THE RISKY RAINBOW OF ARTIFICIAL FOOD DYES:
A VISUAL COMMUNICATION CAMPAIGN DESIGNED TO RAISE CONCERNS
ABOUT POTENTIAL DANGERS OF PETROLEUM-BASED, SYNTHETIC FOOD
DYES AND OFFER HEALTHIER CHOICES TO CONSUMERS

A Thesis
Submitted to the Graduate School
of the University of Notre Dame
in Partial Fulfillment of the Requirements
for the Degree of
Master of Fine Arts

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April 2016
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Abstract

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We eat first with our eyes, so the appearance of food directly influences consumers’ perceptions and purchasing decisions. Food coloring additives have been used in food for centuries, serving as codes that allow us to identify products on sight. Nine kinds of synthetic dyes, approved by Food and Drug Administration (FDA) in the U.S., are derived from aniline, which is petroleum based, and they have long been controversial. Synthetic food colorings add absolutely no flavor or fragrance to the foods we are eating, but do in fact pose quite a few serious risks to human health. Many toxicological studies commissioned and conducted by researchers found that these synthetic dyes might lead to allergic reaction, organ damage, cancer, and ADHD-like
(Attention Deficit Hyperactivity Disorder) behavior in children.\textsuperscript{1} Certain dyes being used in the U.S. are banned in some European countries.

Creating access to scientific knowledge about food coloring is essential for public health. The design goal is to educate consumers on why synthetic food colorings are being used, the potential health hazards of consuming them, and the limited regulations the FDA imposes on their usage. Keeping in mind the specific target audience, parents with young children, from the standpoint of a visual communication designer, the design creates a compelling approach to deliver information which is both instructional and aesthetically appealing. The various integrated elements of the campaign incorporate a strong and consistent visual identity, relevant information and recommendations derived from studies by researchers and specialists, and government reports and regulations. Ultimately, this thesis aims to help people live better and healthier lives by making more informed choices about the food they consume.

To my parents and my husband
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ACKNOWLEDGMENTS

I would like to express my gratitude to every person who has had the slightest input in my thesis project. This work would not have been possible without the guidance of my thesis committee: Andre Murnieks, Robert Sedlack, Emily Beck and Maria Tomasula. I am particularly thankful for Andre Murnieks’ tireless mentorship during this academic year. I also want to acknowledge the ideas and comments received from my esteemed art and design faculty as well as my talented graduate student peers during Graduate Design Seminar and Final Reviews. I would like to offer a special note of appreciation to my close friend Thomas Mann and my family for all of the love, support and direct contributions in the development of this thesis work.
CHAPTER 1:
INTRODUCTION

1.1 “We Eat with Our Eyes as Much as with Our Mouth”

Color affects consumer purchasing decisions when it comes to clothes, home decorations, and food. We make our color choices unconsciously. Downham and Collins’ article state that “the color of our surroundings affects our moods and perception of quality”. According to their theory, all people are sensitive to the color of food. The color we see clearly indicates the flavors of the food we are eating or drinking. Color can stimulate appetite, discourage eating and reduce demand for certain food. This theory explains why restaurants usually like to decorate their environment with warm colors or cast warm-colored light onto the food, which could stimulate a customer’s appetite.

There are several characteristics of food, such as physical, sensory, chemical and biological. Food color, as one of the most noticeable factors of food’s physical attributes, predetermines a consumer’s expectation of both quality and taste to some extent. People may not consider some other quality factors, like flavor, texture or aroma if the color is unacceptable. The judgement of food quality on the basis of color helps people avoid stale beverages, rotten meat and bruised vegetables. Countless tests have been done which reveal that color is directly related to people’s appreciation of food. People associate different foods with different colors, for instance, red to a pepper or a

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strawberry, yellow to a lemon or a banana. Therefore, it will be confusing if an inappropriate color is applied to an unrelated food like purple apple or green coffee. The importance of food color for taste perception is essential to people’s decision for eating it or not. Research even found that color level has significant effects on the perception of sweetness. One study showed that sweetness appeared to increase between 2 and 12% with the increase of red color to a strawberry flavored drink. Psychologist Debra A. Zellner found that color intensity and appropriateness induced odor enhancement in her experiments.

The aesthetic value of color plays an important role in food advertising. To be consumed, food needs to be appealing. Vegetables and meat have their intrinsic colors which can be genetically modified. It is why we are able to see varieties of tomatoes and peppers of different colors sold in grocery stores. To be visually attractive, colors and other food additives may be added to or sprayed on fresh food like vegetables, fruit and meat during growing or processing. Sodium nitrite is often added to meat which makes the meat look very reddish and fresh, and also to keep that appearance longer. With the development of modern manufacturing, especially during past two or three decades, processed foods are taking up more and more space on the shelves in stores. Some food products, which have little or no color, need to count on added color to improve the appearance, such as candy, baked goods and soft drinks. Likewise, in order to keep the uniformity of product’s color due to variation by seasons and processing procedures, food

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manufacturers have to make sure of the consistency of food color. Consequently, food additives, especially food colorings, are used with the purpose of obtaining this effect.

1.2 Attention to Food Additives

―The pursuit of happiness through the enjoyment of food is a centuries old human endeavor.‖

Food is critical to human life and is meant to sustain our health. By enhancing the freshness, visual appeal, texture and taste, food additives can contribute much to convenience and enjoyment. Although their quantities in food are small, their impact is huge. We would not enjoy such a variety of foods without additives. However, numerous kinds of food additives and "edible food-like substances" are being added to consumers’ diets. These additives provide no nutritional value and serve primarily as a marketing tool. The abundant use of these synthetic additives is increasingly raising concerns among nutrition experts about the safety of food found in our local markets.

So what are food additives? —Food additives are substances that are added to food or animal feed during processing or storage. They include antioxidants, preservatives, coloring and flavoring agents, and anti-infective agents. Most food additives have little or no nutritional value." Food additives are put in during the production procedures and become part of a food product. Food additive levels are relatively insignificant to our total diet, because they are used in very low quantity but can achieve the desired effect,

such as enhancing the food’s flavor, extending the expiration date, or adding bright colors.

Some traditional additives have been commonly used for centuries, for instance, to preserve meat or vegetables with salt or to preserve fruit with sugar or syrup. Because of the demand for quality and convenience from the food manufacturers over the late half of twentieth century, more and more additives have been discovered and introduced. Food additives can be categorized into several groups, although there is some overlap between them: acids, acidity regulators, anticaking agents, antifoaming agents, antioxidants, bulking agents, food coloring, color retention agents, emulsifiers, flavors, flour treatment agents, glazing agents, humectants, preservatives, stabilizers, sweeteners, and thickeners.

