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GRAPHIC SYMBOLS VS. TEXT FOR NUTRITION LABELS
USING EYE TRACKING

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# MEASURING THE RELATIVE PROMINENCE OF GRAPHIC SYMBOLS VS. TEXT FOR NUTRITION LABELS USING EYE TRACKING

By

Chang Hoon Oh

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## ABSTRACT

MEASURING THE RELATIVE PROMINENCE OF
GRAPHIC SYMBOLS VS. TEXT FOR NUTRITION LABELS
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As mortality caused by diseases with adult onsets increases, healthy lifestyles become critical. As a result, people are paying more attention to diet and the selection of food products. In this atmosphere, the nutrition information on food labels and functional foods is rising, and the US Food and Drug Administration (FDA) is currently considering revising nutrition labeling.

This study objectively examines the attentive behaviors of subjects when viewing 9 cereals with nutrition information presented in the traditional format and an altered format, which includes the redundant cue of an iconic face for three nutrients that have been linked to disease (sodium, sugar and fat) using eye tracking. Results indicate that the iconic format enhanced the attentive behaviors of study participants for all the three dependent variables analyzed (total time in zone, ($P<0.0001$), probability of noticing in zone ($P= 0.0051$) and number of hits to the zone ($P=0.0039$)) compared to the traditional Nutrition Facts Panel. Although further research is recommended, the fact that the redundant cues increased the probability of viewing the nutritional information, and that people spent longer viewing this information holds promise for labeling policy.

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## TABLE OF CONTENTS

## LIST OF TABLES

## LIST OF FIGURES

# CHAPTER 1. Food and Health Eating Diet

## *1.1. Health and Food in Everyday Life*

There is a Western proverb, "An apple a day keeps the doctor away." It means that good eating helps a person to stay healthy.

Likewise, the Asian proverb "Rice is the best medicine" means the same. Both Proverbs emphasize the important connection of food and health. If we eat meals with care, it helps to maintain our health. We all understand that.

## *1.2. Bad Eating Habits and Risks*

The National Health and Nutrition Examination Survey (NHANES) was performed by the ERS (Economic Research Service), a part of the USDA, in order to measure "the diet quality of the U.S." The survey found that the dietary awareness of Americans has changed.

During the period of 1989-91, about a half of adults in the U.S. rated their quality of diet as very good or excellent. However, in a 2005-2006 survey, only 33% scored their diets as very good or excellent, while 18 to 27 % answered their diets are poor or fair. [1]

### 1.2.1. Obesity and Health Risks

According to the journal 'Business Wire,' more than 100 million Americans have high cholesterol, and nearly 75 million have Diabetes or Pre-Diabetes. Moreover, almost 134 million are "either overweight or obese." Since two-third of adults in America are

overweight or obese, the obesity problem represents a very significant issue in America. [2]

Obesity and diabetes are increasing in the U.S., and more than 300,000 American adults die of obesity-related factors every year. Research has indicated overweight and obesity classifications are critically associated with "diabetes, high blood pressure, high cholesterol, asthma, arthritis, and poor health status." Obesity and adult diseases (Diabetes, strokes, and cardiovascular diseases) are very significant because they are major reasons of adult mortality in United States. [3]

Other studies also indicate weight gain and obesity are correlated with an increased danger of diabetes or other adult diseases. Also, adult people who were overweight in their youth have more adult disease such as diabetes, strokes, and cardiovascular diseases. [3]

As such, eating habits developed in youth are very critical to the prevention of adult diseases because they affect the health status of adults, too. Eating habits need to be controlled from childhood. Recently, the Obama Administration emphasized the "importance of health and wellness" and first lady, Michelle Obama and the President's special project team announced a recommendation report focused on decreasing the obesity rate for children in the U.S. Obviously, the obesity problem is an important concern in the U.S. [2]

Between 1977 and 1996, junk food consumption by children increased nearly 300%. Those changes can partially explain "the rise in childhood obesity observed in the

past few years. [4] This is important because as previously suggested, bad eating habits such as these lead obesity and mortality in adulthood.

Specifically, obesity is now the most prevalent nutritional disease of children and adolescents in the United States. Although obesity-associated morbidities occur more frequently in adults, significant consequences of obesity as well as the antecedents of adult disease occur in obese children and adolescents.[5]

Of course, the obesity problem sometimes results from genetic tendencies, however, it can also be acquired through poor eating habits and the intake of too many calories. In the United States, obesity began to garner attention on the national policy stage after the Surgeon General warned that "obesity had become a new, national epidemic." [6]

This was, and continues to be, an alarming trend due to the fact that obesity is frequently an antecedent to serious diseases. "Increases in obesity and diabetes among US adults continue in both sexes, all ages, all races, all educational levels, and all smoking levels. Obesity is strongly associated with several major health risk factors. [3]

The American Heart Association (AHA) has focused on obesity as "a major risk factor" and has issued appeals for more studies. The AHA report indicates that a 5%-10% weight loss can decrease many health risks. Weight reduction reduces risks associated with high blood pressure, elevated blood cholesterol and diabetes. AHA recommended fat restriction as a good choice for weight loss. [7]

"Obesity greatly increases risks for many serious and morbid conditions, including diabetes mellitus, hypertension, dyslipidemia, coronary artery disease, and some cancers. Obesity is clearly associated with increased risk for mortality, but there has been controversy regarding optimal weight with respect to mortality risk." [8]

## 1.3. Risks from 3 Critical Nutrients (Fat, Sodium, and Sugar)

As a result of these realities, how to choose and eat for healthy lives is a concern. According to one FDA survey, more than half of the public (52%) are concerned about potentially harmful health effects from the foods they eat. The survey suggested that many are anxious about their intake of fat, sugars, sodium and etc. [9]

As such, the U.S. Department of Health and Human Services (HHS) strongly recommends limits on the intake of fat, salt, and sugars, which have been linked to cardiovascular disease, hypertension and diabetes. Nutrient information, in particular these nutrients, which are dictated to appear on the Nutrition Facts Panel (NFP) as a result of the Nutritional Labeling Education Act (NLEA), should be of paramount importance during the purchasing process.

## 1.4. Public and Private Efforts for Healthy Eating

A good diet is important for good health. A healthy and varied diet can help to maintain a healthy body weight, enhance general wellbeing and reduce the risk of a number of diseases including heart disease, stroke, cancer, diabetes and osteoporosis. [10]

Absence of health awareness leads to bad eating habits; bad eating habits are associated with obesity, which, in turn, can lead to mortality that is the result of adult

diseases. For all of these reasons, public policies and guidelines for healthy eating are emerging.

Healthy Eating Guidelines are intended to promote overall health while reducing the risk of developing nutrition-related diseases, like cancer and heart disease. They are directed at all healthy individuals over the age of 14. There is nothing difficult about healthy eating. It is simply a common-sense approach to food that is easy to live with, once you get used to it. [11]

The U.S. Department of Health and Human Services (HHS) recommends food buying plans and has made other guidelines regarding pre-purchase behaviors. For instance, it is strongly recommend that consumers use the nutrition labels mandated on most food products. Specifically, it is recommended that consumers, "Know the limits on fats, salt, and sugars. Read the Nutrition Facts label on foods. Look for foods low in saturated fats and trans fats. Choose and prepare foods and beverages with little salt (sodium) and/or added sugars (caloric sweeteners)." [12]

The National Consumer Council (U.K.) made a healthy eating index table for consumers to formulate their healthy eating plan.

They were given marks out of 10 based on criteria including salt and fat levels in own-brand foods, nutritional information on packaging, the amount of shelf space given to fruit as opposed to sweets and biscuits, the presence of sweets at check-outs, and the availability of advice on healthy eating. [10]

Also, Nutrition Foundation (U.K.) indicates healthy eating tips to enhance people's healthy life. They recommend the following, specific guidelines:

- Eat small quantities of these foods
- Choose low fat or reduced sugar foods where possible
- Use spreads and oils sparingly – opt for fats and oils with a high proportion of monounsaturates and polyunsaturates
- Try to limit consumption of sugar-containing foods and drinks between meals
- Try not to add fat to foods when cooking

Additionally, this same organization proposes to enable better use of the information contained on food product labels. [10]

Keeping in step with varying governments' efforts and consumers' needs, many food companies try to advocate healthy diets through ad campaigns and emphasize that their products are healthy foods in commercials.

# Chapter 2; Ready to Eat Cereals for Healthy Diet

## *2.1. Cereals for Breakfast*

Ready to eat cereal (RTEC) is one of the most popular foods for breakfast around the world. According to one food industry newsletter, most people eat cereals for breakfast, and, as a result, it is the most commonly consumed breakfast item. [13]

Public institutions have emphasized the importance of breakfast as part of a healthy diet, so the importance of the choice of cereal should not be underestimated. The UK's British Nutrition Foundation (BNF) recommends that people have breakfast everyday and has suggested that cereal is an item that can be added to breakfast as a good source of nutrients. [10] The UK is not the only country that has officially recognized the importance of breakfast. The U.S. Departments of Agriculture (USDA) and Health and Human Services (HHS) have indicated that people should eat breakfast as part of their healthy guidelines and that breakfast is an important part of a healthy diet. Additionally, they recommend breakfast cereals because many cereals offer whole grains. [14]

As a result, it is not surprising that the consumption of cereal products is increasing. In China, demand and consumption of cereal is growing and this trend is expected to continue. [15]

According to the *New York Times*, the cereal consumption rate of young adults and teenagers is increasing in the U.S. and college students have been documented to eat cereals for lunch or dinner, as well as breakfast. In the *Times* survey, college students answered that they eat cereal because it is easy and cheap. Also, "NPD Food-world" in

Chicago reports that young people consume more cereals than before because they have regularly consumed cereals since they were toddlers. [16]

## 2.2. Cereal as a Functional Food

### 2.2.1. Various Positive Effects of Cereals

Cereal is one of the important sources of energy for the day. Since ready to eat cereals have the potential for fluent nutrition, individuals who eat cereal products regularly have been reported to be healthier than those who consume them less frequently. [17]

Cereals represent simple, fast and tasty meals (or snacks) to consumers and they frequently have healthful nutrition contents. [18]

***1. Physical Health Benefits Associated with Cereal Consumption***

As part of "the public health nutrition program of UC Berkeley", Gladys Block, PhD, said that cereal eaters usually eat fewer amounts of fat and cholesterol. Meanwhile they eat more fiber per day. Cereals eaters are likely to make smart choices at other meals." [19]

Some research suggests that, the benefits of eating cereals regularly extend beyond nutritional gains, into reducing the chance of diseases.

Cereal usually offers fiber, calcium, iron, folic acid, vitamin C and zinc, as well as a range of micronutrients such as vitamin E, some of the B vitamins, magnesium and zinc. Those contents are critical health maintenance. [20-21]

Research has indicated that people who ate cereals consume more fiber, calcium, folic acid, vitamin C and zinc and less fat and cholesterol. [20]

Vitamins, minerals, fiber and oil in cereal play an important role in lowering "cardiovascular risk factors" and, in 2007, a health study about the relationship between "Breakfast Cereals and Risk of Heart Failure" suggested that "a higher intake of whole grain breakfast cereals is associated with a lower risk of Heart Failure."[22-23]

Fiber, found in many cereals in the form of whole grains, has a preventative effect on chronic diseases such as "coronary heart disease, diabetes and colorectal cancer." [21] The American Diabetes Association recommends that people eat "20-35 grams of fiber" everyday. Eating this amount of fiber each day has been indicated to help to decrease cholesterol levels and reduce the risk of colon cancer. [18]

Many cereals, particularly the bran cereals, which are packed with fiber, reduce the risk of "constipation, diverticulosis, heart disease, and possibly cancer." [24] Cereals which have "oat" contents have been indicated to lower cholesterol levels because the soluble fibers in oats have "beta glucan." The beta glucan content may help to reduce cholesterol levels. [25]

One Italian study announced that ready to eat cereals which contain "Inulin" potentially lowers lipid levels in the blood, reducing the risk of diseases related to blood vessels. [26]

Whole grain cereals have also been linked to the prevention of type 2 diabetes in women. Consumption of cereals containing whole grain may reduce "inflammatory markers among diabetes patients." [27]

### 2. *Maintaining Body Weight*

Body weight is very important to maintain one's health because overweight (or obesity) is positively correlated with many diseases. Millions of American people are dieting to reduce their weight because of health concerns. [28]

Research has suggested that cereal is also helpful to dieters. According to studies which focused on the dietary effects of cereal products, 'whole-grain' breakfast cereal is helpful to managing one's weight. [29] Research suggests that people who regularly eat cereals manage their weight more successfully than people who don't. [30] Furthermore, according to a study conducted at Wayne State University, people who consumed "cold-cereal with low fat milk after dinner," ultimately consumed fewer calories than people who did not eat cold cereals.[31]

Recent research of the American Diabetic Association supports the relationship between cereals and health. The research found that consuming oat cereals helps weight loss in both genders with obesity. [32]

### 3. *Better Mental Activities*

Studies performed in children have also suggested that breakfast may help with mental performance (memory and attention). In one study, groups of children that had no breakfast or glucose drink for breakfast exhibited declines in attention and memory;

however, the memory and attention declines were decreased among the children who had cereals. This research indicates "a typical breakfast of cereal rich in complex carbohydrates can help maintain mental performance over the morning." [33] A larger study also suggested a relationship between eating breakfast cereal and health. Adults who ate cereals every day for breakfast maintained "better mental and physical health, compared to those who consumed it less frequently." In the research, perceived stress, fatigue, anxiety, depression levels were remarkably low among the subjects who ate cereals daily. [34]

## *2.3. Choosing Better Cereals for Health*

It is helpful that consumers choose the right cereals based on their health status. Cereals may contain inappropriate levels of fat, sugar or sodium while other cereal products are rich sources of fiber, vitamins and minerals like iron, magnesium and selenium. For this reason, choosing right kind of cereal provides nutritional advantages and helps to reduce many chronic diseases with adult onsets.[35]

Nutrition experts have recommended purchasing "flaky or puffy cereals" rather than those that are the "dense, nugget" type because the former typically have far fewer calories. Also, it has been recommended that consumers should look for "whole grain" cereal for health diet. [24]

"Whole grains" are rich in fiber content and have been shown to prevent many diseases.

