Impacts of Color-Coded Nutrition Facts Panel and Consumer Responses

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Abstract

Nutrition Facts Panel (NFP) is a critical channel that communicates food nutrition information to consumers. A fundamental question is how to assist consumers in effectively using the valuable information on NFP without them taking the risk of missing important information. This paper introduces the color-coded NFP and investigates its impacts on information search and consumer behavior, such as attention to information, food health perception, food choice, and preferences of the different NFP formats. Results show that the color-coded NFP attracts more attention than the black and white NFP for unfavorite nutrients (fat, sodium, and sugars). Color-coded NFP also leads to consumers' healthier choices for some products (e.g., chips). Besides, the color-coded NFP reduces the time for the consumers to make accurate evaluations of the products' healthiness, reducing the information processing cost. Finally, most respondents prefer color-coded NFP to NFP in other formats (e.g., black and white and gray scale).

Keywords: Nutrition Facts panel, Colored coding, information seeking and processing, food choice, nutrients

1. Introduction

Food nutrition labels are one of the most popular and important food labels worldwide. Food nutrition labels follow specific policy regulations to provide critical and comprehensive nutrient information vital to consumer health. In the United States, food manufacturers are required to follow the federal Nutrition Labeling and Education Act of 1990 to provide nutrient information in the form of the Nutrition Facts Panel (NFP), which is usually on the back or side of a package. NFP has been provided on most packaged food products since 1994 in the United States. Similar labeling systems are also mandatory in other countries, such as Canada and EU countries (Grebitus and Davis, 2017). The NFP requires specific information to be displayed and uniform design, typographic style, color scheme, and standard placement of information (Keller et al., 1997; Grebitus and Davis, 2017). In the United States, the NFP uses the unit of serving size and provides the servings per container. The label is also required to list the "Big 7" nutrient facts, including calories, fat/saturated fat, cholesterol, sodium, carbohydrate, protein, and sugar ([FDA], Food and Drug Administration, 2016). To make it easier to be understood, the amounts of nutrients are stated as the percentage of daily values (DV) of total fat, saturated fat, cholesterol, sodium, total carbohydrates, dietary fiber, Vitamins A and C, calcium, and iron, based on a 2000-calorie daily diet (Food and Drug Administration, 1993). Since NFP provides critical food nurition information related to people's health, FDA has kept improving the regulations related to NFP, making it easier for consumers to make more informed, healthy food choices. The most recent and significant change was in 2014, when FDA proposed modifications to the NFP to make it easier for consumers to "make better informed food choices" (FDA 2022). The major changes include making the calories and serving size information more obvious with larger and bolder font type and the requirement of having added sugars information to the NFP.

Even though NFP has the advantage of including almost all the major nutrients of the products being attached and recent modified changes to make it easier to be understood, it still suffers from some drawbacks. First of all, the usage of NFP largely depends on the perception of the usefulness of the label. If consumers do not perceive the label to be helpful in facilitating the purchase decision, they would not have the motivation to use such a label, even if the label itself provides a host of information (van Trijp, 2009; Grebitus et al., 2015). Secondly, researchers have found little evidence showing a significant effect of the current NFP on consumer purchase decisions (Balasubramanian and Cole, 2002). In fact, when consumers shop grocery, they pay little attention to the nutrient information in most cases (Grunert et al., 2010). Studies have also indicated that the NFP was not efficient in providing useful nutritional information to consumers due to the high information processing cost associated with the label (Zhu et al., 2015). Although consumers would prefer more information, it is ironic that NFP does not benefit from providing a large amount of nutrient information (Drichoutis et al., 2006; Kelley et al., 2009). The existence of NFP grants consumers the accessibility to information. However, it does not guarantee it is being used (Zhu et al., 2015).

High information searching and processing costs are the main reasons that prevent consumers from effectively using the NFP (Drichoutis et al., 2005; Kiesel et al., 2010). Firstly, many consumers do not understand the NFP (Rothman et al., 2006; Visscher, Hess, and Siegrist 2010). Even if consumers know how to read the NFP, it is difficult for them to integrate and comprehend the information quickly enough: the information on nutrients that should be restricted (like sugar and saturated fat) is interspersed with the information on nutrients often encouraged in people's diet (such like fiber) (Temple and Fraser, 2014). Secondly, many consumers do not even bother to turn the product over and check the information from the NFP

located at the back of the package. As a result, the usage of the NFP, in general, is declining (Blitstein and Evans, 2006; Todd and Variyam, 2008).