The function of food additives are:

- To preserve or improve nutritional quality;
- To maintain or improve product safety or quality;
- To aid in processing, control the acid-base balance of foods;
- To enhance sensory characteristics, including texture, color and taste;

The use of food additives is growing with the increasing demand of processed foods since the late 1950s. Because synthetic food additives are cheap and can effectively control the quality and appearance of food, whereas natural food ingredients are more expensive and more difficult to retain the consistent look of food, manufacturers gradually replace many natural ingredients with artificial food additives. With the improvement of people’s living standard, the question of food additive safety has

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received extensive attention in recent years. Consumers may have concerns about additives when they learn about the unfamiliar names on packaging and regard them as chemical compounds with potential hazards, especially when we see so many negative reports about food with excessive or toxic additives which have caused public health scares.  

Although the food and chemical industries claim that all food additives they are using are tested and safe to eat, there have been some health risks associated with these additives. There has been significant controversy relate to the benefits and risks of food additives. Some artificial food additives have been linked with cancer, digestive problems, neurological conditions, ADHD, heart disease or obesity.  

The International Numbering System for Food Additives (INS), which is a naming system for food additives, is defined by Codex Alimentarius of the International Food Standards Organization (IFSO) of the World Health Organization (WHO) and Food and Agriculture Organization (FAO) of the United Nations (UN). Many substances on the list have not been tested, but most scientists consider them to be safe. The U.S. Food and Drug Administration (FDA) put them on the "generally recognized as safe (GRAS)" list, which contains about 700 items. Some substances which are found to be harmful to people may still be allowed, only at the level of 1/100th of the harmful amount. Even though they are used in small amounts under the safe level, the effects of long term or accumulative exposures may harm a human’s body, which needs to be considered.


Food coloring, as one category of food additives, is the most direct ingredient that consumers can detect visually. This drew my attention from the broad spectrum of all food additives to the specific research area of food coloring as an additive.
CHAPTER 2:
THE SCIENCE OF FOOD COLOR ADDITIVES

2.1 Facts about Food Dyes

Color is an important physical attribute of foods and has psychological effects on humans. The appearance of food often influences perception and indicates the flavor. For example, yellow is usually associated with lemon which has a sour taste. ―To feast our eyes‖ is a metaphor, which depicts the importance of colors in our lives. Food coloring is used both in commercial food production and in domestic cooking, such as turmeric color in curry or yellow color in salad dressing. It is common for color additives to be used in various kinds of food, from children’s cereal to sports beverages. Food coloring is also used in a variety of non-food applications, including cosmetics, pharmaceuticals, home craft projects and medical devices. The CFR - Code of Federal Regulations Title 21 in the US defines food coloring as follows: 14

―A color additive is any material, not exempted under section 201(t) of the act, that is a dye, pigment, or other substance made by a process of synthesis or similar artifice, or extracted, isolated, or otherwise derived, with or without intermediate or final change of identity, from vegetable, animal, mineral, or other source and that, when added or applied to a food, drug, or cosmetic or to the human body or any part thereof, is capable (alone or through reaction with another substance) of imparting a color thereto.‖

The functions of adding food coloring include: \(^{15, 16}\)

- To restore color that is lost due to exposure to light, air, temperature extremes, moisture and storage conditions;
- To correct natural variations in color;
- To enhance color that is already present naturally;
- To provide color to uncolored food;
- Make food more attractive, appetizing, and informative;
- Allow consumers to identify products on sight, like candy flavors or medicine dosages;

Archaeologists believe food colors likely emerged in Egypt as long ago as 1500 B.C. Egyptians added natural extracts to improve the appearance of candy and they also used artificial colors in cosmetics and hair dyes.\(^{17}\) In Homer’s Iliad, Saffron is mentioned as a colorant and Pliny the Elder remarks that wines were artificially colored dating back to 400 B.C.\(^{18}\) In other European countries, food was regarded simply as a means of survival during the Middle Ages and because the Middle Ages was a predominately agriculturally based economy, the aesthetic aspects of food were not considered. With the


development of urbanization and trade at the beginning of the Modern Age, spices and colors could be imported from Asian and tropical countries.

Driven by competition and interest among the food producers and traders, the adulteration of foods which contained heavy metals and other toxic elements developed during the Industrial Age. Cheap color compounds were used to restore or add color to food; for instance, cheese was colored with red lead, pickles with copper, and tea with thorn leaves was tinted with copper oxide.¹⁹

In 1856, the first synthetic color, mauveine, was introduced by Sir William Henry. Development of similar colorants soon followed and their usage quickly spread to color foods, drugs, and cosmetics. These dyes were first obtained from by-products of coal processing and, therefore, were referred to as “coal-tar” colors.²⁰ But as their use grew, safety concerns were raised, which led to numerous regulations throughout the world, with each country developing their own legislation. In Germany, colorants which were found to contain dangerous minerals such as arsenic, copper, chromium, lead, mercury and zinc were banned, following the principle of a negative listing²¹ (substances not allowed for use) by the first European food laws. Later, the Pure Food and Drug Act of 1906 of the United States reduced the permitted list of synthetic colors from 700 down to seven.²² In 1950, the FDA launched a new round of toxicological investigations, because many children became ill after eating Halloween candy containing 1-2% FD&C Orange

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In the next few years, the original list of seven colorants which had grown to sixteen, was reduced back to seven by the FDA, but included only two of the original seven. Seven synthetic colors (Figure 2.1) are for regular use and two allowed for specific limited applications.

Figure 2.1: Seven Synthetic Colors Chart Designed by Yan Zhang

All of the color additives permitted by the FDA are classified in two categories: certified colors that are subject to FDA's certification process and natural colors that are exempt from the certification process.

2.2 Natural Food Colorings vs Synthetic Food Colorings

2.2.1 Natural Food Colorings

Colors that are exempt from certification, also named natural food colorings, include any dye, pigment or any other substance derived from natural sources such as fruits, plants, vegetables, minerals or animals. Normally, natural colors are more expensive than synthetic colors and may add unintended flavors to foods. A growing


number of natural food dyes are being commercially produced, partly due to consumer concerns surrounding synthetic dyes; for example: annatto, betanin, caramel color, elderberry juice, beets, carmine, paprika, turmeric, saffron.25

Although food manufacturers have strong economic incentives to continue to prefer synthetic dyes, natural colors are becoming more important not only because of people’s awareness of the harmful effects of synthetic colors but also because of awareness of the medicinal properties of natural dyes.26 For instance, color from the seeds of annatto is used as a natural red coloring in the US. Nestle USA announced it is replacing artificial dyes in their chocolate candy –Butterfinger” with annatto color by the end of 201527. More and more, the benefits of the natural dyes are slowly filtering to the public, and the therapeutic uses are increasing also, because of their nontoxic or less toxic properties and fewer side effects. For example, Vaccinium myrtillus, the blue colorant from bilberry can be used for treating bladder stones, biliary disorders, scurvy, coughs, and lung tuberculosis. Grapes Vitacea, a red-purple dye obtained from the grapefruit, has valuable nutrients including glucose, fructose, potassium, calcium, tartaric acid, malic acid, tannins and anthocyanins. The medicinal benefits are preventing diseases of the

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heart and blood vessels, varicose veins, hemorrhoids, high blood, pressure, swelling after injury or surgery, heart attack, and stroke.²⁸

2.2.2 Synthetic Food Coloring

At the start of the 1900’s, the bulk of chemically synthesized colors were derived from aniline, a petroleum product that is toxic. Although certifiable color additives had been called “coal-tar colors” because the initial materials were obtained from bituminous coal, today they are derived mainly from petroleum. These certified colors generally do not add flavor, fragrance or nutritional value to foods. In other words, they only affect the visual presentation of the food.