There are two kinds of fibers; insoluble fiber and soluble fiber. The former is rich in 'Bran' and the latter is high in 'Oat.' The insoluble fiber helps to prevent "constipation. Diverticulosis, and heart diseases." Moreover, animal studies found that insoluble fiber may reduce colon cancer. The main effect soluble fiber is that it helps "lower cholesterol and lower risk of heart disease."[24]

Because of the potential positives of consuming the right kind of cereals, it is important that consumers understand the nutrient content of what they are choosing. This make the information contained within the nutrition facts panel (NFP) especially "calories, fiber grams, and sugar grams" particularly important.[35]

# CHAPTER 3. Nutrition Fact Panels

## *3.1. Nutrition Facts Panel*

### 3.1.1. Importance of Nutritional Labeling

A primary vehicle for supplying point of purchase nutrition information to consumers is "Nutrition Labeling." [36]

In fact, research conducted in the United Kingdom (UK) suggests that the major source of nutrition information that is used by consumers comes from labels. Studies published in the United Kingdom indicate that 30 % of consumers always read the food labels. [37]

The importance of nutritional labeling to consumers has also been studied in the US, where product labeling is required to conform to FDA and/or USDA requirements for the vast majority of food items sold. [38]

In a study conducted in 2009 by the International Food Information Council Foundation, consumers were asked about "the type [of] information" they find on the package of food and beverage when they decide to purchase food or beverage products. According to the survey, the "Nutrition Facts panel (NFP)" was the most common label element used by consumers to get nutrition information. The other factors that consumers focused on were the "Expiration Date", "Brand name", "Ingredients", "Size of Product", "Nutrition Statements", "Statement about Health Benefits." [38]

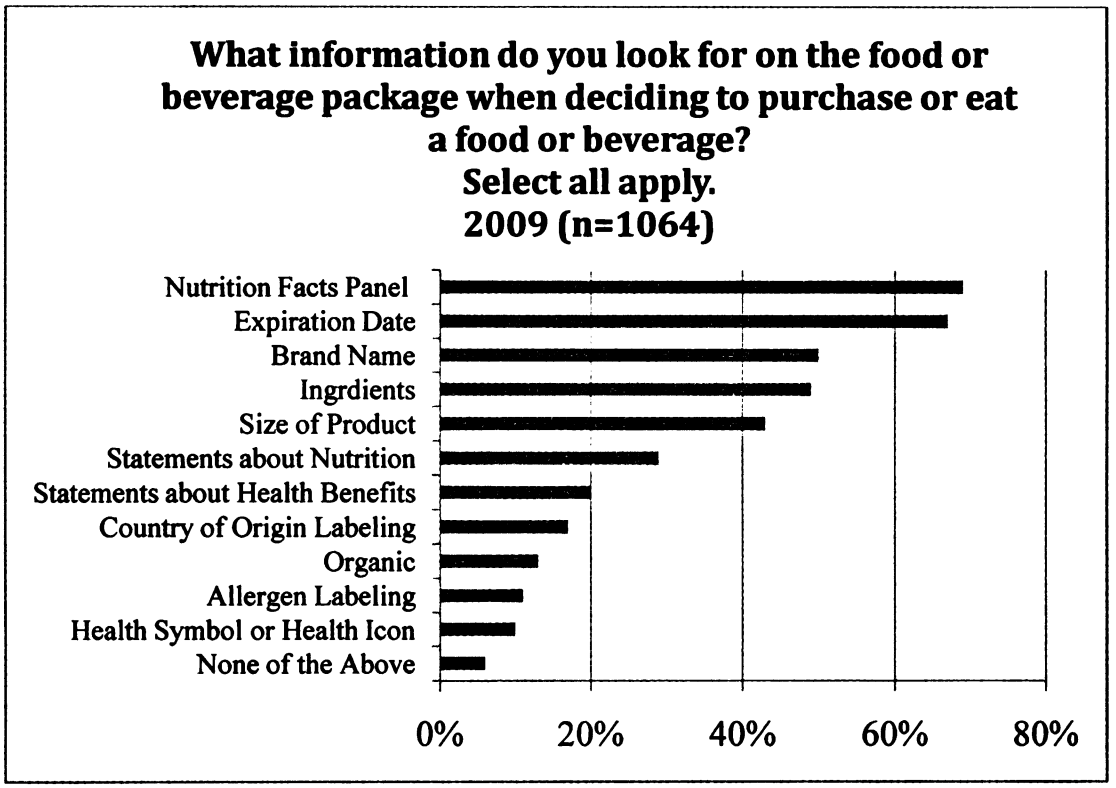


Figure 1- Use of information on food and beverage packages; Data from "International Food Information Council Foundation food and health survey" [39]

According to research conducted by the International Food Information Council Foundation in 2006, health conscious consumers use the NFP information more frequently. [40]

It has been suggested that the importance of the role of the "Nutrition Facts" label is increasing because reading (and using) the information contained on these labels can help to prevent chronic disease and obesity; an issue of growing concern around much of the globe. Americans are showing an increasing interest in the link between food and health, nutrition, diet and the prevention of chronic disease. [41]

According to a recent report of the US Food and Drug Administration (FDA), the percentage of people who read nutrition labels before buying food products reflects this increased interest. In 2002, 44% of people indicated that they read nutrition labels before buying a product, where the number had increased to "54% in 2008." [41]

Furthermore, research at the University of Nebraska, which gauged consumer attitudes, indicated that the presence of a nutrition facts label in dining halls impacted the food choice on campus and outside. After posting the nutrition contents in the dining halls, food consumption was reduced. The nutrition facts labeling is very important because it has been linked to consumption behaviors as well as purchase decisions. [42]

### 3.1.2. General FDA Regulations of Nutrition Facts

In the US, the Nutrition Labeling and Education Act of 1990 (NLEA) has required food manufacturers to provide nutrition information in a standardized format in a truthful and complete manner. Regulated products were required to have this labeling in place by the May 1994 deadline imposed in the associated regulations. The goal of this requirement was to reduce the negative effects of untruthful and exaggerated claims as well as improve the accessibility of nutrition information at the point of sale so as to increase the extent to which consumers could process and use it in their choices. [43]

***FDA Regulations:***

Details regarding the standardized content and formatting of information can be found in 21CFR 101.9(d).

The regulation indicates that there are no size requirements for the "Box" which contains the nutrition facts information. However, the letter size of the "Nutrition Facts" heading must be larger than all other fonts that appear on the nutrition label. Also, a minimum type size of 6 and 8 points are required for the various pieces of required information, and there are minimum spacing requirements between lines of text. [44]

***Overall Rules:***

The Nutrition Facts label is boxed into what is referred to as the "Nutrition Facts Panel," which is located to the right of a package's principal display panel (PDP). The 'NFP' is placed with lists of "Ingredients" and "Name and Address (name and address of distributor, manufacturer and packer). (See Figure 2)

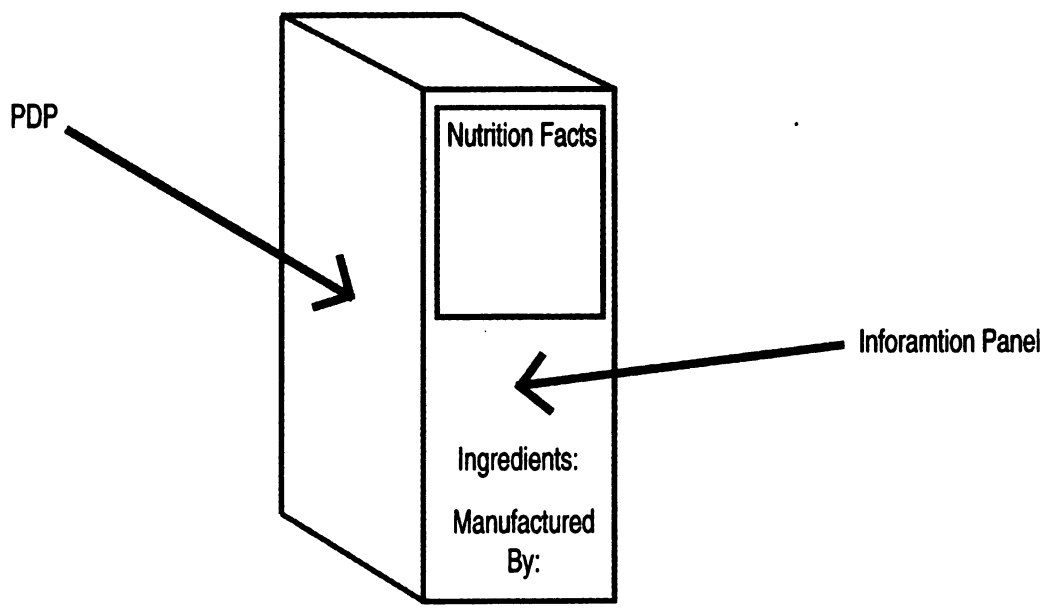


Figure 2- "A Food Labeling Guide" by U.S. Food and Drug Administration" [44]

The box and information are presented in all black or one color type printed on a white or neutral background.

***Typeface and Size:***

The letters in Nutrition Facts Panel use six point or larger and it is suggested that information appears in "Helvetica Black or Helvetica Regular" fonts. Key nutrients and their % Daily Value must be presented in a minimum of 8 points Helvetica Black (but "%" is set in Helvetica Regular).

1. "Nutrition Facts" is set in either Franklin Gothic Heavy or Helvetica Black to fit the width of the label flush left and flush right (a justified format).
2. "Serving Size and Servings per container" are set in 8 point Helvetica Regular with 1 point of leading.
3. The "table labels (for example, 'Amount per Serving')" are set in 6 point Helvetica Black.
4. "Absolute measures" of nutrient content (for example, "1g") and nutrient subgroups are set in 8 point Helvetica Regular with 4 points of leading.
5. "Vitamins and minerals" are set in 8 point Helvetica regular, with 4 points of leading, separated by 10 point bullets.
6. All type that appears under vitamins and minerals is set in 6 point Helvetica Regular with 1 point of leading.

***Box:***

All labels are enclosed by ½ point box rule within 3 points of text measure. [44]

## 3.2. Efforts for Nutrition Labeling Development

As mentioned previously, it has been suggested that "consumers are becoming health conscious and most agree that eating healthily is better way to manage illness than using medications" [45]

### 3.2.1. Motivations of the Better Labels

Despite the growing importance of nutrition facts labeling, research suggests that consumers are struggling with interpreting the information that they provide. Nutrition facts have to be read easily, however, this labeling has been called "confusing," "misleading," and even "inaccurate." [46]

According to a survey of the Wall Street Journal, even "well-educated" individuals who have "the good reading and interpreting skills" have difficulties understanding the label data. [47]

Moreover, a study published in the "Journal of Preventive Medicine," suggested that comprehension errors of labels occurred in populations of not only "lower literacy and mathematic skills" but also "better-educated groups." In other words, the members of well-educated group failed to understand the label information as well as those with diminished educational backgrounds. In the study, the authors report that only 37 % of test subjects calculated "the total grams of carbohydrates in a 20 ounce bottle of soda" correctly. In the case of a whole bagel, 40 % of participants couldn't calculate "how many grams of carbohydrates they would consume if they ate only half a bagel." [47]

Obviously, many consumers are confused by nutrition facts information. As a result, efforts, both public and private, have been started to make labels that are better understood.

The majority of efforts seem to take one of two approaches (1) to create labels that effectively warn and are easily comprehended by consumers (2) to promote a food product highlighting the healthful content of that product. Studies of the former type are

mostly carried out by public institutions or consumer groups, while those of the latter focus are mostly developed by food companies [48]

Globally, there has been a movement to change the formatting of nutritional information. The use of "Health Claims" and varied schemes for Front of Package (FOP) Labeling are good examples of this movement. New formats rely heavily on the use of color cues and icons, combined with text, to convey nutrition information or imply claims of health.

### 3.2.2. Efforts for Nutrition Label Development

#### *I. Health Claims*

***Need of Health Claims***

Health Claims are an example of a nutrition-profiling tool; Nutrition profiling is a method for "categorizing the healthfulness of foods" based on their nutrition contents. [49-50] When food manufacturers attempt to communicate the "health related properties of a food", this can be regarded as a "health claims."[51] See below for example images of health claims.


Figure 3- Health Claims

***Functional Food and Health Claims;***

The term "functional food" means that the food provides various benefits 'beyond basic nutrition.' People can get the various nutrients from functional foods which help their nutrition diet and it may lead not only deliveries of the good nutrition as the whole food itself but lowering the rate of various disease occurrences. [52]

Because of the demand for "functional foods" and their promise of healthful benefits, the number of food product carrying "health and nutrition claims" is growing. [49] Various health claims are seen on the labeling of many food products throughout the world and each health claim is one of the important tools for the marketing of functional foods.[45]Therefore, companies are using health claims (scientific evidence) to raise the marketing benefit. [49]

Clearly, inserting a health claims can improve "the quality of dietary choices and knowledge of diet-disease relationships." [53]

***Regulations to Protect consumers***

Although printed health claims must be based on "scientific evidence" [49], sometimes health claims are based on dubious scientific information. Put simply, untruthful statements are used as health claims at times. Early in the history of label-located health claims, the value of the claims made by food companies was very low. Many, for instance, put ambiguous claims on their package labels to appeal to consumers' desires for healthful products, creating the potential to mislead consumers. [48]

It has been reported that most consumers do not precisely comprehend 'labeling information;" however, information, in the form of a health claim, has been reported to change "consumers' perceptions toward specific food products." [54] Therefore, the potential for misleading consumers exists. As a result, regulations regarding health claims have been prepared as preventive measures by public institutions.

Prior to 1984, in United States, "health claims for food products" were banned by FDA. In 1990, under "the Nutrition Labeling and Education Act (NLEA)", FDA issued regulations authorizing 'Health Claims' for dietary supplements after reviewing the scientific evidence submitted in 'health claim petitions'.[55]

After that, the first trial of a health claim (located on the package) was made by Kellogg Company. Kellogg's suggested the health benefits of certain cereal products as agents of "high fiber content and lower risk of cancer." [43]

By 1990, food labeling was an important policy issue. The US Food and Drug Administration (FDA) developed "a new regulatory regime for health claims" as well as regulations under the directive of the "Nutrition Labeling and Education Act of 1990." Although the regulation of food labels that are subject to NLEA requirements has been relatively stable, arguments regarding the appropriate use of 'health claims' are still ongoing. [53]

During this same period of time, the FDA further reformed nutrition labeling rules by creating regulations that governed the use of "Free Claims." They suggested 'free' claims used on food products that are "inherently free of a nutrient" are misleading unless accompanied by a statement that all foods of that type are inherently free of that nutrient.

(Federal Register 1993) For example, a head of broccoli could not be labeled as "fat free," but instead had to be labeled as "broccoli, a fat free food."[56]

The U.S. has not been the only country involved in discussions of health claims. In 2003, the joint agency Food Standards of Australia and New Zealand (FSANZ) attempted to standardize health claims to prevent them from being misleading. Currently, "the food standard cord (Standard 1.1A.2)" allows the "nutrition content claims" because they are claims for maintenance. However, "disease reduction claims, (with the exception of those directed at the consumption of folate (folic acid), a substance known to reduce the risk of neural tube defects)" are prohibited. [45]

FSANZ implemented "the Claims Framework in the Policy Guideline" and classified three types of claims. See below 3 levels of claims.

- ***Nutrition content claims***

  ; Statements regarding the amount of a nutrient, energy or a biologically active substance in the food

- ***General level health claims***

  ; The presence of a nutrient or substance in a food and its effect on a health function

- ***High-level health claims***

  ; Claims that make reference to a serious disease or biomarker

Health claims on the labeling of food products are becoming more prevalent in many countries and there is some evidence that the claims of health give a positive effect on healthy choices when consumer wants to purchase premium food. [45]

***Concerns about Health Claims***

According to a recent survey of "the global regulatory environment for health claims performed by World Health Organization (WHO)", a majority of countries do not regulate these claims. Among those that report regulation of said claims, requirements vary significantly. [53]

Moreover, consumers, particularly those unfamiliar with nutritional information and those that are illiterate have great difficulty. To prevent such problems, education regarding health nutrition and disease and efforts to make international regulations are necessary. [57]

Although it is touted that 'Health Claim' labels have the potential to affirmatively impact food choices, research is still needed.

The claims mostly include healthy nutrition contents or health support declarations. Sometimes they can lead to misunderstandings or actually misinform consumers, especially if the claims are not created by public institutes. Claims like "good for health", "healthy" or "better choice" are not clear expressions to the consumers. For that reason, FDA recommends that consumers continue to check the Nutrition Facts Panel and read and rely on the percent of 'Daily Value' content to avoid confusion and misinformation. [58]

***Examples; Claims for Public Health***

- ***The "Pick and Tick" symbol***

The Heart Foundation of New Zealand created "pick and tick" symbols. In general, the "pick and tick" symbol is approved on food packages which contain foods lower in "total fats", "saturated fat", "added sugar" and "sodium." The mission of this symbol is "To improve the nutrition health through a food information program which encourages a healthier food supply."


Figure 4- "pick and tick labeling" in New Zealand [59]

- ***The "Green Keyhole" symbol***

The National Food Administration in Sweden introduced the symbol "Green keyhole" during a nutrition campaign in 1989. The symbol is made to give health information on a package label and the symbol indicates "low-fat and high-fibre foods" The aim of the "Green Keyhole" campaign is to help consumers make "low-fat, high-fibre food choices."[60]

Figure 5- Green Keyhole labeling [60]

- ***The "Heart" symbol***

In 2000, the Finnish Heart Association and Finnish Diabetes Associations introduced the 'heart symbol,' a symbol which indicates that the food is a better choice for health because the food has less fat and salt. [61] The "protect heart symbol," of Slovenia, gives the information not only regarding "the amounts of fat, cholesterol, sugars and sodium but [also] the amount of fibre and energy." [62]


Figure 6- "heart symbol" [62]

## *II. Front of Pack (FOP) Labeling*

***Front of Pack (FOP) label***

Front of package (FOP) labeling is a relatively new approach to labeling which places a summary of key information from the more complete nutritional information (e.g. the Nutrition Facts Panel in the US) on the front panel. "Nuval" and "Nutrition Highlights" in cereal products are the examples of FOP labeling. [58]

It has been suggested that many consumers think that FOP labeling is helpful because they do not need to use the "Nutrition Facts" section. However, concerns exist that new FOP systems may result At present, the FDA is gathering information for consideration in order to standardize an FOP labeling system that people can fully trust and adopt. [58]

***Types of FOP Labeling***

Several types of FOP systems are currently commercial. [63]:

- "Fact based systems provide FOP information that brings to the front panel information that is provided in the NFP (nutrition facts panel)."
- "Better-for-you systems use symbols to indicate how a product ranks against a defined set of nutritional criteria."
- "Graded better-for-you systems also use symbols, but with indicators to convey good, better, and best nutritional quality."
- "Numerical rating systems use numbers to rank the overall nutritional quality of a food or beverage."
- "Color-coded systems use colors to provide at-a-glance information about the levels of individual nutrients in a food or beverage"

Many of the FOP systems that have been introduced around the world in the recent past incorporate 'graphic symbols' in an attempt to garner consumer attention and aid in their understanding of the nutritional aspects of a product.