Traffic Light (TL) nutrition label was introduced in 2006 by the UK Food Standards Agency (FSA) to address the attention issue and enhance the understanding of the nutrition label. TL uses red, amber, and green colors to indicate the level (high, medium, and low, respectively) for nutrients in food products (Sack et al., 2009). TL labels are considered better than the traditional black-white NFP for several reasons. First, TL labels can attract consumer attention to the nutrients of food products. The TL label colors also prompt individuals to consider their health, therefore helping avoid energy-dense food and promote nutrient-dense healthier food at the point of purchase. Second, because TL labels are located at the front of the package, consumers can easily access some nutrient information about the food products, significantly reducing the information-seeking cost. Third, TL labels are more effective in improving the understanding of nutrition knowledge when compared with the cases of no label or the regular front-of-package nutrition label (Roberto et al., 2012; Feunekes et al., 2008; Graham et al., 2012). A review of 38 studies shows that symbolic colors make it easier for consumers to determine the healthiness of the food products (Vyth et al., 2009; Hersey et al., 2013). In addition, consumers can more easily interpret and select healthier products with nutrient-specific front-of-package (FOP) nutrition labels that incorporate text and symbolic color to indicate nutrient levels. Therefore, it is better to integrate colors and a few words to indicate the levels of nutrients rather than only displaying the numeric information of food nutrients (Hersey et al., 2013; Ellen, 2017).

Despite numerous studies showing the effect of color labels (e.g., TL labels) on consumers' evaluation of the healthiness of products and the decision making afterward, some

studies found no significant difference between colors color labels and their counterparts, such as those in black-white. The effects of color labels sometimes depend on the scenarios and whether the label uses symbolic colors. Although TL labels can be efficient in transferring nutrition information to consumers, the information provided by the TL labels is incomplete (Pettigrew et al., 2017). They are more of a solution for avoiding energy-dense food rather than a tool to promote nutrient-dense healthier food (Wansink and Chandon, 2006).

Considerable studies have focused on the effects of TL labels and their variations in different formats (Gorton, 2007; Berning et al., 2008; Katz et al, 2009; Kim and Kim, 2009; Vyth et al., 2009; Möser et al., 2010; Scarborough et al., 2015; Olstad et al., 2015; VanEpps et al, 2016; Crosetto et al., 2016). Research on NFP focused almost exclusively on the original NFP or modified NFP (proposed changed label). To the best of our knowledge, no studies have evaluated the effectiveness of color-coded modified NFP in promoting the use of nutrition information on food packaging.

This paper proposes the color-coded NFP that uses the modified NFP as the base and adds a similar color-coding system as the TL outlined by the UK Food Standards Agency (FSA). By adapting the TL system to NFP, the color-coded NFP could take advantage of both NFP and TL labels. Using colors potentially reduces the information searching cost by lowering the difficulty of understanding NFP. At the same time, color-coded NFP does not sacrifice the integrity of information provision, which is one of the main disadvantages of TL labels. Color-coded NFP can provide complete nutrient profiles of products to help consumers identify nutrients that are both encouraged/discouraged to consume. To determine the effectiveness of the color-coded NFP, this study investigates whether color-coded NFP 1) attracts more attention to nutrient information on NFP; 2) improves the understanding of the NFP and perception of the

healthiness of the products; 3) eventually affects the consumer decisions on healthy food choices. This study provides essential information on policies and regulations of NFP and other nutrition labels that aim to explore ways to reduce the information searching cost, enhance consumer information processing ability, and increase the effectiveness of delivering nutrition information to consumers.

2. Method and Results

We developed online surveys with three individual studies to answer the questions surrounding the effect of the color-coded NFP on consumer behaviors. The three studies aimed to test four hypotheses based on the literature on NFP and TL labels and their importance in assisting future nutrition label regulations/policies changes. The specific hypotheses are:

Hypothesis 1a. Color-coded NFP attracts more overall attention than the current black and white NFP.

Hypothesis 1b. Color-coded NFP attracts more attention to the unfavorite nutrients (total fat, saturated fat, sodium, and total sugars) than the black and white version of the Nutrition Facts panel.

Hypothesis 2. Color-coded NFP makes it easier for consumers to make healthy decisions.

Hypothesis 3. Traffic Light Nutrition Facts panel makes it easier for consumers to make accurate evaluations and assessments of the healthiness of the products

2.1 Overview of the Main Study

This study uses two food products, chips (10 oz) and salad kits (10 oz), as the focal products. According to the literature, these two products were chosen as the representatives of unhealthy (chips) and healthy (salad kits) food categories (Grebitus et al., 2017). Each product has three nutrition levels (least healthy, less healthy, healthy), defined by the amount of healthy/unhealthy nutrients presented on the NFP of products. NFP is based on the mock version

of the modified NFP for both chips and salad kits. The NFP of each product is created based on the nutrition level of the real products available in the market. Since there are two different products classified as healthy and unhealthy alternatives, consumers may change their perception, behavior, and decision strategies when facing different products and different nutrition levels.