Compared to natural colors, synthesized colors are easier to produce and less costly, as well as being more stable and brighter in chroma. They are also highly concentrated and widely available. They are used in a variety of non-food applications, including cosmetics, pharmaceuticals, home craft projects and medical devices, such as contact lenses²⁹.

At present, in the U.S., FD&C numbers³⁰ are used by the FDA to certify nine color additives for approved for use within the U.S., while in the European Union, E numbers³¹ are used for all additives, both synthetic and natural, for approved use in food

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³⁰ FD&C: The United States Federal Food, Drug, and Cosmetic Act (abbreviated as FFDCA, FDCA, or FD&C), is a set of laws passed by Congress in 1938 giving authority to the U.S. Food and Drug Administration (FDA) to oversee the safety of food, drugs, and cosmetics. Wikipedia. https://en.wikipedia.org/wiki/Federal_Food,_Drug,_and_Cosmetic_Act#Food_coloring

³¹ E numbers: E numbers are codes for substances that are permitted to be used as food additives for use within the European Union and Switzerland, The –E” stands for “Europe”, Wikipedia. https://en.wikipedia.org/wiki/E_number#cite_note-1
applications. For example, Brilliant Blue FCF is named as FD&C #1 in the US, whereas it is called E133 in EU.

In the United States, the FDA permits seven colors for general use, while two dyes are permitted for limited use in foods. Citrus Red 2 (orange shade) is only allowed to color orange peels, while Orange B (red shade) is only for use in hot dog and sausage casings.\(^\text{32}\)

The following seven artificial colorings are permitted for general use as of 2016.\(^\text{33}\)

**FD&C Blue No.1 – Brilliant Blue FCF, E133 (blue shade)** (Figure 2.2)

![Chemical Structure of FD&C Blue No.1](image)

Figure 2.2: Chemical Structure of FD&C Blue No.1

Molecular formula: C\(_{37}\)H\(_{34}\)N\(_2\)Na\(_2\)O\(_9\)S\(_3\)

IUPAC name\(^\text{34}\): ethyl-[4-[[4-ethyl-[(3-sulfophenyl) methyl] amino] phenyl]-2-(2-sulfophenyl) methylidene]-1-cyclohexa-2, 5-dienylidene]-([3-sulfophenyl) methyl] azanium


\(^{34}\) —“Chemical nomenclature is a set of rules to generate systematic names for chemical compounds. The nomenclature used most frequently worldwide is the one created and developed by the International Union of Pure and Applied Chemistry (IUPAC).” —“Chemical Nomenclature,” Wikipedia, https://en.wikipedia.org/wiki/Chemical_nomenclature
Brilliant Blue FCF has the appearance of a reddish-blue powder. It is soluble in water and can be combined with tartrazine to produce various shades of green. Brilliant Blue FCF is often used in ice cream, cereal, dairy products, sweets, bakery items and beverages. It is also used in soaps, shampoos, and other hygiene and cosmetics applications.\textsuperscript{35}

**FD&C Blue No.2 – Indigo Carmine, E132 (indigo shade)** (Figure 2.3)

![Chemical Structure of FD&C Blue No.2](image)

Figure 2.3: Chemical Structure of FD&C Blue No.2

Molecular formula: $C_{16}H_8N_2Na_2O_8S_2$

IUPAC name: 3,3'-dioxo-2,2'-bis-indolyden-5,5'-disulfonic acid disodium salt

Indigo shade is often used in cereal, beverages and dog’s food. It is also used as a dye in the manufacturing of medicine capsules.\textsuperscript{36}

\textsuperscript{35} – Brilliant Blue FCF (Blue 1),” Wikipedia, https://en.wikipedia.org/wiki/Brilliant_Blue_FCF

FD&C Green No.3 – Fast Green FCF, E143 (turquoise shade) (Figure 2.4)

Figure 2.4: Chemical Structure of FD&C Green No.3

Molecular formula: C$_{37}$H$_{37}$N$_2$O$_{10}$S$_3^+$

IUPAC name: ethyl-[4-[[4-ethyl-[(3-sulfophenyl) methyl] amino] phenyl]-(4-hydroxy-2-sulfophenyl) methylidene]-1-cyclohexa-2, 5-dienylidene]-[(3-sulfophenyl) methyl]azanium

Fast Green FCF is a sea green food dye which is tested as poorly absorbed by the intestines. It can be used for ice cream, jellies, sauces, desserts, baked goods and makeup.$^{37}$

FD&C Red No.3 – Erythrosine, E127 (pink shade, commonly used in glacé cherries) (Figure 2.5)

Figure 2.5: Chemical structure of FD&C Red No.3

Molecular formula: $C_{20}H_{6}I_{4}Na_{2}O_{5}$

IUPAC name: 2-(6-Hydroxy-2,4,5,7-tetraiodo-3-oxo-xanthen-9-yl)benzoic acid

Erythrosine, also known as Red No. 3, is a cherry-pink food coloring. It is commonly used in sweets such as some candies and popsicles, sausages, and widely used in cake-decorating as well as maraschinos.

FD&C Red No.40 – Allura Red AC, E129 (red shade) (Figure 2.6)

![Chemical Structure of FD&C Red No.40](image)

Figure 2.6: Chemical Structure of FD&C Red No.40

Molecular formula: $C_{18}H_{14}N_{2}Na_{2}O_{8}S_{2}$

IUPAC name: Disodium 6-hydroxy-5-((2-methoxy-5-methyl-4- sulfophenyl)azo)-2-naphthalene-sulfonate

Allura Red AC was originally introduced in the US to replace the use of amaranth as a food coloring with the appearance of a dark red powder. It is the most widely used

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dye in the US. People often see it in candy, beverages, cereal, bakery frosting and makeups.  