***Suggested FOP labelings***

*1. Guideline Daily Amounts (GDAs) labeling*

In 1996, Guideline Daily Amounts (GDAs) were developed as "Daily Guideline intakes (DGI)" by the UK Ministry of Agriculture Fisheries and Food (MAFF), now were the Food Standard Agency (FSA). In 1998, a set of GDAs for food labels were suggested to communicate the Government's nutrient intake recommendation. GDAs were created in order to help consumers' comprehension of nutrition information on a package [64].

GDAs have been used for about a decade by many food companies in the UK.[48] GDAs offer consumers the information regarding a product's "energy, fat, saturated fat, carbohydrate, total sugars, fibre, sodium, salt and protein".[65]

Recentrly, the GDAs labeling is spread throughout EU countries. In 2006, the Confederation of food and Drink industries (CIAA) introduced an EU set of GDAs which is based on Eurodiet recommendations and, in 2010, the Members of the European Parliament (MEPs) supported GDAs are the best way to get nutrition information when consumers purchase food products. In July 2008, according to a research performed by APCO Worldwide Insight, many food companies in EU voluntarily inserted GDAs across a broad range of foods. According to the research conducted based on food companies in

France, Italy, Spain, the United Kingdom and the Netherland, nearly half of all respondents (44%) are voluntarily labeling their products with GDA information [64].

See Table 1 and 2 for GDAs for adults and children.

Table 1- "GDA Tables for Men and Women"; Institute of Grocery Distribution (2008) [66]

| NUTRITION INFORMATION | | | GUIDELINE DAILY AMOUNTS | |
|---|---|---|---|---|
| Typical Values | Per 100g | Per 350g serving | Women | Men |
| Energy – kj | 480kj | 1680kcal | - | - |
| -kcal | 115kcal | 405kcal | 2000 | 2500 |
| Protein | 9.5g | 33.3g | 45g | 55g |
| Carbohydrate | 8.6g | 30.1g | 230g | 300g |
| Of which sugars | 2.0g | 7.0g | 90g | 120g |
| Fat | 4.6g | 16.1g | 70g | 95g |
| Of which saturates | 3.0g | 10.0g | 20g | 30g |
| Fibre | 1.5g | 5.3g | 24g | 24g |
| Sodium* | 0.3g | 1.1g | 2.4g | 2.4g |
| *Equivalent as salt | 0.8g | 2.8g | 6g | 6 |

Table 2- "GDAs for children" Institute of Grocery Distribution (2008) [66]

| | GUIDELINE DAILY AMOUNT |
|---|---|
| | 5-10 years |
| Energy (Calories) | 1800 |
| Fat (g) | 70 |
| Saturated Fat (g) | 20 |
| Carbohydrate (g) | 220 |
| Total Sugars (g) | 85 |
| NMES (g) | 50 |
| Protein (g) | 24 |
| Dietary Fibre (AOAC) | 15 |
| Dietary Fibre (NSP) | 11 |
| Sodium | 1.4 |
| Salt (g) | 4 |

GDAs are based on "the estimated daily intake of an average individual eating a diet" from 'Dietary Reference Values' report performed by Committee on Medical Aspects of Food Policy [67]

### *2. Traffic Light System Labeling in U.K.*

An FOP labeling system that is garnering a lot of discussion and attention is the "Traffic light labeling" system, used in the UK.

The Food Standard Agency (FSA) in the U.K. created "Traffic Light Labeling," a system that employs both colors and text to convey information regarding key nutrients. As with most FOP systems, the intention of traffic light labeling is to induce a healthy diet by providing nutritional information to consumers in a format that is easily read and understood. [48]

Traffic light labels are basically an extension of GDAs (Guideline Daily Amount) labeling. While "GDAs" usually indicate the amount of nutrition using a percentage format, "Traffic Light" labeling uses Colors. [68]

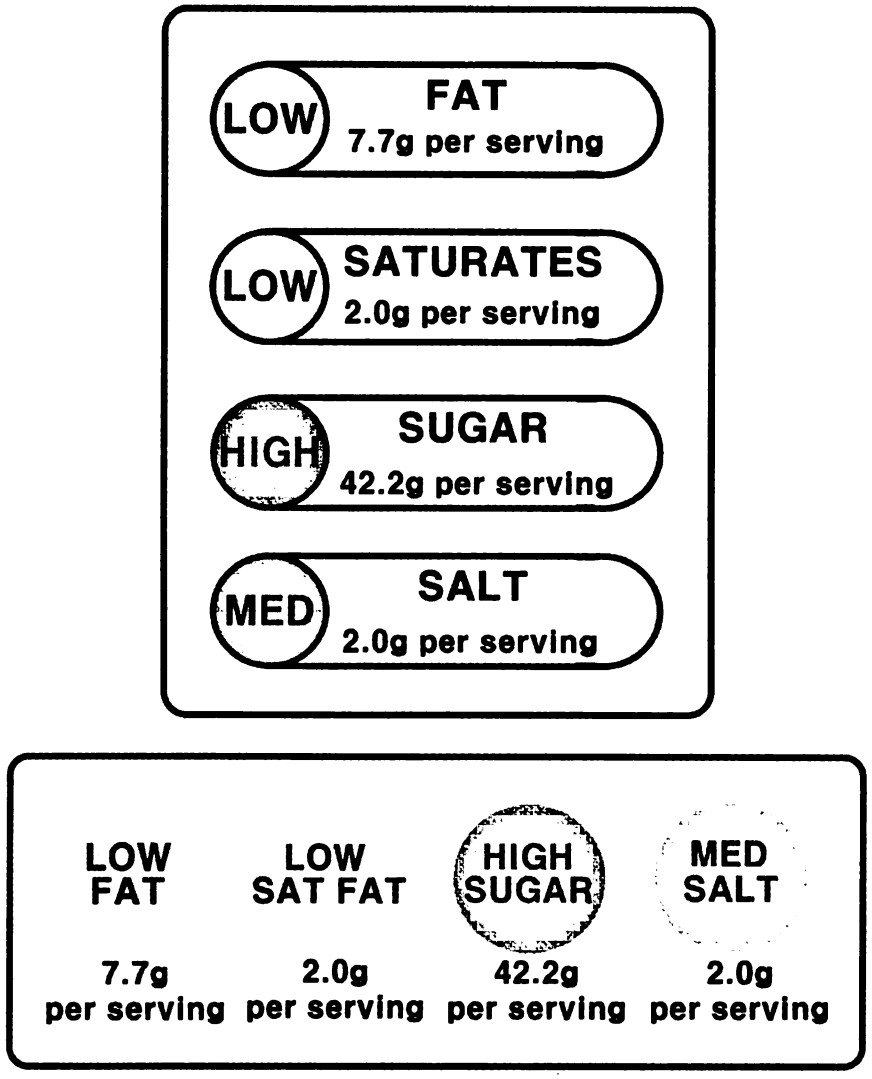


Figure 7- "Traffic Light Labeling" Food Standard Agency, U.K. [69]

FSA standards recommend that the Traffic Light system include the amounts of 3 nutrients (health fat, sodium and sugar) per 100g serving. These nutrients were selected for inclusion in the FOP format because of their links to detrimental health effects. Color serves as a redundant cue for the information; red, amber and green light levels, correspond with high, moderate and low amounts of the nutrients, respectively. [48]

Cutoffs for each of the nutrient levels (Fat, Sodium and sugar) are posted on the

"U. K. Food Standard Agency" webpage; See Table 3.

Table 3- Levels of Nutrition Contents (Fat, Sodium, and Sugar)

| Density Level | FAT (/100g) | SODIUM (/100g) | SUGAR (/100g) |
|---|---|---|---|
| **High (Red)** | More than 20g | More than 1.5g | More than 12.5g |
| **Medium (Amber)** | more than 3g & less than 20g | more than 3g & less than 1.5g | more than 5g & less than 12.5g |
| **Low (Green)** | less than 3g | less than 0.3g | less than 5g |

Research investigating the "Traffic Light" labeling performed by FSA U.K. suggests that consumers showed strong reaction to the number of "reds" presented on a product. Simply put, consumers have a tendency to look for products that contained "fewer reds" as opposed to "more green." Since people regard the "red" color as cautionary, warning of danger, the effect of the "red" color was noted to be bigger than "green" or "amber". Also, the report states that, "when looking at a single product, the number of 'reds' or 'greens' often influenced their decision. In some cases, the presence of any red provoked further investigation. In other cases seeing more than two reds may lead to a rejection. [63]

As such, the use of the, "Traffic Light" labeling system has potential to significantly impact behavior. However, eating a varied and balanced diet is the goal;

some "foods which are considered HFSS [high fat, sugar and salt] also contribute a wide variety of beneficial nutrients to their diet and can be consumed as part of a healthy balanced diet." Currently, the "traffic light" system is being voluntarily inserted in these categories of food: sandwiches, wraps, filled baguettes and similar foods, ready meals, burgers, sausages, pies, pasties, quiches, breaded, coated or formed meat products and alternatives, pizzas and breakfast cereals. [63]

## 3.3. Opinions for Label Development

As mentioned above, there are many efforts related to label development, using various formats.

Consumers usually do not use nutrition labels because of "lack of interest" and "lack of time." According to research completed by McIlveen and Semple (2002), people who didn't read food labels commented that they didn't read labels because they can't understand the information on the labels. Lack of interest can lead to consumers that don't read nutrition labels and they cannot improve their diet. [70]

Literacy level affects the ability to read, interpret and understand nutrition labels. Also, graphic presentations have been indicated to be helpful to comprehension rates in consumers with low literacy. [57]

# CHAPTER 4. Materials and Apparatuses

In this chapter, the first section provides a description of the materials used during the course of study, and the second includes a description of the eye tracking apparatus and the settings employed.

A convenience sample of 24 subjects was recruited via word of mouth and an advertisement (see APPENDIX 2) that was announced during a required undergraduate class at the school of Packaging and through the employee pool at MSU.

In order to participate, subjects had to be 18 years of age, could not wear hard contact lenses, or be legally blind. In exchange for participation, subjects were provided a $10 Best Buy™ gift card.

Upon arrival, after informed consent was obtained, subjects were assigned a number; recorded data is tied to this number, not subject name. Subjects began by filling out survey questions which included: demographic information, information about healthy eating and consumption patterns (frequency, preferences, and etc.), and self-reports of personal information (e.g. age, gender, height and weight and etc). See APPENDIX 3 for more detailed information.

## *4.1. Materials*

### Visual Acuity Test Card (Dow Corning Ophthalmics Product)

Following the short survey previously described, each subjects' visual acuity was tested a using a Dow Corning Ophthalmics Inc. (Norfolk, Virginia 23508) Near Point Visual Acuity Card (see Figure 8).

The dimensions of the card are '7"(w) x 4"(h)' and the size of printed letters moderately decreases from the top to the bottom of the test card.

Subjects were tested in good light and instructed to hold the card 16" from their eyes and read the lowest line that they could decipher. In accordance with Dow's instructions, the visual acuity recorded for the subject coincided with the lowest line on the card where they were able to correctly report all letters; the potential range of recorded acuities was 20/20 to 20/120.


Figure 8- Near point Visual Acuity Card, Dow Corning Ophthalmics (Left; front, Right; back)

Visual acuity was measured with corrected eyesight. Subjects wore corrective eyewear that would normally be required for reading tasks during the visual acuity tests.

## Color Blind Test Book (Pseudo Iso-Chromatic Plate Booklet)

Immediately following the test of visual acuity, each subject's ability to see color was testing using the Pseudo Iso-chromatic Plates Booklet manufactured by Richmond Products (Albuquerque, New Mexico).

This blue covered booklet has 14 plates of numbers which screen for the ability to see red and green colors (see Figure 9). Each subject was asked to read the number printed on each page of the book. Subjects were allowed to view each stimulus for approximately 2 seconds before responding to a given test plate. In accordance with manufacturer's instructions, when the number of correct responses was $\geq 10$ (out of a possible 14 test plates), the response was recorded as "Normal" color vision.

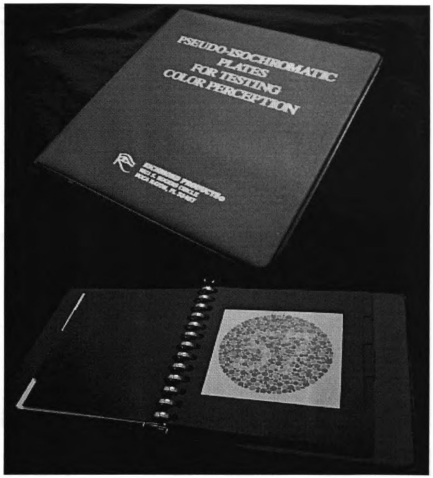


Figure 9- Color Blind Test Book (Pseudo Iso-Chromatic Plate Booklet)

**Labels for Eye Tracking Stimulus (NFP labels with PDPs)**

Nine, commercially-available cereals were selected across a range of nutritional densities (See figure 10). The corresponding Nutrition Facts Panels (NFPs) were modified, resulting in two levels of presentation for the eye tracking stimulus: (1) text only (the commercially-available format) and (2) facial icons inserted. As such, there were a total of 18 unique files to be viewed by subjects (9 cereals x 2 presentations of NFP).


Figure 10- 9 Front Package Labels (PDP) of commercial cereal products

### *1. Text-only (Commercially Available) NFPs*

Figure 11 shows the nine NFPs that corresponded to the cereals selected for use in the study. 9 PDPs and NFPs were scanned at a resolution of 300 dpi. The PDP was saved as a JPEG picture format.

Each cereal's corresponding NFP was scanned at the same resolution with the same scanner and sized to 2500 pixels by 3600 pixels, and, as with the PDP image, saved in a JPEG picture Format. The Scanned images were then combined (see Figure 12 and 13) using Adobe Illustrator CS2® (San Jose, CA), and saved as a single JPEG image in which the PDP was on the left hand side of the computer screen with the NFP to its immediate right. In the Adobe Illustrator CS2® Software, a border was created to frame and unify the size of all slide images. Therefore the size of all PDP +NFP, combined images were 3184 pixels (X) by 3601 pixels (Y), including into the box frame.

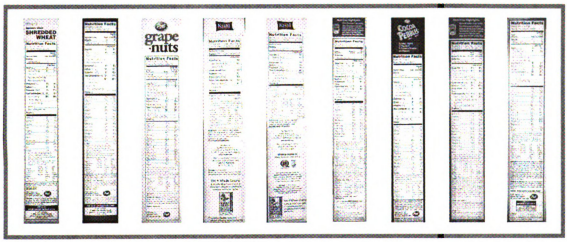


Figure 11- Normal nutrition facts labels of commercial cereal products


Figure 12- Normal Nutrition Facts Labels with PDP for the Control Data


Figure 13: a single example of the traditional NFP Label with PDP for the control data

(70% scales of the actual size)

### 2. *Icons inserted NFPs : GNFP*

Scanned images of the NFPs were modified using Adobe Illustrator CS2® (San Jose, CA), to create the second level of presentation (iconic) for the NFPs. Iconic or graphics were created for three nutrients, Based on the critical role that they have been identified to have in lifestyle diseases of importance in the US (heart disease, hypertension and diabetes). See Chapter 1 for more information about health risks caused from Fat, Sodium and Sugar.

Table 4- the standard quatity levels of 3 Critical Nutrition

| Density Level | FAT (/100g) | SODIUM (/100g) | SUGAR (/100g) | FACIAL ICON |
|---|---|---|---|---|
| High | More than 20g | More than 1.5g | More than 12.5g | FROWN |
| Medium | more than 3g & less than 20g | more than 3g & less than 1.5g | more than 5g & less than 12.5g | NORMAL |
| Low | less than 3g | less than 0.3g | less than 5g | SMILE |

*Data in Table 4 founded in U.K. Food Standard Agency website. (http://www.eatwell.gov.uk/healthydiet/fss/)

Using Illustrator CS2® software, the researcher designed facial icons intended to represent three levels of nutrient density. (3 levels: Smile, Normal, and Frown faces) See the examples of facial icons below.

