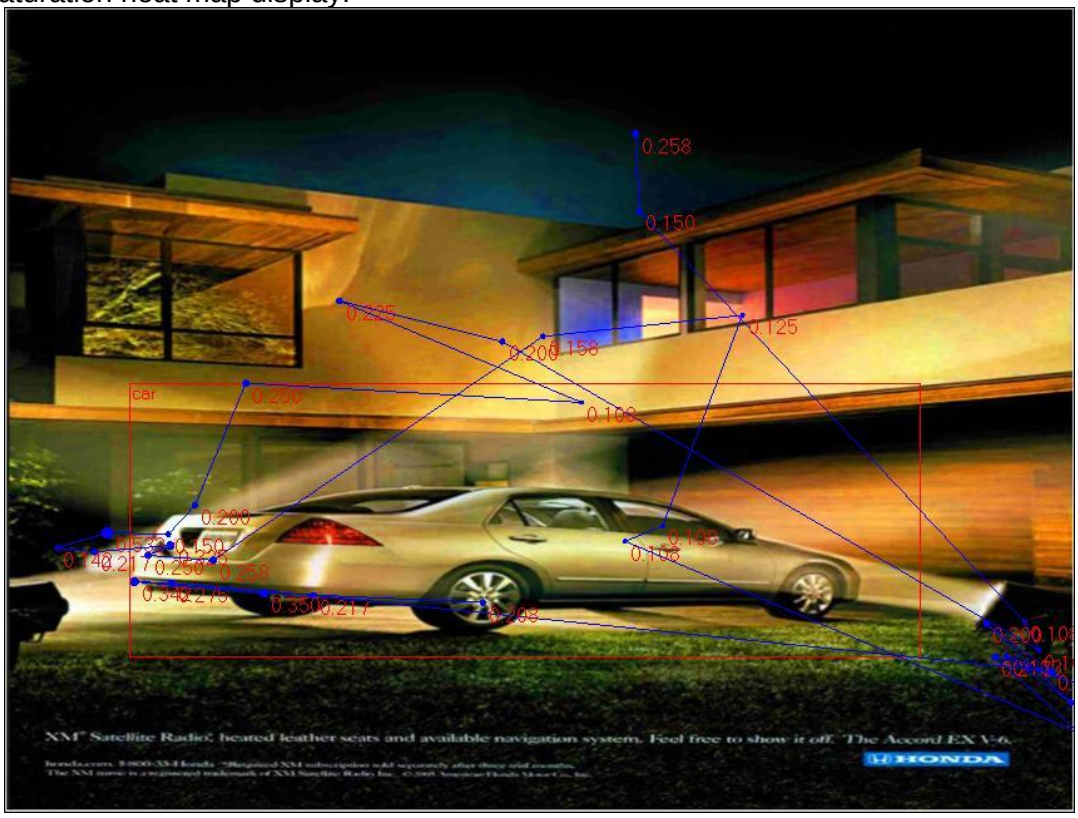


Control saturation plot of fixations.

Appendix I



High saturation heat map display.



High saturation plot of fixations.

Appendix J



Look this way:

The role of color saturation in print advertisements

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Introduction

When designing an advertisement, companies pay attention to the most minute details like color palette, balance of textual and pictorial information, relative size of objects, and overall mood that the advertisement evokes. There is a great deal of literature on how these aspects positively and negatively affect consumer perception of the products being advertised, but there are not many studies that do so using an eye tracker, and even fewer that break down the examination of color into the three components of hue, saturation, and value.

There is strong evidence that color advertisements are viewed first, more often and for longer periods of time than black and white ads (Lohse, 1997), and that color advertisements can have a heavier impact on the target audience's emotions (Piotrowski & Armstrong, 2012) and opinions of companies and products alike (Lictle, 2007).The present study proposed to examine how one component of color, saturation, would affect viewer perception.

Research Questions



Does the level of color saturation affect an individual's fixation patterns when viewing print advertisements? Specifically, does saturation affect the duration and location of fixations? Additionally, does the level of color saturation affect the rating of advertisement attractiveness? Finally, does the level of color saturation affect an individual's willingness to buy the advertised product?

Left- An Applied Science Laboratories (Bedford, MA) Eye-Trac 6 Control Unit with user interface software and H6 Head Mounted Optics headpiece was used to collect data on eye movement while E-Prime 2.0 software (Psychology Software Tools; Pittsburgh, PA) was utilized to control the presentation of stimuli and organize recorded tracking data.

References

Lichtle, M. (2007). The effect of an advertisement's colour on emotions evoked by an ad and attitude towards the ad . *International Journal Advertising* , *26*(1), 37-62.

Lohse, G. (1997). Consumer eye movement patterns on yellow pages advertising. *Journal of Advertising*, 26(1), 1-13.

Piotrowski, C., & Armstrong, T. (2012). Color red: Implications for applied psychology and marketing research. *Psychology and education*, *49*(12), 55-57.

Materials and Procedure

Participants ($N = 35$) were randomly sorted into three groups to view a set of five advertisements while their eye movement was recorded by a headset mounted eye-tracking device. The advertisements were digitally altered to reflect high, control, and low color saturation levels.



Figure 1. Above left- Example of a high saturation condition advertisement . Above right- with fixation plot overlay.

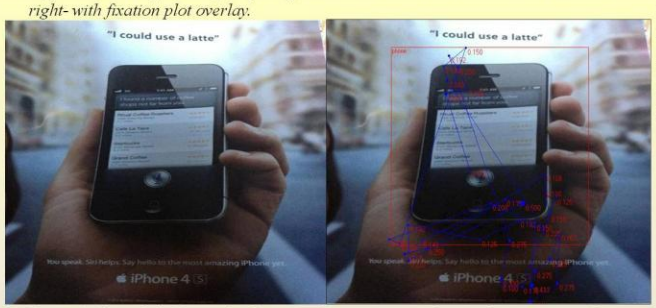


Figure 2. Above left- Example of a control saturation condition advertisement . Above right- with fixation plot overlay.



Figure 3. Above left- Example of a low saturation condition advertisement . Above right- with fixation plot overlay.

After viewing the advertisements, participants responded to a 15 item post-test questionnaire containing items relevant to perception of advertised content, motivation to buy products after viewing and likeability of the advertisements shown. The two questions regarding participant motivation to buy products and attractiveness of advertisements were based on a 6-point Likert Scale. The question about perception of advertised content was free response where participants were asked to identify where they believed they looked first when viewing the advertisement. There were also 3 additional questions which were used to collect demographic information about the major, minor, and favorite color of participants

[*Sample Questionnaire*]

1. After viewing the advertisement, I am more likely to buy this product.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

2. I found the advertisement to be pleasing to the eye.

1	2	3	4	5	6
Strongly Disagree	Disagree	Somewhat Disagree	Somewhat Agree	Agree	Strongly Agree

3. What part of the advertisement do you think you looked at first?

_____

_____

Results

A one-way ANOVA eye-tracking design was used with the level of color saturation (low, control, high) as the between-subjects variable.

Results indicated that color saturation has a positive effect on both average fixation duration and average number of fixations, where individuals in the low saturation conditions had higher average numbers of fixations for longer periods of time than did individuals in the control or high saturation groups. Saturation did not have an effect upon advertisement attractiveness ratings or likelihood of buying the presented product, but attractiveness of advertisement and likelihood of purchasing the product were found to be positively correlated. These results shed light on how the individual components of color affect viewing of advertisements and open up paths for further research.