**FD&C Yellow No.5 – Tartrazine, E102 (yellow shade)** (Figure 2.7)

![Chemical Structure of FD&C Yellow No.5](image)

Figure 2.7: Chemical Structure of FD&C Yellow No.5

Molecular formula: $C_{16}H_9N_4Na_3O_9S_2$

IUPAC NAME: Trisodium (4E)-5-oxo-1-(4-sulfonatophenyl)-4-[(4-sulfonatophenyl)hydrazono]-3-pyrazolecarboxylate

Tartrazine has lemon yellow which is water soluble. It is a commonly used color all over the world, and can also be combined with FD&C Blue 1 or Green S (E142) to produce various green shades. It is often used in pastries, candy, cereals, beverages, sauce, ice cream, jelly, canned fruits and pickles.  

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FD&C Yellow No.6 – Sunset Yellow FCF, E110 (orange shade) (Figure 2.8)

![Chemical Structure of FD&C Yellow No.6](image)

Figure 2.8: Chemical Structure of FD&C Yellow No.6

Molecular formula: $C_{16}H_{10}Na_{2}O_{7}S_{2}N_{2}$

IUPAC name: Disodium 6-hydroxy-5-[[4-sulfophenyl]azo]-2-naphthalenesulfononate

Sunset Yellow FCF has orange color that may be added to foods to induce a color change. It is the third most widely used dye which may be found in jelly, jam, sweets, cheese, soft drinks, cereals, sausages, etc. It can also be found in other yellow, orange, and red food products. Sunset Yellow is often used in conjunction with E123, Amaranth, in order to produce a brown coloring in both chocolates and caramel.\(^{42}\)

When looking at food labels, we might find colors other than the seven artificial dyes called "lake" dyes. Color additives are available for use in food as either "dyes" or "lakes". Lakes are insoluble compounds which are made by combination of dyes and salts. Unlike the seven artificial dyes, most of which are water-soluble and manufactured as powders, granules or liquid, lake dyes are oil-dispersible. Because lake dyes are more stable than dyes and not oil-soluble, they are widely applied to food products containing fats and oils or dry food items. Typical uses include beverages, bakery, pet’s food and gums. Lake dyes are also widely used in pharmaceuticals, cosmetics, soaps, shampoos,

plastics, painting pigments, etc. In the U.S., lake dyes are also required to be listed in the ingredients chart on the packaging labels.
3.1 Introduction and History

Use of synthetic colors has been controversial in the U.S. since the 1970s, when pediatrician Dr. Benjamin Feingold first publicized his research, which found a link between children’s behavior and consumption of food additives. As a result of extensive research, artificial food color is suspected of causing increased hyperactivity in children. An important 2004 meta-analysis of food dyes and hyperactivity claimed that "our results strongly suggest an association between ingestion of AFCs [synthetic food dyes] and hyperactivity." Three years later, a study, conducted by Southampton University for the U.K. Food Standards Agency (FSA), was published in the British medical journal, The Lancet. That study presented evidence that certain color additive mixtures, whether by themselves or when mixed with preservatives, possibly cause hyperactivity in 3-Year-Old and 8/9-Year-Old Children. The researchers concluded that "the finding lends strong

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support for the case that food additives exacerbate hyperactive behaviors (inattention, impulsivity and over-activity) at least into middle childhood."  

In 2008, the Center for Science in the Public Interest (CSPI) with support from two dozen physicians and researchers, formally petitioned the FDA to ban eight of the nine certified color additives that are currently regulated for use in foods in the United States. CSPI contends that these additives cause hyperactivity and behavior problems in some children. A supporting report, “Food Dyes: A Rainbow of Risks,” referred to a number of studies on the nine kinds of artificial colors and children’s behavior. This report also requests the FDA to require warning labels on foods containing these color additives.

The FDA did not respond to the publication of the Southampton study. However, after the petition was received from CSPI, the FDA reviewed the available evidence, but did not make any changes. However, Europe acted in response to the study. In July 2008, the European Parliament approved a measure that requires foods containing any of the colors used in the Southampton study to bear a warning notice that the food dye may have an adverse effect on activity and attention in children.” The European Parliament passed a law that require a warning label on all the packages of foods (Figure 3.1) that

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46 “Food Dyes,” Center for Science in the Public Interest, http://www.cspinet.org/fooddyes/


contain one or more of the dyes after July 20, 2010, which must be marked "may have an adverse effect on activity and attention in children."49 The UK encouraged the food companies to voluntarily stop using six colors by the end of 2010. In the U.S, any food containing the color additives certified by the FDA must be listed by name as ingredients on the food label, using the official name of the FD&C and color numbers or lakes. However, the FDA still holds the conservative attitude toward food dyes that are linked to food intolerance and ADHD-like behavior in children.50

Figure 3.1: Warning Labels on the Packages of Food

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3.2 The Risky Rainbow

Today’s food dyes are complex organic chemicals that are derived from aniline, a toxic petroleum product. Because of their properties, cheaper, more stable, with brighter colors, they are all too commonly used in many aspects of human’s lives.

The nine currently approved dyes raise many health concerns, but remain in use, despite having only a visual effect on food. In recent decades, a wide variety of animal tests\textsuperscript{51, 52} have been conducted to estimate the safety of individual color additives in the human diet. It should be noted that no animal is a perfect model for studying carcinogenic effects in humans, because the body structure and function of rabbits, rats and mice can be very different from humans in the relevant biochemical pathways. However, researchers and scientists found that Red #40, Yellow #5 and Yellow #6 are among the food colorings that have been linked to various health risks in animal tests.\textsuperscript{53, 54}

Blue #1 is used to color candy, soft drinks, and pastries. It has the capacity for inducing an allergic reaction in individuals with pre-existing moderate asthma and there has been some evidence that it may cause cancer in mice, but those studies have not been replicated. It had previously been banned in Austria, Belgium, Denmark, France, Germany, Greece, Italy, Norway, Spain, Sweden, and Switzerland, but has been certified


\textsuperscript{52} K.R. Butterworth, I. F. Gaunt, et al., —Acute and Short-Term Toxicity Studies on Erythrosine BS in Rodents,” Food and Cosmetics Toxicology 14, no. 6 (1976): 525-31.