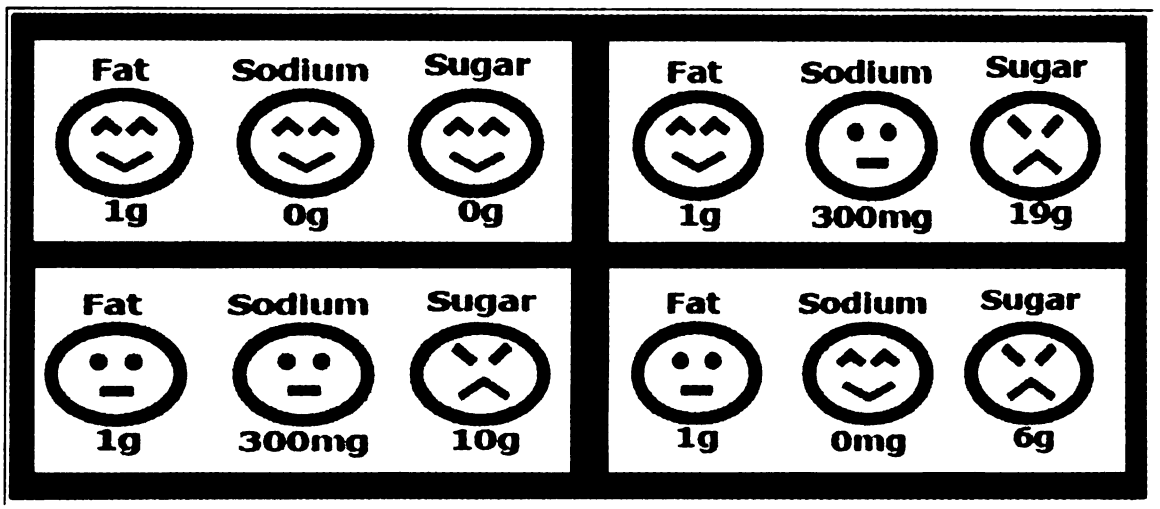


Figure 14- Sample images of facial icons for the graphic nutrition facts panels (GNFP)

NFPs were modified by adding these facial icons set based on the nutrient levels (fat, sodium and sugar) present in the specific products, just below the calorie report in the traditional NFP.

See figure 15 for a presentation of all 9 cereals with modified NFPs and Figure 16 for a single example. (70% scale of the actual size)


Figure 15- Graphic Nutrition Facts Labels with PDP for the Test Data


Figure 16- a single example of icon inserted NFP (GNFP) Label

with PDP for the test data (70% scales of the actual size)

## 4.2. Apparatuses

### The ASL Pan Tilt Optics Eye Tracker (Model 504)

In order to test for an effect of iconic format on the noticeability of information related to the select nutrients, an Applied Science Laboratories (Boston, MA), Pan Tilt Optics eye tracker (ASL Eye-Tracker model 504) was used. (See Figure 17)

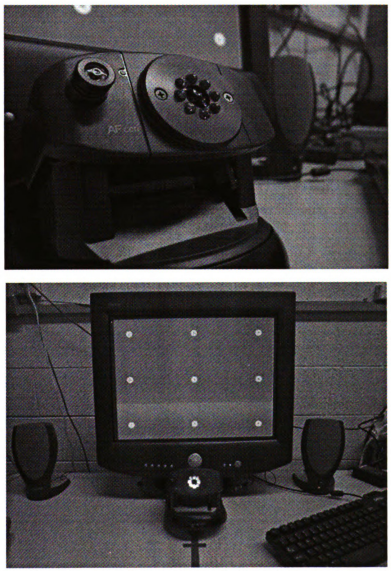

Figure 17- Pan Tilt eye camera and eye-tracker setting for the experiment

This eye-tracker is designed to accurately measure a person's pupil diameter and point of gaze on a stationary (room fixed) scene space. The followings are the explanations of apparatus features and operation.

*Major Component and Operations:* The pan tilt eye camera's infrared LED ring a (round the eye camera lens) provides eye illumination. The beam from LED illuminates the pupil and creates a small bright spot of light (known as corneal reflection). The Pan tilt provides 25° of tilt capability and 100° of pan angle. This pan tilt eye camera optic module can be controlled by remote controller.

*Eye Calibration and Data Recording*: The reflections of corneal and pupil data were saved when subjects watched the 9 points on the bull's eye target screen. After the eye calibration, the gaze points of subject during a slideshow consisting of the 18 images of cereal boxes could be recorded in Eye Response® Gaze Tracker® software (Boston, MA).

## Chin Rest

To minimize unconscious movement and to get more accurate data from Pan Tilt eye-tracker, the researcher asked subjects to rest their heads on a chin rest, fixing the eye relative to the scene. The height of the chin rest can be adjusted and research did not begin until a subject was comfortable. (See Figure 18)

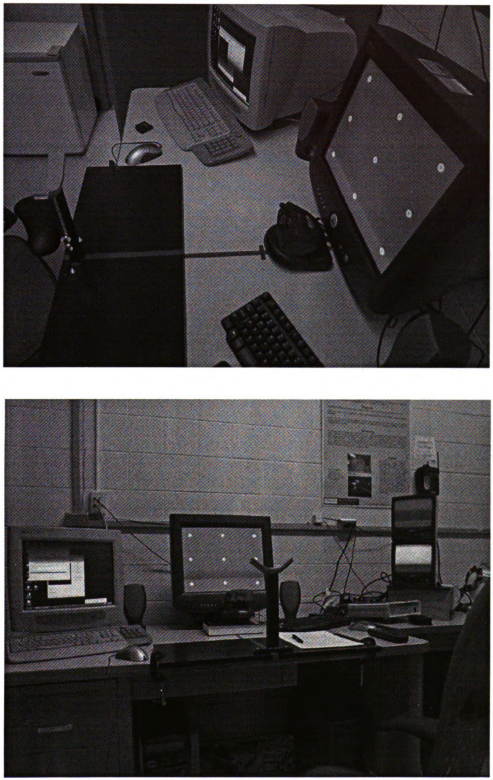

Figure 18- the Layout of Eye tracker setting with a Chin Rest

### Bull's Eye Target

The Bull's Eye Target image was set as a desktop background picture and it was used to calibrate each subject's eye before eye tracking. See Figure 19.

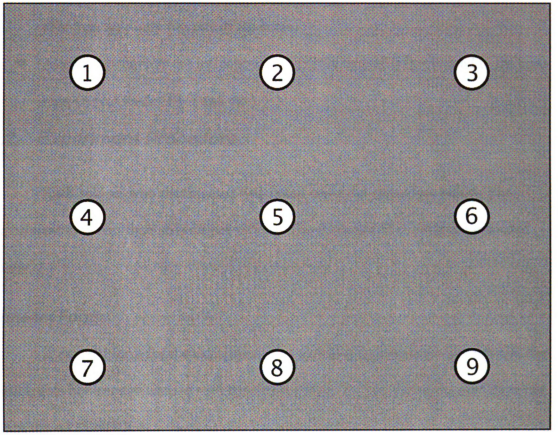


Figure 19- The bull's eye target image for subjects' eye calibrations

# CHAPTER 5. Methods

## 5.1. Working Hypothesis

- Nutrition information presented in varied formats (iconic and text) is more notice able than text-only formats of the same.
- Attentive behaviors are influenced by a confluence of factor related to the consu mer. (Age, Gender BMI and etc.)

## 5.2. Experiment Procedure

Each subject who participated was tested using the procedure below. The experiment took less than an hour per subject. The sequence of experiment provided below.

### *Consent Form:*

A consent form for the experiment was provided to each participant and all the participants had enough time to read the consent form. A copy of the consent form can see in the APPENDIX 1.

### *Additional Explanation*

If any subject needed a more specific explanation about the research experiment or the instrumentation, the researcher provided a verbal explanation and answered all questions.

### *Visual Acuity Test*

Before Eye Tracking began, a visual acuity test was performed to qualify their eyes' ability to resolve images (i.e.:20/20, 20/30, 20/40 and etc).

The researcher held the visual acuity test card on a wall in front of the subjects. The distance between the card and a subject was controlled as 16" per the test method instructions. Subjects were asked to read from the upper to the lower letters until they were unable to decipher the line of text. The subjects' visual acuity coincided with the lowest line where they could decipher all letters correctly.

### *Color Blindness Test*

To verify a subjects' ability to see color, a test of red-green color blindness was performed. Subjects were asked to read the numbers on contained within Pseudo-Isochromatic Plates manufactured by Richmond Products.

### *Collection Subject Information*

A data recording sheet was given to each subject and demographic information was collected. This included: gender, the highest level of education completed, age, height, etc. The data recording sheet is offered in Appendix 3.

### *Eye Tracking*

Subjects were seated in front of Pan Tilt eye camera and asked to place their head on the chin rest. After subjects were determined to be comfortable, the researcher calibrated the subjects' eye using a file that contained nine fixed points (see Figure 19).

After the eye calibration, eye tracking began. Subjects were shown the 18 image slide show, with each image appearing a single time for a period of 10 seconds each. Slides were separated by a grey screen, which appeared for a period of three seconds, as well as at the beginning and ending of the slide show. Slide order was randomized to minimize any effect of fatigue or run order.

Using Gaze Tracker Software, look zones were constructed for: 1. the nutrition information, 2. the net contents, 3. the brand name, 4. the graphic image that appeared on the PDP 5. Health claims. It is important to note that the health claims were not included in the analysis, as only two products contained this zone. Zones were drawn so that they accurately followed the image of interest. Data from Gaze Tracker was exported into an Excel Spreadsheet to create a flat file that was analyzed in SAS statistical software (Cary, NC).

### *Survey*

After eye-tracking, subjects were asked to respond to a survey regarding their cereal consumption behaviors and the importance of healthy eating. (See APPENDIX 3)

### *Compensation*

All subjects were given a 10$ Best-buy Gift card. (See APPENDIX 2)

# CHAPTER 6- Results, Analysis and Discussion

## *6.1. Arranging Data for Result Interpretation*

As discussed in the Methods section of this document, the researcher collected both data that characterized the user (e.g. visual, acuity demographics, consumption preferences, self reported height and weight etc. See Data Recording Sheet in APPENDIX 3) and 'eye tracking data.' This enabled the researcher to get a basic understanding of the subject's physical conditions, cereal purchasing habits, opinions about healthy eating, calculate each subject's BMI, etc.

The eye tracking data was collected as a video file which was later processed using Gaze Tracker® software. For Analysis, five "look zones (LZs)" of interest were drawn on each of the 18 files created to serve as visual stimulus for the subjects.

The 5 look zones were: the nutrition information, the product's Net Weight, the Brand name, the Large Graphic Image on the PDP and Health Claim on PDP. However, only four zones were analyzed. The look zone 5, "Health Claims," was removed from the analysis because not all products contained such claims. The data measured in the other four look zones were used for the purpose of analysis.

As explained in the Methods Chapter, 18 slide image files consisting of 9 brands of cereal at two levels were presented to subjects in randomized order of appearance. One treatment level was represented by the nine brands in their commercial presentation (identified as NFP configurations) and the other level was the same nine brands that had their NFPs modified to include iconic faces.

Henceforth, treatment one will be referred to as the NFP configuration, while those modified (with the addition of iconic faces) will be referred to as 'Graphic Nutrition Facts Panels (GNFP).'

Nine cereal products were purposefully chosen for the research so that they were nearly evenly distributed into three levels of health (i.e. healthy= 2 or more smiles; moderate = 2 or more straight faces and unhealthy= 2 or more frowns). (See Table 5)

Table 5- Health Levels of Used Cereal Products

| | Cereal Brand | Fat (per 100g) | Sodium (per 100g) | Sugar (per 100g) | Overall Healthfulness=Code |
|---|---|---|---|---|---|
| 1 | **Shredded Wheat** | Smile | Smile | Smile | Healthy = 3 |
| 2 | **Berry Burst Cheerios** | Smile | Frown | Frown | Unhealthy = 1 |
| 3 | **Cocoa Pebbles** | Moderate | Frown | Frown | Unhealthy = 1 |
| 4 | **Honey Nut Cheerios** | Moderate | Frown | Frown | Unhealthy = 1 |
| 5 | **Kashi Cinnamon Harvest** | Smile | Smile | Frown | Healthy = 3 |
| 6 | **Kashi Honey Puffs** | Moderate | Smile | Frown | Moderate = 2 |
| 7 | **Grape Nuts** | Smile | Moderate | Moderate | Moderate = 2 |
| 8 | **Raisin Bran** | Smile | Moderate | Frown | Moderate = 2 |
| 9 | **Select Apple Caramel Pecan Crunch** | Moderate | Moderate | Frown | Moderate = 2 |

Data collected to serve as response variables included: the proportion of people that noticed a zone (i.e. the probability of hitting a zone), the number of hits to a zone and time in zone. To compare the interaction between eye tracking data and consumer information, a flat file was created and analyzed using SAS Statistical Software (Cary, NC).

## 6.2. *Subject Demographics (Various Human Factors)*

A total of 31 people 18 years and older participated in the eye tracking experiment. Inevitably, some data is lost during the course of eye tracking (e.g. eye blinks, head movements, etc). Collected data was examined to determine the total loss of time per subject; subjects that were not tracked for more than 20% of the total viewing time were not analyzed. After the filtering, data from 24 subjects was included in the analysis; i.e. seven subjects were removed. (See the APPENDIX 4)

Subjects were asked to respond to a series of survey questions so that their consumption behaviors and preferences could be characterized.

### Age

A convenience sample was drawn primarily from the student population at MSU through word-of-mouth advertising. Subjects ranged in age from 20 to 63 years (ave.28.7$\pm$11.54). Most of the subjects (20 of 24 participants) were in their twenties.

See Figure 20 for frequencies of subject by age.

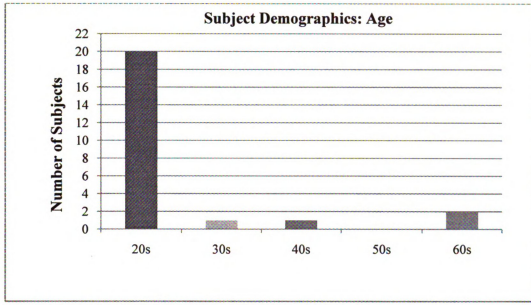


Figure 20- Frequency chart of subjects by age

## Gender

Among the 24 participants included in the data analysis, 11 were male (code=1) and 13 were female (code=2). (See Figure 21 for frequency by gender)

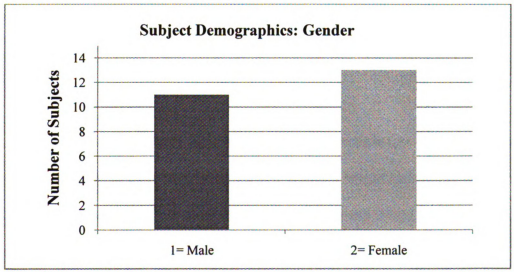


Figure 21- Frequency counts of subjects by gender

## Visual Acuity

Visual acuity, based on a subject's corrected eyesight, was measured and recorded (visual acuity code; 20/20 = 1, 20/30 = 2, 20/40 = 3 and 20/50 = 4)

About half (13 members out of 24) of tested participants were measured to have visual acuity of 20/30. (See Figure 22 for subject frequency by visual acuity)

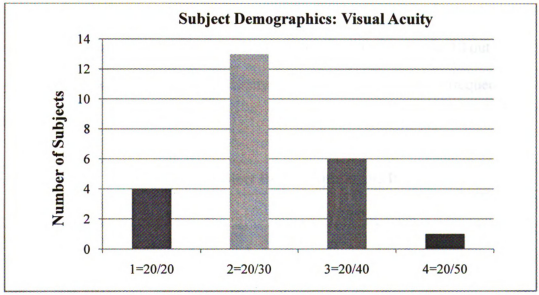


Figure 22- Subject frequency by visual acuity

## BMI (Body Mass Index)

BMI is a measure of body fat based on height and weight that applies to adult men and women. BMIs were calculated using the self-reported height and weight of subjects and the calculator available from the National Heart, Lung and Blood Institute website (Source of BMI; www.nhlbisupport.com/bmi/). This calculation provided 4 levels of BMI, which gives an indication of the degree of obesity of an individual. (BMI Code; Underweight = 1, Normal weight = 2, Overweight = 3 and Obesity = 4) (See Table 6)