Besides the specific questions in three studies testing the primary hypothesis, the survey also assesses the frequency of respondents checking NFP when purchasing the products in grocery stores. The primary reasons for respondents using (for NFP users) and not using NFP (for NFP non-users) are examined. Then, respondents are presented with an example of the NFP and asked to indicate the nutrients they paid attention to and used to make the decisions.

Qualtrics helped distribute the survey to its representative consumer panels in the United States. Respondents have to be self-identified as the primary household grocery shopper, who is 18 years or older. During the distribution of the survey, two "trap" questions were used to identify the respondents who did not read the survey questions carefully (John et al. 2015). The respondents who failed the trap questions were eliminated from the final analysis. Since the study uses the color-coded NFP based on the TL system, we also screened out the respondents who are Colorblind for red or green. The final panel consists of 571 total valid respondents. After the random assignment, a total of 287 respondents were selected to answer the questions for the chips, and the rest 284 answered the questions for salad kits.

Table 3-1 summarizes the demographics of the sample respondents and the comparison with the 2017 Census data. Since the study focuses on the household primary grocery shoppers, the sample ends up with more females (68.1%) than males (31.9%). Respondents' median ages were 45 to 54 years. The sample data generally matches the population in terms of age, income,

and gender. However, the sample contains more respondents with higher education attainment, consistent with previous studies that used an online survey (Lindhjem & Navrud, 2011; Gao et al., 2015).

2.2 Study 1 - Effects of Colors in Attracting Attention

2.2.1 Study Design

Study 1 uses a set of between-subject questions that employ a 2 (change toward healthier or toward less healthy) × 2 (traffic light or black/white) design. Before the beginning of the studies, respondents are randomly assigned to see one example of the questions, which informs them of the structure of the question type and the choice scenario they are going to see in the study. Respondents are randomized to answer the questions for either chips or salad kits after the practice questions. Each product has three nutrition levels associated, based on real nutrition labels from the local grocery market, least healthy, less healthy, healthy. For better interpreting the healthy level, we also name least healthy as "low", less healthy as "medium", and healthy as "high" nutrition level. Specifically, the least healthy option for chips has 160 calories, 10 grams (13%) of total fat, 1.5 grams of saturated fat (8%), 170 milligrams of sodium (7%), 15 grams of carbohydrate (5%), and 1 gram of dietary fiber (4%). The less healthy option for chips has the same nutrition composition expect for less sodium, which is 60 milligrams (3%) instead of 170 milligrams (7%). The healthy option has fewer calories (120 instead of 160), less total fat (2 grams, 3% instead of 10 grams, 13%), more dietary fiber (2 grams, 7% instead of 1 gram, 4%), while a little bit more sodium than the lowest level among the three (135 milligrams, 6% instead of 60 milligrams, 3%), more carbohydrate (23 grams, 8% instead of 15 grams, 5%). Generally, the healthier option of chips has fewer calories and less total fat, a little bit more sodium, carbohydrate, and fiber. For the case of salad kits, the least healthy option has 210 calories, 18 grams of total fat (24%), 3 grams of saturated fat (15%), and 440 milligrams of sodium (20%).

The less healthy option has 150 calories, 12 grams of total fat (16%), 2 grams of saturated fat (10%), and 390 milligrams of sodium (17%). The healthy option has 90 calories, 6 grams of total fat (8%), 1 gram of saturated fat (5%), and 330 milligrams of sodium (14%). Therefore, the healthier option for the case of salad kits would have fewer calories, less total fat, less saturated fat, and less sodium.

The nutrition level in the middle (less healthy) is chosen as the benchmark as well as the baseline. Respondents are allowed to observe the benchmark NFP label for 15 seconds and then given a short break for 3 seconds. After that, a second NFP label is presented, and respondents are given another 15 seconds to find the places of difference and indicate the place where NFP has changed compared with the first one. There are two directions of changes in general, one toward healthier and one toward less healthy. The influence of label formats is also compared by using both black and white version of the current modified NFP and the label with the color-coded NFP using the Traffic Light color system.

2.2.2 Dependent measures

The dependent measures used in this study are the time respondents needed to finish the attention tasks and the accuracy rate of finding the places of differences. The Qualtrics built-in timer records the time spent on each of the tasks.