\textsuperscript{54} B. F. Feingold, —Hyperkinesis and Learning Disabilities Linked to Artificial Food Flavors and Colors,” The American Journal of Nursing 75, no. 5 (1975): 797-803.
as a safe food additive in the European Union (E.U.), so today it is no longer banned in most of the countries of the E.U.\(^ {55} \)

Blue #2 is harmful to the respiratory tract if swallowed. It is also an irritant to the skin and eyes. This colorant can be found in pet food, soft drinks, and pastries, and has been shown to cause brain tumors in mice. This dye is banned in Norway.\(^ {56} \)

Green #3 has been found to have tumorigenic effects in experimental animals, as well as mutagenic effects in both experimental animals and humans. It can cause irritation of eyes, skin, digestive tract, and respiratory tract in its undiluted form. It is banned in European Union.\(^ {57} \)

Red #3, mainly used in cherries for cocktails has been correlated with thyroid tumors in rats. It also causes chromosomal damage, neurochemical and behavioral effects. It is banned in European countries.\(^ {58} \)

Red #40 A study, led by UK FSA, found a possible link between the consumption of these artificial colors and a sodium benzoate preservative and increased hyperactivity" in the children, which was published in 2007\(^ {59} \). It is approved by the E.U.


\(^ {57} \) “List of Food Dyes around the World,” Artificial Food Coloring Wiki, http://artificialfoodcoloring.wikia.com/wiki/List_of_Food_dyes_around_the_world


as a food colorant, but the local laws of E.U. member countries banning food colorants are preserved. In Norway, it was banned between 1978 and 2000.60

Yellow # 5 appears to cause the most allergic and intolerance reactions of all dyes, particularly among asthmatics and those with an aspirin intolerance. It may also cause thyroid tumor, neurochemical problems and hyperactivity. This dye is banned in Norway and Austria.61

Yellow #6 is a sulfonated version of Sudan I, a possible carcinogen, which is frequently present in it as an impurity. It may be responsible for causing an allergic reaction in people with aspirin intolerance, resulting in various symptoms including gastric upset, diarrhea, vomiting, nettle rash (urticaria) and swelling of the skin (angioedema). This color has also been linked to hyperactivity in young children. As a result of these problems, there have been repeated calls for the total withdrawal of Yellow #6 from food use. It has been banned in Norway, Sweden and Finland.62

The determining factor of ensuring the safety of substances in our diet is quantity. Anything consumed in excessive amounts will be harmful, even those substances which we are enjoying in our daily diet. Just like too much sugar can cause diabetes and obesity, and too much water may harm our kidneys.


4.1 Potential Solutions

4.1.1 Regulations

There was no control over use of artificial colorings when they were first introduced, so inevitably legislation was enacted to protect consumers. A list of seven permitted synthetic colors eventually was adopted in the U.S. early in the last century. Alteration of legislation has been continuing for many years, as more studies concerning food coloring and health have given rise to a receptive consumer audience.

A ban on the use of artificial food coloring is the most direct solution, in light of the problems that they might cause. Appendix A lists numerous petitions calling for the cessation of use of artificial dyes, as a reaction to the research on food dyes by non-profit organizations, individual scientists’ research, or news reports that can be found in published literature and media outlets. Most of the petitions suggest that food manufacturers should stop using synthetic food dyes, especially in products consumed widely by children. The organization CSPI petitioned Congress to fund the Institute of Medicine to evaluate the studies on diet and behavior and on the safety of pharmaceuticals used to treat ADHD. They also appealed to Congress to hold hearings on the effects of diet on behavior, including possible risks associated with drugs used to treat
ADHD, and on the FDA’s response to the body of research and consider legislation to ban the use of synthetic dyes.\(^6^3\)

4.1.2 Going to the Natural Way

There are so many kinds of safer alternatives to synthetic dyes -- natural dyes. More and more people are aware of various problems caused by unhealthy or dangerous food additives. There have been calls from the public for going to organic and natural foods.\(^6^4\)\(^6^5\) Plants, insects and animals are major sources of natural colorings. Plant sources include roots, barks, leaves, flowers, fruits and berries.

- Natural red colors, which can be used to replace synthetic Red #3 or Red #40, are annatto, cranberry, safflower, orchil, pomegranate, dye’s root from the madder plant, brazilwood and beetroot;
- Natural blue colors, to replace synthetic Blue #1 or Blue #2, can come from red cabbage, grape skin, woad plant, spirulina, centaurea cyanus; blueberry and black berry;
- Natural yellow colors, as alternatives for synthetic Yellow #5, are from turmeric, chamomile flowers, milkwort flowers, golden beet or weld;


• Natural orange colors, to substitute for synthetic Yellow #6, are from stigmas of the saffron flower, marigold flowers, carrot, pumpkin, or orange peel;

• Natural green colors, to use instead of synthetic Green# 3, are obtained from ripe buckthorn berries, ragweed, spinach, broccoli or kiwi;

The most important dyes extracted from insects and animal sources are crimson and scarlet (from the cochineal insect), natural sepia (from the ink sac of the cuttlefish), crimson (from the kermes louse) and tyrian purple (from the murex shellfish).

The demand for natural dyes in the international market is increasing, due to the increased awareness of the therapeutic and medicinal properties and their benefits among public and also because of the recognized profound toxicity of synthetic colors. The use of natural colors is growing in light of the consumer’s distrust of the food industry. Interest in natural colors is also seen in legislation in Japan and in European countries that have banned trading of foods made with synthetic colors. In European countries, there has been pressure from consumers and retailers to develop more natural products and to enforce the laws which limit the use of synthetic colors. As we enter a new millennium this impetus is increasing. Corporate marketing is repositioning and restating their goals to provide more natural ingredients. This encouragement for using natural food colors to replace the artificial ones has brought about changes which are being implemented and followed in several international food corporations. Some in the food industry want to take a precautionary position; therefore, many companies are working to replace artificial colorings with natural colorings in everything from cereal to soft drinks to powdered cheese.

66 Chaitanya, "Food Coloring," 87.
• In 2013, Kraft decided to remove artificial dyes Yellow No. 5 and Yellow No. 6 from some varieties of its Macaroni & Cheese.  
  
• Nestle in the U.S. will remove artificial flavors and colorings from all of its chocolate candy products by the end of 2015.  
  
• Mars announced on February 2nd, 2016 that it will remove all artificial colors from its human food products as part of a commitment to meet evolving consumer preferences.  
  
• General Mills is taking artificial colors and flavors out of its cereals by the end of 2016.  

Many of these decisions were made under the influence of consumers’ petitions, which were asking for the removal of artificial dyes from their manufactured food products.  

Consumer’s selection of foods with natural ingredients, provided by the processing industries, has contributed to the significant increase in the natural food color market. The investment in the market for natural food color across the globe has reached


US $1 billion and is continuously growing, because of the demand for natural food colors as opposed to synthetic food colors.” 71

4.2 A Designed Campaign and App Prototype

The government and the food industry are the decisive factors in the use of artificial food dyes. For consumers, they have opened options for choosing their personal diets -- cheap and artificial ingredients vs. healthy and natural food. How are the informed consumers affecting change, and how are consumers creating a dialogue with the government and food industry through their buying choices, are the two important questions that help to contribute to the dialogue with the public in the role of graphic designer.