Table 6- The BMI Categories (Data Source from; http://www.nhlbisupport.com/bmi/)

| Level of Obesity | BMI Value | Code |
|---|---|---|
| Underweight | <18.5 | 1 |
| Normal weight | 18.5–24.9 | 2 |
| Overweight | 25–29.9 | 3 |
| Obesity | BMI of 30 or greater | 4 |

The majority of subjects were indicated to be normal weight, but 10 out of 24 subjects (41.7%) were overweight or obesity. (See Figure 23 for subject frequency by BMI status)

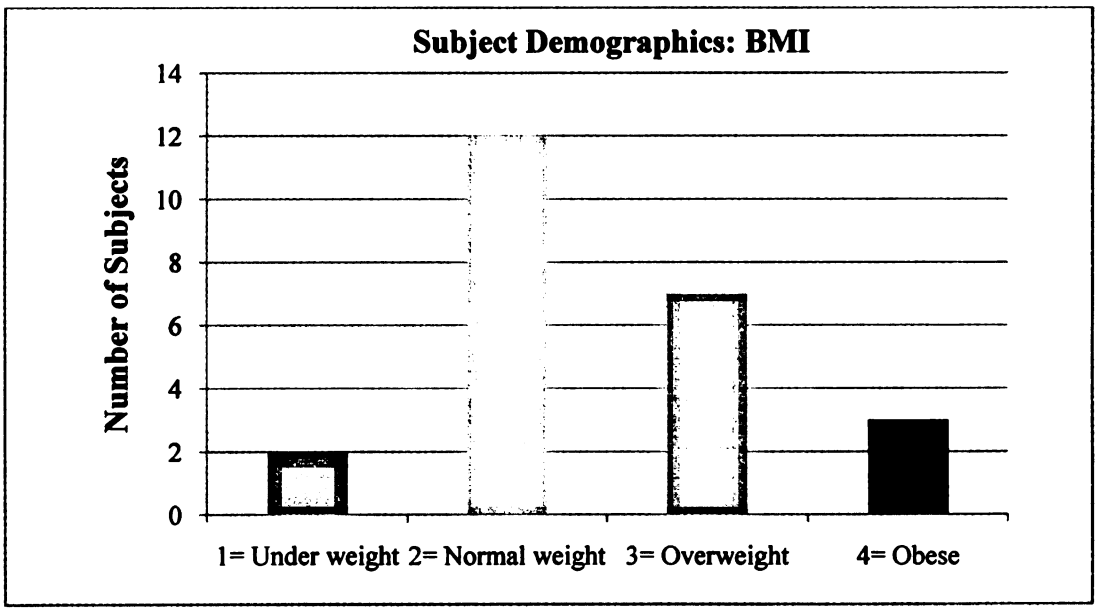


Figure 23- Subject Demographics: BMI

## The Opinion for Healthy Eating Question

Subjects answered a series of survey questions. Using a 5-point Likert scale, subjects indicated their level of agreement with the statement "Healthy Eating is Important for my Life." The 5 answers were coded as 'Strongly Disagree = 1, Disagree = 2, neither disagree nor agree = 3, Agree = 4, Strongly Agree = 5.'

All but two subjects indicated that healthy eating was important to some degree, with 13 agreeing and 9 strongly agreeing with the statement. (See figure 24 for frequency reports)

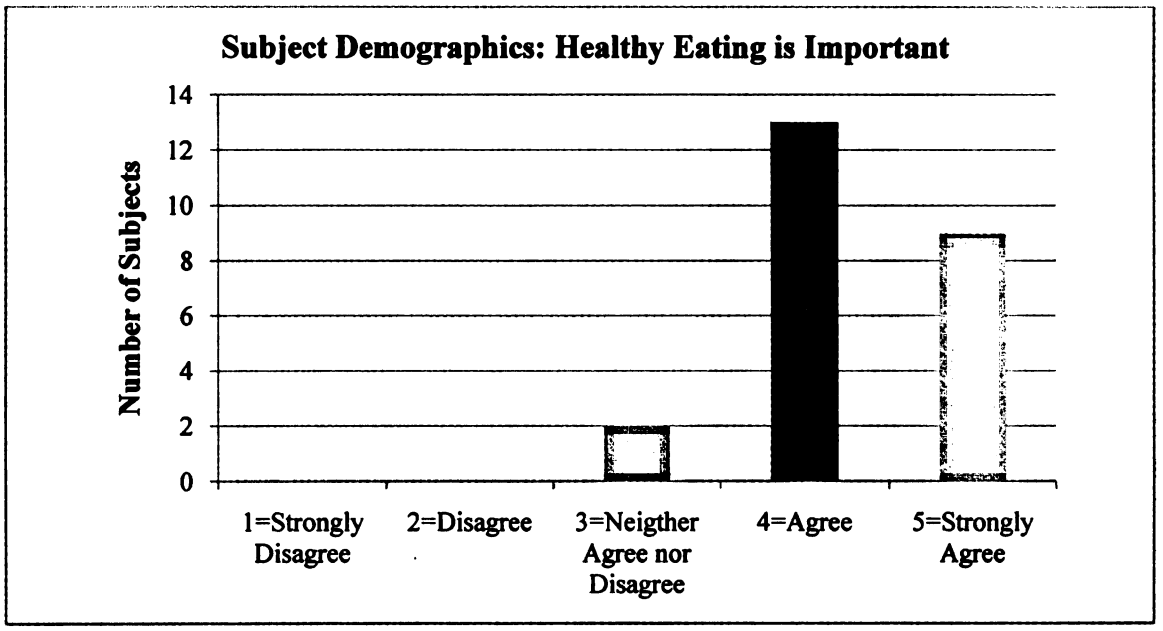


Figure 24- Frequency of Response to the statement, "Healthy Eating is Important for my Life"

## 6.3. *Interpretations of Eye Tracking Data*

Data were analyzed for all 24 subjects using binary (noticed, yes/no), ordinal (number of hits) and variable (time in zone) outcomes.

Statistical analysis and more specific explanations of each dependant variable are continued below.

### 6.3.1. Section 1: The probability number of noticing in a zone (Binary response: Noticed Yes or No)

The success or failure of a subject to notice one of the zones of interest was modeled as 'a binary response variable (noticed/did not notice)', with zone being a four level categorical value.

As mentioned above, the 4 zones were: the Nutrition Information, the product's net weight, the brand name, and the large graphic image on the PDP. The zone "Health Claims" was removed from the analysis because not all products contained such claims. Usable data was collected from a total of 24 subjects after filtering subjects with data losses of greater than 20%.

The GLIMMIX (General Linear Mixed Model) procedure of SAS (SAS Institute Inc., Cary, NC) was used for statistical analysis. The probability of noticing a zone was modeled as a function of: subject, brand (9 levels), the health level of a cereal (3 levels), nutrition information formatting (2 levels) and zone (4 levels).

Nutrition Information Formatting (NIF: NFP or GNFP) and health level of a cereal were modeled as fixed effects. BMI, age, gender, their visual acuity, the healthful

level of the person's favorite cereal, and the importance that subjects placed on eating healthy were considered for possible inclusion on the model, but excluded if they did not improve the model fit (P>0.10).

The final model included the fixed effects: Nutrition Information Formatting (NFP v GNFP), zone and health level and their interactions and the random effects BMI and age. (See Table 7) In NIF, traditional Nutrition Facts Panel (NFP) was coded as 1, and icon inserted graphic Nutrition Facts Panel (GNFP) coded as 2.

Table 7- Type III Test of Fixed Effects of the probability of noticing a given zone

| *Effect* | *Num DF* | *Den DF* | *F Value* | *Pr>F* |
|---|---|---|---|---|
| Nutrition Info Formatting (NIF) | 1 | 1488 | 0.01 | 0.9150 |
| **Zone** | **3** | **1488** | **19.96** | **<0.0001** |
| **NIF x Zone** | **3** | **1488** | **2.90** | **0.0337** |
| Reported Health Level | 2 | 1488 | 1.27 | 0.2806 |
| Reported Health Level x NIF | 2 | 1488 | 0.65 | 0.5199 |
| **Reported Health Level x Zone** | **6** | **1488** | **3.40** | **0.0024** |
| Reported Health Level x NIF x Zone | 6 | 1488 | 0.11 | 0.9956 |
| **BMI x Zone** | **4** | **1488** | **3.17** | **0.0132** |
| **Age** | **1** | **1488** | **4.48** | **0.0345** |

*Bolded effects are significant at $\alpha$=0.05.

### *1. NIF x Zone*

Based on the significant interaction term that was indicated between Nutrition information and zone when the dependent variable was the probability of noticing a given zone, pairwise comparisons were examined. As mentioned above, code numbering NFP1 was the traditional nutrition facts panel (NFP: control) and NFP2 represented the icon inserted GNFP; graphic nutrition facts panel (test).

The LSD method was used for the pairwise comparisons in this section.

Table 8- Pairwise comparison of NIF with Zone for the probability noticing a zone

| | **Zone 1 (nutrition facts panel )** | **Zone 2 (net weight)** | **Zone 3 (brand)** | **Zone 4 (large graphic on PDP)** |
|---|---|---|---|---|
| **NFP1 (=traditional NFP)** | $0.8049 \pm 0.03^{a, A}$ | $0.1062 \pm 0.02^{b, A}$ | $0.9429 \pm 0.17^{c, A}$ | $0.9675 \pm 0.01^{c, A}$ |
| **NFP2 (=icon inserted GNFP)** | $0.9041 \pm 0.02^{a, B}$ | $0.0964 \pm 0.02^{b, A}$ | $0.9331 \pm 0.02^{a, A}$ | $0.9404 \pm 0.02^{a, A}$ |

* Values in the same row with different lowercase letters provide evidence of statistical significance at $\alpha=0.05$.

** Values in the same column with different capital letters provide evidence of statistical significance at $\alpha=0.05$.

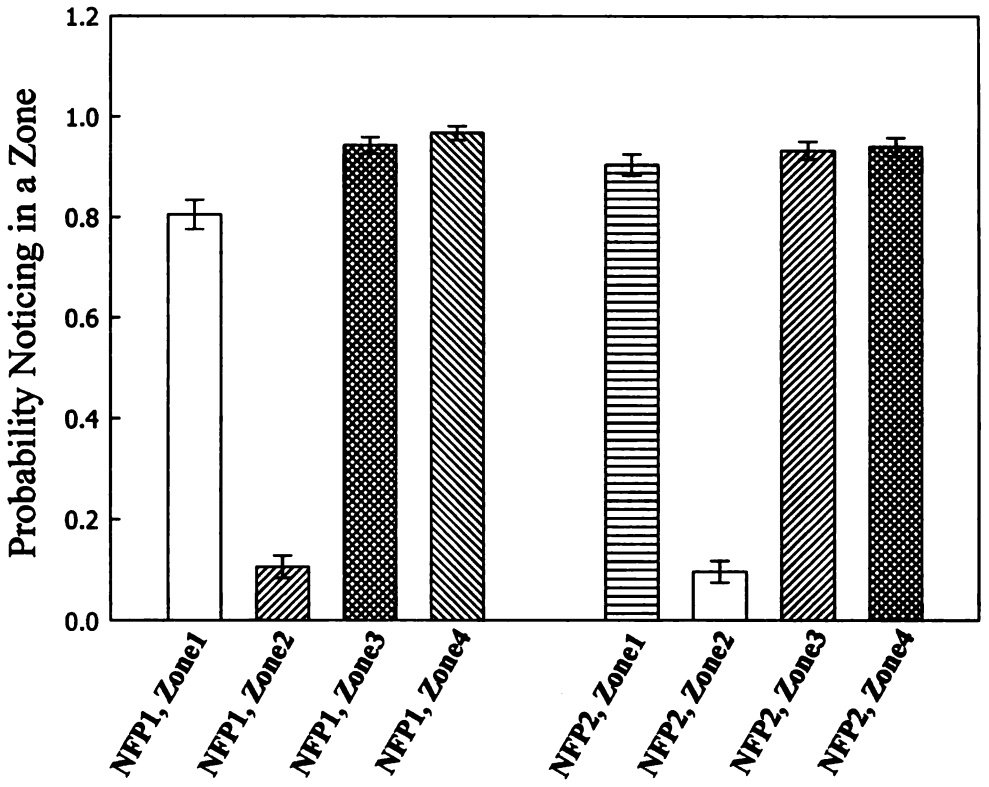


Figure 25- Bar chart for pairwise comparison of NFP with ZONE as Function of the probability of noticing a zone

Although the main effect of NIF was not indicated to be significant (0.9150), this is to be expected, as it compares all zones across the two levels of treatment (the images that had the altered and unaltered nutritional information). However, when the interaction term was explored, data suggested that participants were significantly more likely to notice the nutritional information when presented in GNFP format (90.4%) than the traditional NFP format (80.5%) (P= 0.0051). This suggests that icon presentation of nutrients in the Nutrition Facts Panel (NFP) has the potential to attract the attention of consumers to this section.

There was no evidence of difference when the formats were compared across other zones (column comparisons). This was to be expected, as all other zones of the two formats were identical. Data analysis provided no evidence of statistical difference on the probability of noticing the brand name (94.2% and 93.3%) (P=0.6666) as compared with the graphics presented on the PDP (96.8% and 94.0%) (P=0.2370).

However, in the case of the traditional nutrition facts panel (NFP1), subjects were significantly less likely to view the nutrition facts information (8.0%) compared with the brand name (9.4% at P <0.0001) or the PDP graphics (9.7% at P <0.0001).

Not surprisingly, for both treatments, the net contents (Zone 2) was the element least likely to be noticed (10.6% and 9.6%) (P=0.7372).

### *2. Health level of Cereal Products x Zone*

Table 9 indicates the pairwise comparison for the probability of noticing a zone. LSD method was used for the pairwise comparisons in this section.

Table 9- Pairwise comparisons of cereal health level with zone on the probability of noticing a given zone

| | **Zone 1 (nutrition facts panel)** | **Zone 2 (net weight)** | **Zone 3 (brand)** | **Zone 4 (large graphic on PDP)** |
|---|---|---|---|---|
| **Health Level1 (Unhealthful)** | $0.8537 \pm 0.03^{a,A}$ | $0.08847 \pm 0.02^{b,A}$ | $0.9605 \pm 0.02^{c,A}$ | $0.9750 \pm 0.01^{c,A}$ |
| **Health Level=2 (Moderately Healthy)** | $0.8756 \pm 0.03^{a,A}$ | $0.07121 \pm 0.02^{b,A}$ | $0.9518 \pm 0.02^{c,A}$ | $0.9053 \pm 0.02^{ac,B}$ |
| **Health Level=3 (Healthful)** | $0.8542 \pm 0.04^{a,A}$ | $0.1609 \pm 0.04^{b,A}$ | $0.8792 \pm 0.04^{a,B}$ | $0.9647 \pm 0.02^{c,AB}$ |

* Values in the same row with different lowercase letters show evidence of statistical significance at $\alpha=0.05$.

** Values in the same column with different capital letters provide evidence of statistical significance at $\alpha=0.05$.

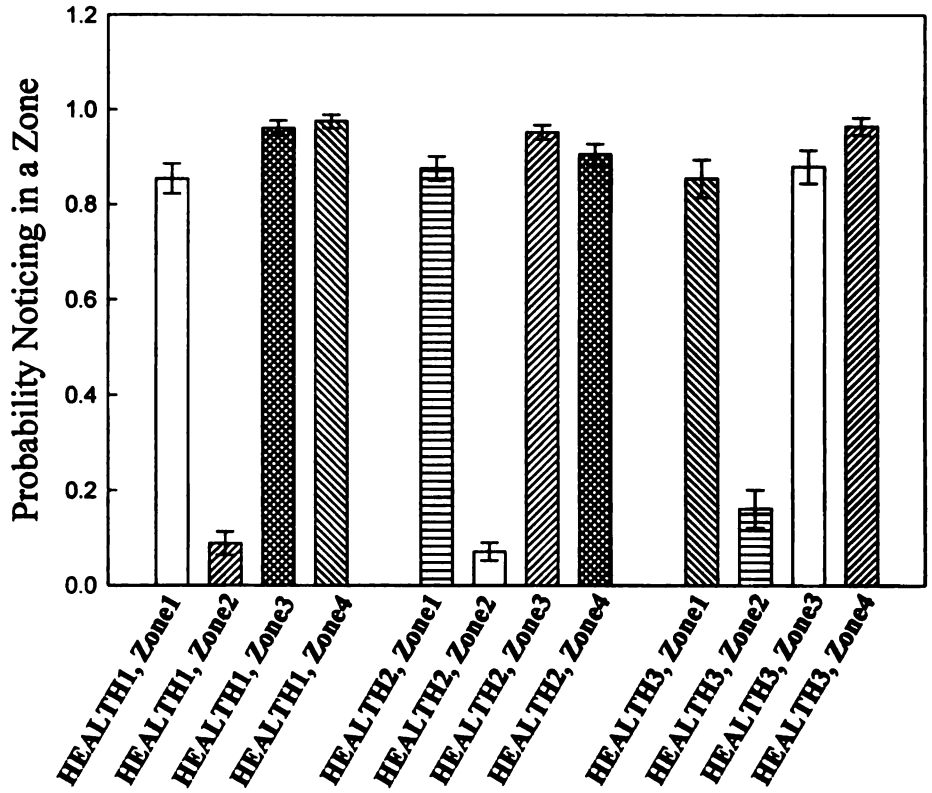


Figure 26- Bar chart for pairwise comparison of Health Level with Zone as function of the probability noticing in a zone

Data depicted in Table 9 and Figure 26 did not provide evidence of an effect of health level on the probability of noticing the nutrition information (see column one, Table 9). In other words, cereals that were categorized as "healthful," moderately healthful," or "unhealthful" (based on the key nutrients identified in Table 9) did not appear to elicit differing attentive responses when the probability of noticing the nutrition information was the dependent variable of interest.

There was evidence of a difference in the probability of noticing the brand name and large graphics on the PDP across levels of healthfulness. Participants were

significantly less likely to notice the brand name when it was level 3 (a "healthy cereal" 88%) as compared to cereals characterized as "unhealthy" 96% (P=0.0204) or "moderately healthy" (95%; P=0.0292) There was no evidence of difference in the probability of noticing a brand name when the unhealthy (96%) and moderately healthy cereals (95% ) were compared (P=0.6900).

Pairwise analysis of zone 4, the graphic information presented on the package PDP, also provided evidence of significant differences in the probability of noticing the graphic, based on level of healthfulness. Moderately healthy cereals had graphics that were significantly less likely to be viewed (90.5%) when compared to "unhealthy" cereals (97.5%; P= 0.0256). However, when the probability of viewing the graphic elements on moderately healthy cereals (90.5%) was compared with healthy cereals (96.4%), no evidence of a difference existed (P= 0.0733). Similarly, data provided no evidence of a difference when the probability of viewing the graphic element of a "healthy" cereal (96.5%) and an "unhealthy" cereal (97.5%) were compared.(P=0.6513)

### *3. BMI x Zone*

BMI was also examined for correlation to the probability of viewing a given zone. See Table 10.

Table 10- Correlation of BMI with each zone level and probability noticing in a zone

| | Zone 1 (nutrition facts panel) | Zone 2 (net weight) | Zone 3 (brand) | Zone 4 (large graphic on PDP) |
|---|---|---|---|---|
| **BMI** | -0.1873 ± 0.1742 | -0.3782 ± 0.2237 | -0.6715 ± 0.2345 | -0.3819. ± 0.2399 |
| **Pr > t** | 0.2824 | 0.0912 | 0.0042 | 0.1116 |

Table 10 suggests that there is less negative correlation between BMI and noticing in zone1 than those in zone 2, 3, and 4.

### 6.3.2. Section 2: Numerical Response Variable- the Number of Hits in a Zone

As with the probability of noticing, the number of hits in a zone was also modeled. Nutrition Information Formatting (NFP vs. GNFP), Zone, and Health Level of a Cereal (see Table 11) were modeled as fixed effects. BMI, age, Gender, Favorite Cereal, Healthy Eating Importance question and Visual Acuity were considered for incorporation into the model, but later removed as their inclusion did not improve model fit (p-value >0.10).

The GLIMMIX (General Linear Mixed Model) procedure of SAS (SAS Institute Inc., Cary, NC) was used. The final model included 3 fixed effects and their interactions,

as well as BMI, Age, Gender and Healthy Eating Importance. Pairwise comparisons were conducted using an LSD procedure (See Table 11).

Table 11- Type III Test of Fixed Effects of the Number of Hit in a Zone

| *Effect* | *Num DF* | *Den DF* | *F Value* | *Pr>F* |
|---|---|---|---|---|
| **Nutrition Info Formatting (NIF)** | **1** | **1485** | **4.64** | **0.0314** |
| **Zone** | **3** | **1485** | **16.58** | **<0.0001** |
| **NIF x Zone** | **3** | **1485** | **7.61** | **<0.0001** |
| **Reported Health Level** | **2** | **1485** | **3.77** | **0.0234** |
| Reported Health Level x NIF | 2 | 1485 | 0.34 | 0.7127 |
| **Reported Health Level x Zone** | **6** | **1485** | **15.30** | **<0.0001** |
| Reported Health Level x NIF x Zone | 6 | 1485 | 1.49 | 0.1775 |
| **BMI x Zone** | **4** | **1485** | **19.91** | **<0.0001** |
| Age | 1 | 1485 | 3.20 | 0.0739 |
| **Gender x Zone** | **4** | **1485** | **12.80** | **<0.0001** |

*Bolded effects are significant at $\alpha$=0.05.

### *1. NIF x Zone*

Pairwise comparisons of NIF formatting (NFP vs GNFP) with Zone were examined for possible effects on the number of hits in a zone.

Table 12- Pairwise comparison of NIF with Zone for number of hits in a zone

| | Zone 1 (nutrition facts panel) | Zone 2 (net weight) | Zone 3 (brand) | Zone 4 (large graphic on PDP) |
|---|---|---|---|---|
| **NFP1 (=traditional NFP)** | $4.5162 \pm 0.21^{a,A}$ | $0.03270 \pm 0.02^{b,A}$ | $3.6430 \pm 0.18^{c,A}$ | $4.5034. \pm 0.21^{a,A}$ |
| **NFP2 (=icon inserted GNFP)** | $5.1122 \pm 0.23^{a,B}$ | $0.2333 \pm 0.03^{b,B}$ | $3.4927 \pm 0.18^{c,A}$ | $3.8852 \pm 0.19^{d,B}$ |

* Values in the same row with different lowercase letters provide evidence of statistical significance at $\alpha=0.05$.

** Values in the same column with different capital letters provide evidence of statistical significance at $\alpha=0.05$.

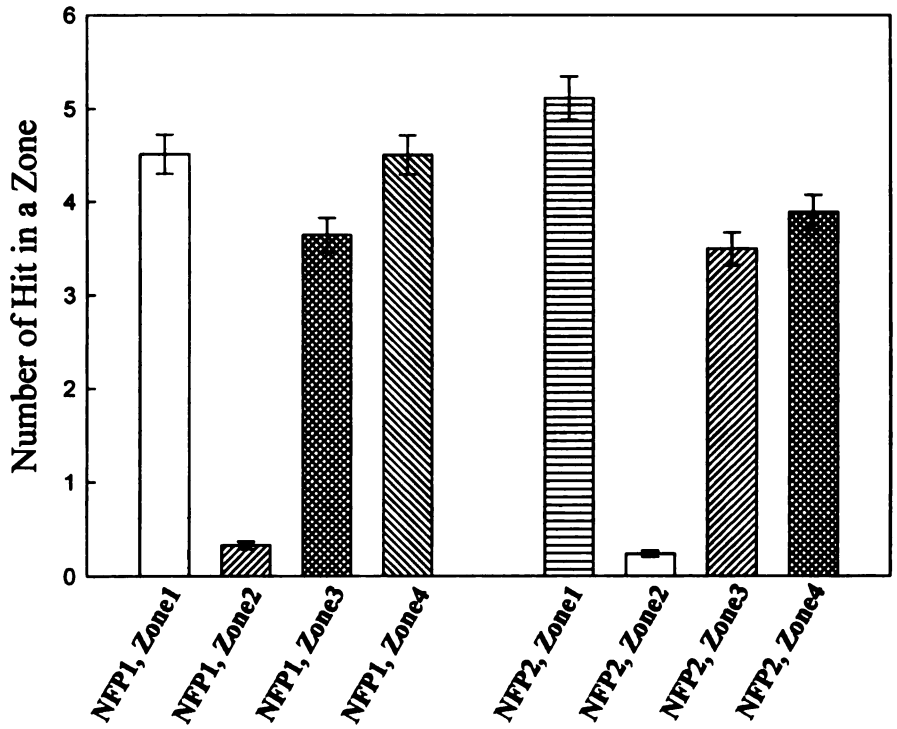


Figure 27- Bar chart for pairwise comparison of NIF with Zone as function of number of hits in a zone

Comparisons of the nutritional information suggest that the iconic format garnered more hits than did the traditional (text only) NFP (5.11 vs. 4.52; P = 0.039).

When comparing the zones when nutritional information was presented in a traditional (text only) format (NFP1), the nutritional information (4.50) and the graphic on the PDP (4.50), data did not suggest that the zone elicited a different number of hits (P= 0.9492). However, the number of hits elicited by these zones was significantly different than the brand name (3.64; P <0.0001) or the net contents (0.03; P<0.0001).

When this same comparison was done for the stimulus material that contained the nutritional information in the GNFP format, all zones were statistically significantly different from one another ($\alpha$=0.05). The icon inserted nutritional information (GNFP) had a higher number of hits than all other zones (5.11), and the net contents had the least number of hits (0.23).

### *2. Health level x Zone*

Table 13 indicates the pairwise comparisons by a cereal's health level when the dependent variable was the number of hits in a given zone. For the pairwise comparison, the LSD method was used. (See Table 13 and Figure 28)

Table 13- Pairwise comparison of cereal health level with Zone for number of hits

| | Zone 1 (nutrition facts panel) | Zone 2 (net weight) | Zone 3 (brand) | Zone 4 (large graphic on PDP) |
|---|---|---|---|---|
| **Health Level1 (Unhealthful)** | 4.8693± 0.28$^{a,A}$ | 0.3064± 0.05$^{b,A}$ | 4.4345± 0.27$^{a,A}$ | 4.7163± 0.28$^{a,A}$ |
| **Health Level=2 (Moderately Healthy)** | 4.9900± 0.26$^{a,A}$ | 0.2194± 0.03$^{b,A}$ | 3.8952± 0.21$^{c,A}$ | 3.2938± 0.17$^{d,B}$ |
| **Health Level=3 (Healthful)** | 4.5656± 0.32$^{a,A}$ | 0.3134± 0.06$^{b,A}$ | 2.6276± 0.21$^{c,B}$ | 4.7111± 0.33$^{a,A}$ |

* Values in the same row with different lowercase letters provide evidence of statistical differences at $\alpha$=0.05.

** Values in the same column with different capital letters provide evidence of statistical differences at $\alpha$=0.05.

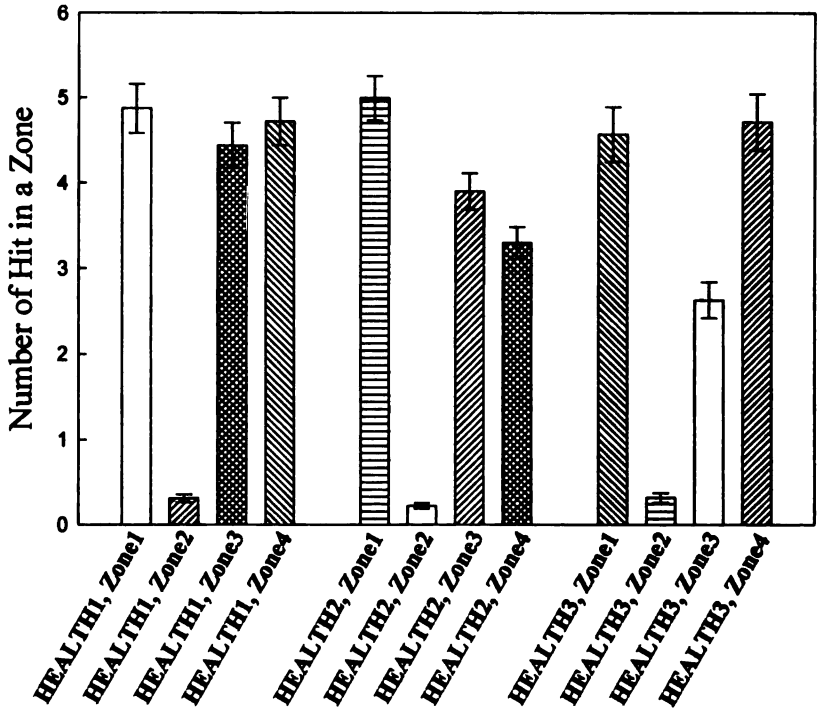


Figure 28- Bar chart for pairwise comparison of Health Level with ZONE as function of the Number of hits

From Table 13 and Figure 28, data provided no evidence of a statistical difference of a cereal's healthfulness on the number of hits when viewing the nutritional information at $\alpha$=0.05.

There was an effect of the healthfulness of a cereal on the number of hits to zones three and four (brand name and graphic information). "Healthy" cereals registered significantly fewer hits to the brand name (2.63) than did the "Moderately Healthy" (3.90) (P<0.0001) or those that were unhealthy (4.43) (P<0.0001). There was no evidence of difference when hits to the brand name were compared for those that were moderately healthy (3.90) and those that were "unhealthy" (4.43) (P=0.0732).

The number of hits to the graphic information also indicated evidence of difference when the healthfulness of the cereals was compared. The graphics of "moderately healthy" (3.30) cereals registered significantly fewer hits than those that were "healthy" (4.71) (P <0.0001) or "unhealthy" (4.72) (P <0.0001).

### *3. BMI x Zone*

Data presented in Table 14, suggests a positive correlation of BMI with Zone 1.

Table 14- Correlation of BMI with each zone level for the number of hits in a zone

| | **Zone 1 (nutrition facts panel)** | **Zone 2 (net weight)** | **Zone 3 (brand)** | **Zone 4 (large graphic on PDP)** |
|---|---|---|---|---|
| **BMI** | 0.2114. ±0.0372 | -0.4916 ±0.1340 | -0.4657 ± 0.0402 | -0.0538 ± 0.0397 |
| **Pr > t** | < .0001 | 0.0003 | 0.2466 | 0.1764 |

### *4. Gender x Zone*

Table 15 indicates the pairwise comparisons of gender with zone for the number of hits in a given zone. The LSD method was used for the pairwise comparisons. (See Table 15 and Figure 29)

Table 15- Pairwise comparisons of gender with zone for the number of hits in a given zone

| | **Zone 1 (nutrition facts panel)** | **Zone 2 (net weight)** | **Zone 3 (brand)** | **Zone 4 (large graphic on PDP)** |
|---|---|---|---|---|
| **Gender 1 (Male)** | $4.2574. \pm 0.23^{a,A}$ | $0.4439 \pm 0.05^{b,A}$ | $3.3827 \pm 0.19^{c,A}$ | $3.9285 \pm 0.21^{a,A}$ |
| **Gender 2 (Female)** | $5.4230 \pm 0.27^{a,B}$ | $0.1718 \pm 0.03^{b,B}$ | $3.7565 \pm 0.20^{c,A}$ | $4.4537 \pm 0.22^{d,A}$ |

* Values in the same row with different lowercase letters provide evidence of statistical significance at $\alpha$=0.05.

** Values in the same column with different capital letters provide evidence of statistical significance at $\alpha$=0.05.