This thesis project is the culmination of research and exploration during my Master of Fine Arts candidacy in Visual Communication Design, which has focused on family-based social interventions to protect and promote healthy lifestyles. My thesis is a visual communication campaign titled “The Risky Rainbow” which is designed to reveal the potential health risks of synthetic food dyes and suggest healthy alternative choices to consumers. The outcome of this campaign will call attention to the dangers of synthetic food dyes and influence change in the consumers’ retail and dietary behavior.

Visual communication design does not solely focus on advertising and packaging, but can also be leveraged to deliver information in a more targeted and provocative way to promote positive behavioral change. The outcome of The Risky Rainbow visual communication campaign will reveal the ugly truth behind the glorified appearance of food products and the psychological influence of colors on consumers. The goal of this

thesis research is to educate consumers, especially young parents, on the health hazards associated with synthetic, petroleum-based food colorings, and to compare and contrast natural dyes and artificial dyes. A proper understanding of how synthetic food colorings function will enable consumers to live healthier lives by making more informed choices.

The tactics of this campaign act as a means of displaying the facts and transmitting information with consumer’s interaction, making an effort to bring balance between the industry and the power of the consumer. The design is fact-driven, and it informs the target audience using researchers’ statistics and collection of evidence from mass media. On the one hand, this project exists in the exhibition space as a discursive campaign which combines traditional design approaches: creating a visual identity using a series of posters and infographic handouts to communicate the data, evidence, opinions and concerns with regard to food coloring. On the other hand, an interactive mobile app can offer comprehensive information and alternatives to the health-minded users, to communicate with the consumer at the crucial moment of decision and purchase in the supermarket.
CHAPTER 5:
RESEARCH ANALYSIS AND VISUAL DESIGN FOR THE CAMPAIGN

5.1 Literature Review, Research Analysis and Interviews

Design is a process that produces appropriate outputs, and it should be focusing on problems or important issues rather than simply showing a designer’s creativity. My methodical practice of this thesis project includes a back-and-forth process of literature review, research, planning, interview, iteration, prototyping, testing, adjustment, and post-testing. Key stages of the method contain four parts: discovery, planning, creativity, and application. Systematic thinking is beneficial to enable a designer to provide better understanding and solutions to the viewers.

Design method shows an approach that a designer can adopt to gain understanding of a topic, construct a plan, develop ideas, and then apply them to various projects, ranging from simple items like posters, handouts to more complex components like visual identity, websites, applications, even interdisciplinary designs. Projects may vary in terms of content, scale and difficulty, but the general principles will still be valid.

To define objectives is the first step, and then the designer has to figure out a series of actions to guide solutions. Living a healthy lifestyle is a significant concept in my work as a designer. The use of food additives was my focus at the beginning of my thesis research. After digging into this topic, I decided to focus on the harmful nature of synthetic food coloring additives. Once my topic was chosen, I worked to answer the four questions below. To answer these questions, I completed a thorough literature review,
including journals, books, governmental documents, online data and articles as well as online videos.

Research questions:

- What is the difference between natural dyes and synthetic dyes?
- Why and how do we use synthetic dyes in food?
- What are the hazards of synthetic dyes to humans?
- What can we do to avoid synthetic dyes?

The documented answers to these questions have been discussed in the previous chapters of this thesis. Interviews with specialists were also conducted. In order to gain a better understanding of this topic, I talked with PhD students majoring in chemistry at the University of Notre Dame, acquiring useful information from the standpoint of academic research, like the functions and hazards regarding artificial dyes. Trips to various supermarkets to document ingredient lists in certain foods were conducted. I documented comparisons of food products with or without artificial dyes to exhibit the visual difference and highlight the ingredients listed on their labels to further assist the customers, because seeing how the artificial food coloring is labeled is also beneficial in the design process. (Figure 5.1)
Based on the information I collected about food dyes, I worked on organizing and translating the scientific and abstract information into a visual form for the target audience. The objective of my design is to make it easier for the target audience to understand and absorb the research and evidence, so their purchasing behavior will be effectively influenced. Which way is the most effective approach to convey the thought? How to deliver the information that had been collected to the viewers? These are the two main questions before the design iteration phase. To organize and restructure my research findings, various approaches for information delivery had been considered and the possible methods to deliver the information came to my mind.

At the beginning of design process, I summarized and analyzed the information collected by my research and developed a series of infographic posters which present the basic data and evidence about the seven artificial dyes approved by the FDA. The design was tested in summer of 2015, by viewers in the 25 to 35 age range, some of whom were parents. The audience had different responses to the information presented by the
infographs, according to their educational background, race, gender and age. (Figure 5.2) For example, A Chinese mother, Huifen Wang, who studies chemistry, read the text and data first in order to gain basic understanding of artificial food dyes according to her major. She understood the harms immediately after seeing the molecular structure of the dyes, because in chemistry the hexagon shape normally indicates a synthetic element that can be harmful to human body.

![Image: Interviews and Infographics Test with Various Families]

Figure 5.2: Interviews and Infographics Test with Various Families

5.2 Design Ecosystem: Poster Series, Infographic Handouts, Mobile App Prototype, Display in Exhibition Space

System thinking is very important in the design process and for the decisions we make. It is also an approach for looking at how things influence each other and correlate. Information can be massive and overlapping, which requires a designer to make sure that all the variables come together to influence the big picture. All of the visual elements for the campaign are pieces of a system of interrelated parts.

After the viewer’s test of the initial design, the final decision regarding the approaches for my thesis design was made. The visual design of this campaign includes
five parts: visual identity, a series of posters, infographic handouts, prototype of a mobile app and a display in an exhibition space.

The infograph of a communication ecosystem (Figure 5.3) illustrates how different parts of the design are connected and how viewers could interact with the information through various approaches. In this design campaign, when a consumer goes to public places such as markets or doctors’ offices, he could learn about the critical differences between natural and artificial food dyes from posters or handouts which would direct him to the website and app. The digital format will provide consumers with more in-depth details such as reports, resources from governmental and scientific publications, petitions, etc. The digital components will also provide detailed and instructional information about the food products’ coloring agents by scanning the product’s barcode. As consumers collect this data, they can build their own healthy diet profile with the app. By sharing the information through social media like Facebook and Twitter, this communication ecosystem can influence a multitude of consumers to change their purchasing behavior. As viewers learned about the information through various kinds of media, their actions such as avoiding certain products that contains harmful additives, and the signing of petitions, can impact the manufacturer’s decision to choose natural dyes over of artificial dyes.

The efficacy of the campaign’s visual language was tested in local grocery markets, the university housing for graduate couples with children, and peer input from members of Art, Art History & Design. Collecting data from these tests helped in the selection of the most effective graphic design aesthetic for successful communication of the information to a mass audience.
Figure 5.3: the Infographs of a Communication Ecosystem designed by Yan Zhang
5.2.1 Visual Identity

A visual identity is a way to represent the brand through critical components: names, logos, typefaces, and colors. An identity system spells out how to present a unified front to others, allowing an individual entity - a school, college, or department, for example - to leverage the value of its legitimate connection to a respected institution. Visual identity plays a significant role in expressing the values and characteristics of an organization. With the application of unified visual language, all the elements in the design system of my thesis project can be visually connected, which also helps to reinforce the purpose of this thesis campaign.

To develop a visual identity for this campaign is the primary step in the design process. A "rainbow" has universally positive connotations. Proverbially, the symbolic meaning of rainbow is associated with life, hope, creation, divinity or good luck. However, these seven colors of the FDA proved artificial dyes form a rainbow which would risk people’s lives. "The Risky Rainbow" uses an incongruous and ironic tone in order to evoke viewers’ curiosity and consideration about this visual campaign.

Artificial food colorings are derived from aniline, a petroleum-based product that is a toxic organic compound. Its chemical structure has the hexagon shape which is adopted in the logo design (Figure 5.4). The combination of hexagon and oil drop shape informs viewers about the properties of artificial dyes. The geometric shape also expresses the impression of a chemical based product. The logo design adopts a simple style-geometric shape with san serif fonts-which helps it incorporate well with other elements in the visual campaign, such as posters and app interface.

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5.2.2 A Series of Posters

An effective poster design can be a good tool for capturing the attention of the target audience. The poster must attract and hold the readers’ attention in a short amount of time. Powerful images, bright colors, concise words and interesting layout are usually the basic rules that a designer follows. Keeping in mind, that “form follows function”, the best design should work as intended and be presented appropriately.

I considered what imagery would best convey the message of my campaign. The most significant part of the campaign is to communicate, that artificial dyes can cause various problems to humans, especially children. Certain artificial dyes can cause relative symptoms that vary by a person’s age. I determined that a series of posters (Figure 5.5) representing each dye linked to different problems among children would address the information clearly and comprehensively. I paired expressive images of children eating foods with specific dyes. Each poster focuses on one synthetic dye, so the content is simple and clear. The bright colors from the artificial dyes help to evoke the viewers’ disgust and the expressions on the children’s faces communicate the dangers to the children.
Figure 5.5: Poster Series of the Risky Rainbow Campaign
Designed by Yan Zhang
As Eric Karjaluoto says, “unique approaches should arise naturally, not be forced on a project.”

Throughout the design process, various visual languages approaches were tested, such as photographic style, pencil drawing and vectorial illustration. Finally, a pen and ink drawing method was adopted in the design. The visual language is pure and unique. The contrast between the appearance of the natural organic drawing and the rational geometric logo combined with the background of artificial colors, creates a strong visual impact, so viewers are easily drawn to the illustrations as well as to the color contrast.

In the poster series, I chose the portraits of children differing by age, gender and race, so they encompass the range of my target audience. Each poster represents a child with certain facial emotion along with the food coloring he/she ate that can cause problems for his/her body. Based on the – less is more” rule, the posters eliminate any superfluous detail. Viewers will be initially attracted to the large image of the child’s face and a certain kind of food layered with the artificial food coloring, and then become curious about the reason for the display. As viewers get closer to the poster, they are able to read the text about a certain dye based on scientific research underneath the child’s portrait. For example, the headline - –The Ice Cream Might not be so Sweet” - appears on the Red #3 posters, the body copy gives more detail information about this dye - –The pink color in many brands of strawberry ice cream does not come from real strawberries. It is made with Red#3, which has been shown to cause thyroid tumors in laboratory tests performed by the European Food Safety Authority (EFSA).” In the poster, the audience can also discover the subtle background pattern, which is made of the specific dye’s

molecular structure. A link to a mobile app leads people to a portal where they can get more comprehensive information about food dyes.

A possible extension of my thesis project is to find out the ideal resources for the campaign such as places to display the posters. Public spaces such as grocery stores, bus or train stations, and pediatrician’s offices are ideal options for showing the posters. Shoppers seeking healthy food must pay a lot of attention to the quality of food they eat. Public places like transportation stations have a large number of potential viewers. Parents who take their children to the pediatrician’s office can be cautioned immediately by the information on the posters.

5.2.3 Infographic Handouts

A vast quantity of information was found during the research phase which is abstract, complicated and even boring to the viewers. In my design I needed to communicate this influx of information in an efficient, clear and effective way. As Jason Lankow said in his book, “Infographics, in many different forms, are at the forefront of this new way of thinking. The visualization of information is enabling us to gain insight and understanding quickly and efficiently, utilizing the incredible processing power of the human visual system.” 74

Infographics work as a tool to rapidly spread the message of this visual communication campaign. The infographic handouts (Figure 5.6) include the most important facts about certain dyes, like names of artificial dyes, use in certain food, regulation in different countries, health concerns caused by the dyes, and natural alternatives. Viewers can access the information quickly. As with the posters, a link

appearing under the infographs will lead people to the mobile app platform. To be consistent with the visual language of the poster series, the infographics are also designed in a hand drawing style. On the back side of the infographic handouts, images with children’s faces echo the posters’ information.
Figure 5.6: Infographic Handouts of the Seven Artificial Food Dyes
Designed by Yan Zhang
5.2.4 Design of Mobile Application

A great deal of published documentation and websites on food coloring exist; however, what is lacking is a connection or portal between the sources and problem sufferers or potential viewers. Most of the information sources are actually invisible to the public because many people are unaware of the problems caused by artificial food colorings.

The posters grab the audience’s eyes and call attention to artificial food dyes; then infographic handouts help them learn the basic information about the seven FDA approved dyes. The mobile application offers the viewers a platform to learn comprehensive information about food coloring. As a development of mass transmission media, an app is the most effective approach to deliver and disseminate information. Eric Karjaluoto believes that “Interaction system is multifaceted design structures that allow users to make sense of unfamiliar spaces and new information.”\(^5\) My goal in developing the app design is to produce a digital experience that is easy and intuitive. Viewers should be able to obtain the knowledge and facts about food dyes effectually with the interactive application.

One important feature of the app is that customers can scan the barcode of a package and learn in-depth information about the food. (Figure 5.7) Warning sign will alert the user if artificial food dyes are contained. Options with natural ingredients or without artificial dyes are also offered. An app user can add a searched food to his/her personal diet list as either –like/no.”