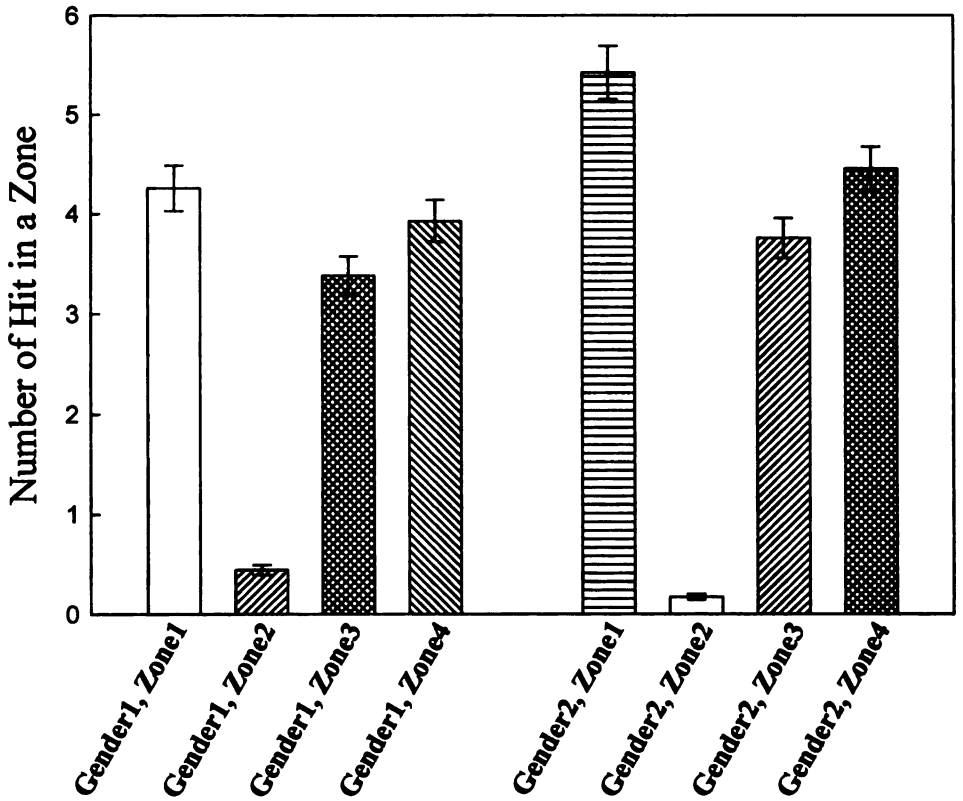


Figure 29- Bar chart for pairwise comparison of Gender with Zone as function of number of hit in a zone

From Table 15 and Figure 29, females made significantly more hits (5.42) to nutritional information than their male counterparts (4.26) ($P<0.0001$). However, men registered a higher number of hits to the net contents (0.44) than did females (0.17) ($P<0.0001$). No gender differences were evident when the number of hits to the brand name were compared ($P= 0.1141$). There was a marginal difference in the number of hits between at zone 4 (graphic images on the PDP) females (4.45) registered compared with males (3.93) ($P=0.0508$).

When within gender comparisons were made between zones of interest, there was evidence of a difference in the number of hits of all zones of interest when viewed by females ($\alpha$=0.05) (see Table 15). Females had the greatest number of hits on the nutrition facts zone (5.42), followed by the PDP graphics (4.45), then the brand name (3.76), and, finally, the net contents (0.17).

Males followed a similar pattern, registering the most number of hits to the nutritional information (4.26), followed by the PDP graphics (3.93), brand name (3.39) and, finally, the net contents (0.44). However, for males, data analysis provided no evidence of a statistical difference when their viewing behaviors of nutritional information (4.26) and PDP graphics (3.93) were compared (P=0.0939).

### 6.3.3. Section 3: Numerical Response Variable- the Total Time Spent in a Zone

Nutrition Information Formatting (NFP vs. GNFP), Zone, and Health Level of Cereals were modeled as fixed effects. BMI, Age, Gender, Favorite Cereal, Healthy Eating Importance and Visual Acuity were added to the model, but later removed because they did not improve model fit (p-value > 0.10).

For statistical analysis The Mixed procedure of SAS (SAS Institute Inc., Cary, NC) was used. The final model included 3 fixed effects and their interactions, as well as BMI and Gender. See Table 16. Pairwise comparisons were conducted using the LSD method.

Table 16- Type III Test of Fixed Effects of the Total Time Spent in a Zone

| *Effect* | *Num DF* | *Den DF* | *F Value* | *Pr>F* |
|---|---|---|---|---|
| **Nutrition Info Formatting (NIF)** | **1** | **1485** | **3.97** | **0.0465** |
| **Zone** | **3** | **1485** | **59.05** | **<0.0001** |
| **NIF x Zone** | **3** | **1485** | **17.27** | **<0.0001** |
| Reported Health Level | 2 | **1485** | 2.11 | 0.1217 |
| Reported Health Level x NIF | 2 | 1485 | 0.22 | 0.8005 |
| **Reported Health Level x Zone** | **6** | **1485** | **8.77** | **<0.0001** |
| Reported Health Level x NIF x Zone | 6 | 1485 | 0.39 | 0.8848 |
| **Gender x Zone** | **4** | **1485** | **2.89** | **0.0213** |
| **BMI x Zone** | **4** | **1485** | **13.72** | **<0.0001** |

*Bolded effects are significant at $\alpha$=0.05.

### *1. NIF x Zone*

Pairwise comparisons of nutrition information formatting (NFP vs. GNFP) with zone were examined for possible effects on the time spent in each zone.

Table 17- Pairwise comparisons of nutrition formatting with zone for the total time spent in a zone

| | Zone 1 (nutrition facts panel) | Zone 2 (net weight) | Zone 3 (brand) | Zone 4 (large graphic on PDP) |
|---|---|---|---|---|
| NFP1 (=traditional NFP) | $1.3004 \pm 0.04^{a,A}$ | $0.04533 \pm 0.04^{b,A}$ | $1.0205 \pm 0.04^{c,A}$ | $1.1344 \pm 0.04^{c,A}$ |
| NFP2 (=icon inserted GNFP) | $1.7204 \pm 0.04^{a,B}$ | $0.04977 \pm 0.04^{b,A}$ | $0.9490 \pm 0.04^{c,A}$ | $1.0172 \pm 0.04^{c,B}$ |

* Values in the same row with different lowercase letters provided evidence of statistical significance at $\alpha$=0.05.

** Values in the same column with different capital letters provided evidence of statistical significance at $\alpha$=0.05.

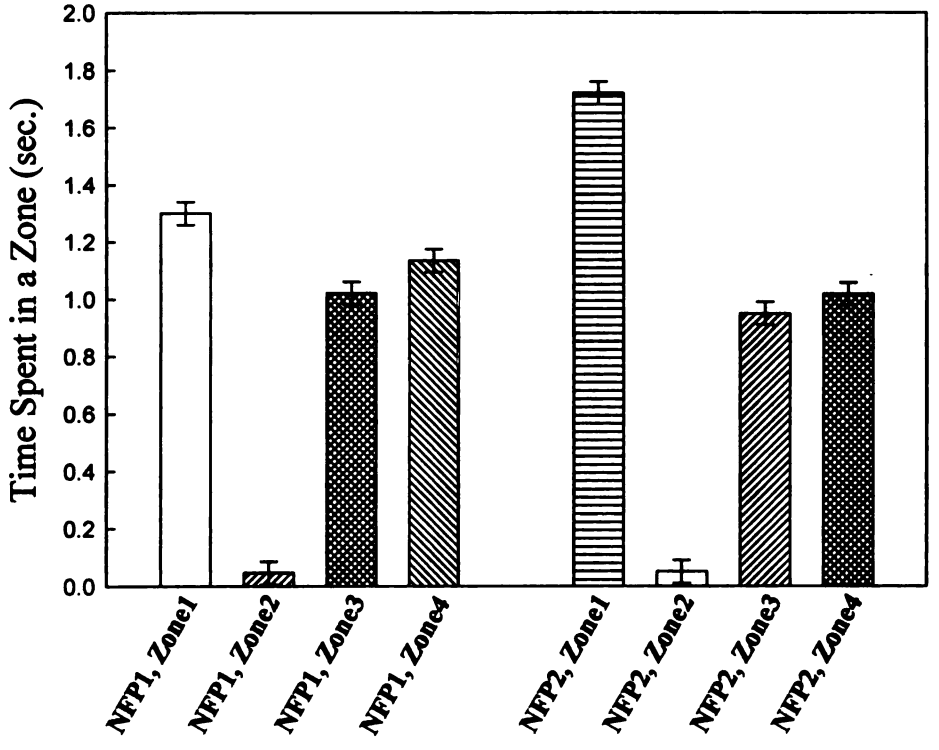


Figure 30- Bar chart for pairwise comparison of NIF with Zone as function of Time spent in zone

When the results (time in zone) are compared across the two formatting treatments (NFP vs. GNFP), the nutritional information (P <0.0001) and PDP graphics (P=0.0478) indicated evidence of statistical differences in viewing time. For the nutritional information, the GNFP format was viewed significantly longer by subjects (1.72) than the NFP (traditional) (1.30) (P<0.0001). However, study participants spent more time viewing the PDP graphics of the traditionally formatted packaging (1.13) than they did on the package that contained the GNF label (1.02) (P=0.0478). For the net contents, there was no significant differences between the GNFP formatted label (0.05) and NFP (0.05) at P=0.9402. Comparison of the brand names across the two formats did not appear to elicit a significant difference in viewing time; the time was 1.02 seconds for the brand names that appeared in the traditional formats, and 0.95 seconds for the brand names that appeared with nutritional information that had been modified to include icons (P= 0.2271).

When zones were compared within nutritional format, both formats exhibited a similar pattern. When time is zone was considered to be the measure of attentive behavior, no statistical difference (a=0.05) was evident when brand name and PDP graphics were compared for both formats (traditional NFP and icon inserted GNFP). In the traditional NFP a comparison of the brand name (mean =1.02) and graphic information (mean=1.13) provided evidence of marginal significance (P=0.0548).

Like the labels that appeared in traditional formats (NFP), a comparison of the brand name (mean =0.95) and graphic information (mean=1.01) for those that appeared with the GNFP formats provided no evidence of statistical significance P=0.2500. Both formats elicited the greatest amount of time viewing on the nutrition information (1.30

for traditional formats and 1.72 for icon inserted GNFPs) and the least amount of time was spent (for both) on the net contents (0.05 at traditional NFP and 0.05 at GNFP).

### *2. Health level x Zone*

Table 18 indicates the pairwise comparisons for the total time spent in a given zone. The LSD method was used for the pairwise comparisons. (See Table 18 and Figure 31)

Table 18- Pairwise comparison of a cereal's health level with zone for the total time spent in a given zone

| | **Zone 1 (nutrition facts panel)** | **Zone 2 (net weight)** | **Zone 3 (brand)** | **Zone 4 (large graphic on PDP)** |
|---|---|---|---|---|
| **Health Level=1 (Unhealthful)** | $1.4583 \pm 0.05^{a,A}$ | $0.05201 \pm 0.05^{b,A}$ | $1.1175 \pm 0.05^{c,A}$ | $1.1217 \pm 0.05^{c,A}$ |
| **Health Level=2 (Moderately Healthy)** | $1.5709 \pm 0.04^{a,A}$ | $0.03375 \pm 0.04^{b,A}$ | $1.0332 \pm 0.04^{c,A}$ | $0.8454 \pm 0.04^{d,B}$ |
| **Health Level=3 (Healthful)** | $1.5020 \pm 0.06^{a,A}$ | $0.05689 \pm 0.06^{b,A}$ | $0.8037 \pm 0.06^{c,B}$ | $1.2604 \pm 0.06^{d,A}$ |

* Values in the same row with different lowercase letters provide evidence of statistical significance at $\alpha=0.05$.

** Values in the same column with different capital letters provide evidence of statistical significance at $\alpha=0.05$.

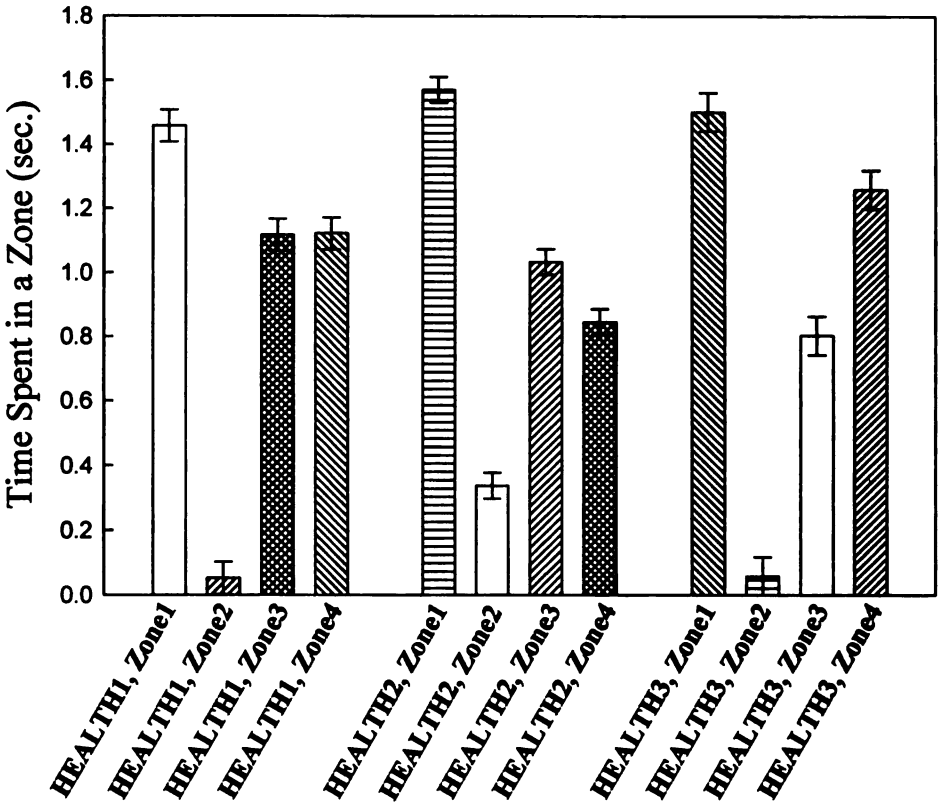


Figure 31- Bar chart for pairwise comparison of Health Level with Zone as function of total time spent in a given zone

When the two formats of labeling were compared, there was no evidence of an impact of the cereal's level of healthfulness on the time spent in the when the nutritional information was compared at $\alpha$=0.05. This was also the case for the net contents. However, data analysis did indicate a difference in the attentive behaviors of subjects (as indicated by time in zone) when they viewed the brand name and graphic information. "Unhealthy" cereals (1.12) and "moderately healthy" cereals (1.03) registered the greatest amount of time in the brand name as compared "healthy" (0.80) ($P<0.0001$; $P=0.0019$, respectively).

Comparisons of cereal healthfulness and the attentive behaviors (as measured by time in zone) were also evident when subjects viewed the PDP graphics. The level of attention garnered by "healthy" (1.26) and "unhealthy" (1.12) was not significantly different (P=0.0750). However, the level of attention garnered by the "moderately healthy" products (0.85) was significantly less than the others; when compared to "healthy" products (mean 1.26) P<0.0001 and "unhealthy" products (mean 1.12) P <0.0001).

### *3. BMI x Zone*

Table 19 suggests that the mean estimate value is positive only at the correlation of BMI with Zone 1. It also indicates less negative correlation between BMI and hitting in Zone1 than those in Zone 2, 3, and 4.

Table 19- Pairwise comparison of BMI with ZONE for the total time spent in a given zone

| | **Zone 1 (nutrition facts panel)** | **Zone 2 (net weight)** | **Zone 3 (brand)** | **Zone 4 (large graphic on PDP)** |
|---|---|---|---|---|
| **BMI** | 0.0512 ±0.03486 | -0.0054 ±0.03486 | -0.1409 ±0.03486 | -0.2101 ±0.03486 |
| **Pr > t** | < .1419 | 0.8768 | < .0001 | < .0001 |

### *4. Gender x Zone*

Table 20 presents the pairwise comparisons of gender with zone when the total time spent in a zone was the resultant variable. The LSD method was used for the pairwise comparisons. (See Table 20 and Figure 32 below)

Table 20- Pairwise comparisons of Gender with Zone for the total time spent in a given zone

| | Zone 1 (nutrition facts panel) | Zone 2 (net weight) | Zone 3 (brand) | Zone 4 (large graphic on PDP) |
|---|---|---|---|---|
| **Gender 1 (Male)** | $1.5461. \pm 0.04^{a,A}$ | $0.05675 \pm 0.04^{b,A}$ | $1.0689 \pm 0.04^{c,A}$ | $1.1069 \pm 0.04^{c,A}$ |
| **Gender 2 (Female)** | $1.4747 \pm 0.03^{a,A}$ | $0.03835 \pm 0.04^{b,A}$ | $0.9007 \pm 0.04^{c,B}$ | $1.0447 \pm 0.04^{d,A}$ |

* Values in the same row with different lowercase letters provide evidence of statistical significance at $\alpha$=0.05.

** Values in the same column with different capital letters provide evidence of statistical significance at $\alpha$=0.05.