Figure 5.7: Scan Barcode of a Package and Learn Details about the Food Designed by Yan Zhang

Another feature is the informational panel. When users open the app on their mobile device, they are able to obtain links to information about food dyes from news reports, journal articles and government documents, videos and petitions. They can also learn the difference between natural dyes and artificial dyes. (Figure 5.8)
Another feature of the app is a petition section where users are able to read, sign and initiate petitions, (Figure 5.9) that ask the food industry to stop using the artificial dyes. The petitions and feedback will be delivered to the manufacturers and FDA when it reaches a certain number of supporters. Therefore, somehow, the food companies and governmental institutions have to respond to the customers’ appeals, such as to stop using artificial dyes or look for natural substitutes. There are links to social communication websites offered by the app, like Facebook, Tweeter, Pinterest, Vimeo and Instagram, so information can go viral and reach more viewers.

Figure 5.9: Petition Section of the App Designed by Yan Zhang

5.2.5 An Exhibit in the Public Museum on University Campus

In order to explore a larger venue and format to expand the components of this visual communication campaign, an exhibit in a public museum presents an interesting challenge. This project exists as a multifaceted campaign that includes a combination of
traditional visual communication approaches, such as large-scale posters, app design and infographic handouts, while also utilizing an interactive installation.

The layout of components in the installation (Figure 5.10) leads the viewer through the information effectively. The audience is initially attracted to the children’s faces on the posters. The posters are mounted on the wall with a transparent colored film curtain projecting obliquely from the wall, so the viewer can observe the poster either directly or through the curtain. Each transparent curtain is of a color which is complimentary to the color of the food on the poster.

![Installation of the Campaign in the Museum Designed by Yan Zhang](image)

Figure 5.10: Installation of the Campaign in the Museum Designed by Yan Zhang

While looking directly at the posters, the viewers can see the actual colors of the food. When they step to the side and look at the posters through curtain, the color of that curtain will alter the color of the child’s food to create a dark unappetizing tone, which reveals the petroleum based property and harmfulness of artificial food dyes to children. (Figure 5.11)
Figure 5.11: Looking at the Posters through Curtains and without Curtains

Details about certain dyes will be seen at the bottom of the posters when viewed up close. Beyond the information about artificial dyes from the poster installation, the audience will learn more truth about this visual campaign from a conceptual app prototype. An iPad installation showcases how the customer can interact with all of the information on the app. (Figure 5.12) The infographic handouts with basic information about the seven artificial dyes will also offer a URL to the app if the viewer wants to check out more details when they get home. (Figure 5.13)
Figure 5.12: The Conceptual App Designed by Yan Zhang

Figure 5.13: Infographic Handouts Displayed in the Museum
As a specific occasion to display my work, the Museum presents a comprehensive display of all the elements of this design campaign. I am working to develop the methods for designing this exhibit as a model that can be applied to various public places. These tactics act as a means of delivering messages at the points of consumer interaction. A consumer will obtain basic knowledge about food dyes through the poster and handout, an interactive app piece opens a portal to reveal more truth and help the viewer to get involved in the campaign. Although audience participation can often be small with such a method, the purpose is to caution the customer and encourage learning and change behavior. From the research testing and feedback review, most viewers showed positive reactions after studying the information in my design presentation. They start by checking the ingredients on food labels, and stop taking in food with artificial dyes.
CHAPTER 6:
CONCLUSION

Food fulfills the basic physical need for human beings. And the visual appeal of food is one of the decisive factors in consumer’s purchasing process. Consumers are easily attracted by bright, beautifully colored food. Since FDA approved artificial food dyes pose so many threats and problems for consumers, shaping consumer perception away from naturally colored or uncolored food towards artificial colored ones creates a problematic effect on their health.

Most of consumers are unaware of the hazards of artificial dyes, because the research conducted by specialists can be confusing and difficult to understand; also, the information about food coloring that can be obtained is questionable. Therefore, there is a strong demand to create approaches where everyone could learn about the information, share their experience and interact with each other, even promote the adjustment and improvement of the governmental regulations which compel the decisions of manufacturers.

As designers, it is our responsibility to make sure that information we are communicating can be fluently and successfully transmitted through the design. We are in a unique position to restore the power of objectivity and interpret the complicated information in a summarized, easy-to-understand way that can be absorbed and influence viewers. Design implementation is important in our working process, but we cannot turn away from the significance of design thinking and research. To focus on the real needs of
customers, interviews and tests with specialist and target audiences also play an essential role in design methodology that cannot be neglected.

*The Risky Rainbow* is a visual communication campaign which integrates strategies like research, analysis, designing and testing. It can be adjusted by using systematic, effective design and used for other visual communication campaigns with similar goals of informing the public about a certain health problem, educating and helping consumers live a healthier life. Developing a design strategy to be implemented in other concepts is also another objective of my research exploration.
APPENDIX A:

PETITIONS ASKING TO STOP USING ARTIFICIAL FOOD DYES


Center for Science in the Public Interest, Petitioning Food and Drug Administration and 1 other, —Tell the FDA to Ban Harmful Synthetic Food Dyes,” 4,431 supporters, https://www.change.org/p/tell-the-fda-to-ban-harmful-synthetic-food-dyes

Julie Rossi and CSPI, Petitioning Crayola President and Chief Executive Officer Mike Perry, —Stop Telling Kids to "Color Their Mouth" with Fake Dyed Candies,” 7,970 supporters, https://www.change.org/p/crayola-stop-telling-kids-to-color-their-mouth-with-fake-dyed-candies

Sue Dengate Woolgoolga, Australia, Petitioning Unilever Australasia, —Hundreds of reports show food colouring Annatto 160b is harmful to children - urgently remove from all Streets ice cream variations,” 5,711 supporters, https://www.change.org/p/unilever-australasia-hundreds-of-reports-show-food-colouring-annatto-160b-is-harmful-to-children-urgently-remove-from-all-streets-ice-cream-variations

antibiotics-adhd-medications-allergy-medications-cold-remedies-pain-relievers-vitamins-and-toothpastes


Fifth Grade Class, Petitioning United States Food and Drug Administration and 2 others, —Remove synthetic food dyes from food or place a warning label on products containing synthetic food dyes,” 58 supporters, https://www.change.org/p/united-states-food-and-drug-administration-robert-aderholt-margaret-hamburg-remove-synthetic-food-dyes-from-food-or-place-a-warning-label-on-products-containing-synthetic-food-dyes


Kelley Keady Dorchester, MA, Petitioning FDA, —Ban the use of artificial food color, require labels on all food coloring,” 322 supporters, https://www.change.org/p/fda-ban-the-use-of-artificial-food-color-require-labels-on-all-food-coloring#petition-letter


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http://www.webmd.com/diet/the-truth-about-seven-common-food-additives


International Association of Color Manufacturers (IACM). http://www.iacmcolor.org/