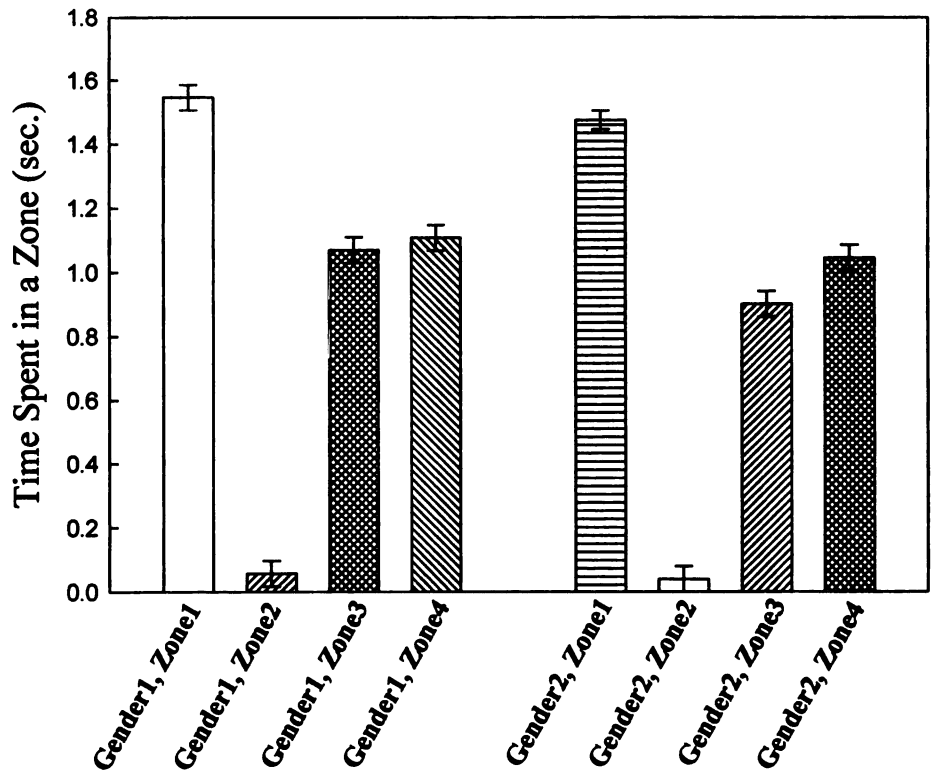


Figure 32- Bar chart for pairwise comparison of Gender with Zone as function of total time spent in a given zone

When comparing the attentive behaviors of the genders in each of the zones, only one zone, the brand name, elicited a statistically different response in terms of the time spent. Women spent significantly less time (0.90) viewing the brand name than men (1.07) (P=0.0032).

When making comparisons across the zones within gender, men spent significantly more time on the nutrition information than any other zone (mean 1.55) and significantly less time viewing the net contents (0.06) ($\alpha$=0.05). Moderate to the brand and net contents, were the PDP graphics and brand name, which were not significantly different from one another: brand (1.07) and PDP graphics (1.11) at P=0.5294.

Women followed a similar pattern to men, viewing the nutritional information (1.47) significantly longer than any other zone ($\alpha$=0.05). Unlike men, however, evidence collected from women suggested significant differences in the time that they spent viewing the brand name and PDP graphics, such that they spent significantly more time on the graphics (1.04) than the brand name (0.90) (P=0.0100). As with their male counterparts, females also spent significantly less time viewing the net contents (0.04) compared to all other zones $\alpha$=0.05.

# CHAPTER 7. Conclusions, Limitations and Future Study

This study investigated the attentive behaviors of 24 subjects (aged 20-63) while viewing 18 flattened graphic images (PDP + nutritional information) of cereal packages using a pan-tilt, bright-pupil eye tracker. Of the 18 images, 9 appeared in the commercially available format (traditional NFP) and 9 were modified to include a redundant cue (facial icons) for three nutrients: fat, sodium and sugar (GNFP). Cereals were purposefully selected to be roughly equally distributed across three levels of "healthfulness" ("healthy," "unhealthy," and "moderately healthy.")

Analysis of eye-tracking data concentrated on four Look zones (zone1= NFP, zone2=Net Weight, zone3=Brand, and zone4=Large Image on the PDP). Each subject saw each of the 18 images for a time period of ten seconds and the order of presentation was randomized to minimize effects of run order.

Study results can be used not only to investigate the effectiveness of facial icons to convey nutritional information, but also can be used to develop insights into the attentive behaviors of consumers based on their characteristics (gender, BMI, etc.) and a given cereal's level of "healthfulness."

## *7.1. Effectiveness of the Graphic Nutrition Label and Consumer Behavior*

About half of the subjects were overweight (BMI: 25 – 29.9) or obese (BMI: greater than 30). Yet, when asked about the importance of eating and health, no one suggested this to be unimportant.

### 7.1.1. Effectiveness of the Facial Icon

The research suggested that the icon inserted into the nutrition facts label (GNFP) is more noticeable than the traditional nutrition facts label in cereal products. In all 3 sections of data analysis (the probability number of noticing in a zone, the number of hits in a zone and the total time spent in a zone), the nutritional information with the icon inserted registered significantly higher values than the traditional NFP for the nutritional information. Specifically, when the dependent variable was the probability of noticing in the nutrition zone, the mean value of the iconic formats was 90%, as compared with 80% for the traditional NFP ($P = 0.0051$). When the dependent variable was the number of hits to a zone, the mean value nutritional information that appeared in the altered format was 5.1122 hits as compared with the NFP (mean 4.5162) ($P = 0.0039$). When the total spent time in a zone was considered the dependent variable, mean values for the nutritional information that appeared in altered formats was 1.7204 seconds as compared with the traditional NFP (mean 1.3004 seconds) at $P<0.0001$.

This is somewhat expected, as a review of the literature indicates that facial stimuli capture attention when people are engaged in another task [71], thereby making face stimuli immune to the phenomena of inattentional blindness [72] or attentional blink [73-74].

Additionally, facial expressions of emotion have been indicated to be readily evaluated in the near absence of attention [75-77]. Finally, it has been suggested that the inclusion of pictorial icons can increase the ease with which information is encoded and remembered [78]. People extract the basic meaning from pictures extremely rapidly [79]

and form relatively long lasting memories of them [80], even when people or not actively attempting to form memories of them [81]. As such, further research into the use of facial icons relating to their ability to convey nutritional information is suggested.

### 7.1.2. Other Consumer Behaviors

Some interesting results that have the potential to impact future research occurred regarding the differences in genders. When comparing the attentive behaviors of the genders using the number of hits to the zone as the dependent variable, although both genders "hit" the nutrition information more than any other zone, woman (mean=5.4230) hit significantly more times than men (mean=4.2574) at $P<0.0001$.

Another interesting finding concerned a cereal's "healthfulness" and the attentive behaviors of subjects when the dependent variable was the probability of noticing a given zone. Participants were significantly less likely to notice brand names for "healthful" cereals than those that were "unhealthy" or "moderately healthy." Specifically, the mean value (at brand name) of healthful cereals was 88%; this was less than the registered mean for unhealthy cereals 96% ($P=0.0204$). Also, the mean value of the healthful cereal (88%) was significantly less than that of the moderate healthy cereal 95% at $P= 0.0292$. Further exploration into this finding is warranted as it could be the result of a confluence of factors (color, graphics, marketing, etc.)

Comparisons of the probability of noticing the graphics found on the PDP across varied levels of "healthfulness" also showed significance. The graphics of the two extremes of "healthfulness" (i.e. "healthy" and "unhealthy") were more likely to be viewed than their "moderately healthy" counterparts. Specifically, the mean value of

"unhealthy" cereal (98%) was greater than "moderately healthy" (91%) at P=0.0256. Also, the mean value of "healthy" cereal (96%) was greater than "moderately healthy" (91%) at P=0.0433. One possible reason for this is that the graphics of the extremes are tuned to provide congruence with the level of health (i.e. they are more extreme), where the moderate cereals are not "tuned" to the message at hand, eliciting less attention to the graphics.

## 7.2. *Limitations and Expectation for Future Study*

### 7.2.1. Limited Variation in the Subject Population

The data was collected from 24 subjects using a convenience sample of a relatively uniform age. (See Chapter 6) Small sample size of a very limited subject pool means that the results presented here cannot be generalized. However, data does provide pilot information regarding the attentive behaviors of people viewing cereals. The ASL Pan Tilt eye-tracker is set in a laboratory of school of Packaging. Undoubtedly, the laboratory nature of this setting influences the behaviors of people as they view items.

### 7.2.2. Package Labels on a Two Dimensional surface

In commercially-available, FDA regulated products, the PDP and NFP are placed on different surfaces. Namely, cereal packages are usually 3 dimensional boxes.

However, in this study, 2 dimensional formats (flat files) were used (See Chapter 2). As such, subjects were automatically exposed to the nutritional information, where in more ecologically valid settings; they would have to rotate the package for exposure to

ensue. As such, it is recommended that the experiment be repeated using a more ecologically valid setting (e.g. homes) with Mobile eye tracking equipment.

# APPENDIX 1. Research Consent Form

# Michigan State University

## School of Packaging

103 Packaging Bldg. East Lansing, MI48824

INSTRUCTIONS AND RESEARCH CONSENT FORM –
Employing eye tracking to measure attentive behaviors regarding labels

You are being asked to participate in a research study. The purpose of this research study is to understand how people attend to various components of food labels while they are making purchase decisions.

As part of this research, we will record your gender, height, weight educational background, age and ask you to fill out a brief survey regarding your consumption of cereal and dietary behaviors. This information will be tied to a subject number; you will not be identified by name and your confidentiality will be maintained to the maximum extent of the law. Information retrieved during this entire study will be stored in a password protected computer in locked laboratories/offices in the School of Packaging for a minimum of 3 years. The room will be accessible only to authorized researchers of Dr. Laura Bix's research team and the University's Institutional Review Board (IRB). This study on the will take no longer than 1 hour.

We will also test your visual acuity (20/20, 20/30, 20/40, etc.) and color blindness. These tests will be conducted by asking you to view a series of cards and asking you to decipher images to the best of your ability.

### *Eye-tracking*

After these tests have been run, we will begin the eye tracking portion of the study. The eye tracker is a very sensitive eye movement monitor, which can tell us exactly where your eyes are looking while you are viewing a package label. A beam of light that cannot be detected by the human eye will be shown into your eye. The instrument tracks the movement of your eye by tracking the movement of the beam.

***Setup and Calibration:***

You will be seated in front of our computer. In front of the computer, there sits a small camera system that has the light beam. We will ask you to stay still, with your chin resting on a chin rest as we adjust the camera, chair and chinrest so that it shines the light into your eye. To calibrate the instrument, you will be asked to move nothing but your eyes to a series of dots on the computer screen. Once calibrated, testing will begin. During testing you will be asked to sit as still as possible with your chin on the chinrest, and move nothing but your eyes.

***Experiment Procedure:***

A series of 18 cereal labels will appear on the screen, one at a time for ten seconds each. The researcher will prompt you to look at the labels as you would before deciding whether or not you would want to choose to purchase this cereal to eat for breakfast.

If you have any questions at any time please ask.

If you choose to discontinue your participation you will still receive the $10 Best Buy card.

The results of the study will be treated in strict confidence and that you will remain anonymous. Your privacy will be protected to the maximum extent allowable by law. Within these restrictions, results of the study will be made available to you at your request.

Risks associated with participating include minor discomfort during the time when you are asked to rest your head on the chin rest and remain still. Additionally, we will be asking personal information that you may not feel comfortable disclosing such as your height and weight. Please feel free to omit questions that you are not comfortable answering, or choose to discontinue research at any point during the study without penalty. You will not be penalized for discontinuing the research or omitting answers i.e. you will still be eligible for the gift card.

Your participation in the study does not guarantee any beneficial results to you. The study however does carry a potential benefit to society. Using the data generated in this study, future research could focus on redesigning food labels.

As mentioned previously, your participation is voluntary: You may choose not to participate at all, or you may refuse to participate in certain procedures or answer certain questions without consequence.

If you have any concerns or questions about this research study, such as scientific issues, how to do any part of it, or to report an injury, please contact the researcher, Dr. Laura Bix, 153 Packaging East Lansing, MI 48824 at 517-355-4556 or bixlaura@msu.edu.

If you have questions or concerns about your role and rights as a research participant, would like to obtain information or offer input, or would like to register a complaint about this study, you may contact, anonymously if you wish, the Michigan State University's Human Research Protection Program at 517-355-2180, Fax 517-432-4503, or e-mail irb@msu.edu or regular mail at 207 Olds Hall, MSU, East Lansing, MI 48824.

I voluntarily agree to participate in the Eye Tracking study of cereal labels.

_____

Date: _____

You will be provided with a copy of this consent form.

## APPENDIX 2. Recruitment Advertisement for Research Experiment

# Cereal Labeling Research


Participants wanted for research concerning cereal labeling. In exchange for your participation, you will receive a $10 Best Buy gift certificate. The study will take no longer than 1 hour. To participate in this study:

- You must be able to provide your own transportation to the School of Packaging at Michigan State University
- You must be over 18 years of age
- You must not be legally blind
- You must not wear hard contact lenses
- You must be willing to provide a contact phone number or email so that researchers can contact you to remind you of your appointment

You are being asked to participate in a study of cereal labels being conducted by graduate student Chang-hoon Oh.

As part of his Master's Program, Chang-hoon is investigating cereal labels. To do this, he is using an ASL eye tracker. If you choose to participate, you will be hooked up to the eye tracker which will track your eye movements as you look at 18 different labels.

You will also be asked to answer a brief questionnaire about your eating habits and cereal purchasing behaviors and be asked basic demographic information. Instrument set up and the test itself should take no longer than 45 minutes.

Prior to testing, your visual acuity (20/20, 20/30, 20/40, etc.) and a test for color blindness will be administered. These tests involve viewing a series of cards.

If at any time you are uncomfortable with the testing or wish to discontinue the data collection process, you may discontinue participation without penalty.

If you are interested in pursuing this opportunity, please contact Chang-hoon Oh at ohchang@msu.edu to make an appointment.

If you have questions or comments regarding this study, please contact Dr. Laura Bix, Associate Professor of Packaging at Michigan State University at 517-355-4556 or bixlaura@msu.edu.

# APPENDIX 3. Data Recording Sheet

**Data Recording Sheet**

**Cereal Labeling Study**

Subject #_____

**Male** **Female** **Other**_____

Number of times per day you eat cereal_____

Number of different cereals purchased per week _____

**Favorite Cereal**_____

Most commonly consumed Cereal_____

Highest level of education completed

8th Grade High School Undergraduate Graduate Doctorate

Age_____

**Height**_____

**Weight_____(lbs)**

**Visual Acuity_____**

**Color Blindness Score_____**

**----------Eye tracking----------**

**Do you have any of the following conditions? (circle all that apply)**

Diabetes Hypertension High Cholesterol

**Does anyone in your immediate family have any of the following? (circle all that apply)**

Diabetes Hypertension High Cholesterol

| **How often do you?** | | | | | |
|---|---|---|---|---|---|
| | Never | Rarely | Sometimes | Frequently | Always |
| **Read nutritional labels** | | | | | |
| **Diet to lose weight** | | | | | |
| **Diet to gain weight** | | | | | |

| **Healthy eating is important for you** | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| **Strongly Disagree** | **Disagree** | **Neither Agree nor Disagree** | **Agree** | **Strongly Agree** |

| **Healthy eating is important for your family** | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| **Strongly Disagree** | **Disagree** | **Neither Agree nor Disagree** | **Agree** | **Strongly Agree** |

| **How do you consider your physical health at present?** | | | | |
|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 |
| **Poor** | **Fair** | **Neutral** | **Good** | **Excellent** |

Please indicate which of the following cereals you have eaten, of the ones that you have eaten, please indicate how many times per week you have eaten them?

# APPENDIX 4. Subject Filtering Data Based on Time Loss

| Subject # | Time Loss Average (per 10sec.) |
|---|---|
| 1 | 0.103 |
| 2 | 0.247 |
| 3 | 0.108 |
| **4** | **7.386** |
| **5** | **N/A (abandoned)** |
| 6 | 0.312 |
| 7 | 0.685 |
| **8** | **6.384** |
| 9 | 0.141 |
| 10 | 0.515 |
| **11** | **5.004** |
| 12 | 0.657 |
| 13 | 0.531 |
| 14 | 0.321 |
| 15 | 0.51 |
| 16 | 1.615 |
| 17 | 1.082 |
| 18 | 0.166 |
| **19** | **4.621** |
| 20 | 0.6685 |
| 21 | 0.111 |
| 22 | 1.641 |
| 23 | 0.177 |
| 24 | 1.488 |
| **25** | **6.622** |
| 26 | 0.212 |
| 27 | 0.413 |
| 28 | 0.706 |
| **29** | **5.899** |
| 30 | 0.434 |
| 31 | 0.455 |

* Filtered data (average time loss more than 2sec./10sec.) marked as gray color.

* 1 subject abandoned during the experiment. (Subject # 5)

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