2.2.3 Results

The results of the time needed for each the four attention tests for both the products are indicated in Figure 3-1. For the two products, the chips would need slightly more time for the respondents to finish the attention test compared with the salad kits, with the exception when the black/white version of the NFP label is given and the nutrition level changes from level medium to level high. In general, the respondents submitted the attention questions a little bit earlier, giving the 15 seconds restriction, ranging from 13.3 to 14.6 seconds. When the traffic light is

applied, there is no significant reduction in the time needed to finish the task using the paired t-test for both chips and salad kits. There is no significant difference in the time needed for the respondents to finish the attention tasks, with the exception that it takes significantly longer for the respondents to finish the attention task when black/white is used, changing the health level from medium to low than with the change from medium to high. For the salad kits case, there are no significant differences among the time needed for the respondents to finish the attention tasks when the traffic light is applied. All the tasks are finished within an average of 13 to 14 seconds.

The results of the overall accuracy of finding the difference between the chips and salad are presented in Figure 3-2. In this graph, it presents the aggregated successful rate of finding the places of differences for chips and salad kits when the two label formats are implemented. In general, when the traffic light is applied, there is a significant increase in the overall success rate of finding the difference for the case of chips when the traffic light version of NFP is applied using the paired proportion test (p-value=0.0060). However, the traffic light does not significantly increase the overall success rate for the case of salad kits (p-value=0.2741).

The results of the accuracy in finding the difference between two products, chips and salad kits are presented in Figure 3-3 and Figure 3-4, respectively. For the case of the chips, when the nutrition level changes from medium to high, there are changes in the NFP label in the contents of calories, fat, sodium, carbohydrate, dietary fiber, and sugars. When the TL label is applied, there is a significant increase in the success rate of finding the changes in fat (p value=0.05), sodium (p value=0.01), and sugars (p value<0.001) when healthy level changes from medium to high. However, on the other hand, the attention paid to calories, carbohydrate and fiber are lower when the TL label is applied, replacing the black and white version of NFP, while only the decrease in the attention to carbohydrate is significant though (p value<0.001).

When the nutrition level changes from medium to low, the nutrients only have a change in sodium. There are 80% of respondents who can distinguish the change in sodium when the TL label is used compared with 62% in the case using the black and white version of NFP. The increase in the success rate is also significant (p-value=0.007).

For the case of salad kits, the results are similar in the spread patterns of attention in the major nutrients in both directions of changing the nutrition. When the TL label is applied, when the nutrition level changes from medium to high, there is a significant increase in the success rate finding the difference in sodium (p-value=0.008), while there is also significant decrease for the protein (p-value=0.006) and minerals (p-value=0.049). When the nutrition level changes from medium to low, there is only a significant increase in the success rate finding the difference in sodium (p-value=0.056). In the two cases where the nutrition levels are changing, there is a higher chance for the respondents to find the difference in calories, fat, and sodium, compared with protein and minerals, no matter whether the black and white version of NFP label is used or the TL version of the label. It is obvious that in general, the attention paid to calories, fat, and sodium is significantly higher than the attention paid to the minerals, as for the salad kits case.

To sum it up, calories, fat, and sodium are the three top-ranked nutrients being recognized by the respondents. In the case of chips, the TL NFP significantly increases the overall attention efficiency as a total of 389.2% compared with 348.9% in the two comparative groups. In the salad kits case, the total attention efficiency of TL label is 497.8% compared with 486.6%. One general conclusion is that the TL label using the British traffic light food label system would attract more attention overall for the product of chips, while not for the case of salad kits case.

To look into specific nutrients, the TL label system would attract more attention to the nutrients being highlighted by the Color, and that is fat, sodium, and especially sugars. These nutrients seem to become even more critical in making respondents be aware and maybe consider limiting the intake of them. However, meanwhile, the study also suggests that the TL format may drag some of the attention to these nutrients as there is less attention to other information such as carbohydrate, protein, minerals, and fiber. The implementation of Color itself may distract respondents' attention from other nutrients and therefore, may lead to these facts less attended in general. It indicates that the attention paid to the labels is relatively consistent, and when there is Color applying to certain nutrients, respondents will pay more attention to these nutrients as a result.

2.2.4 Discussion

This study provides significant insights for the policy implications. First of all, the implementation of TL light significantly increases the attention paid to three nutrients, including fat, sodium, and sugars, especially for the case of unhealthy food products (chips). However, this form of the label may potentially bring the problem leading to the neglect of other nutrients. Similar to the case of the traffic light front-of-package food label, the TL NFP may become more effective when dealing with the avoidance of these unfavorite nutrients intake while lacking the function of persuading the favorite nutrients, if the current British TL color system indeed applies (Wansink and Chandon, 2006). Nevertheless, this newer format of the label is only tested in this study using two representative products and three health levels each. More tests, products, and nutrition levels are needed in order to reach a consolidated conclusion whether the traffic light version of NFP would help in all perspectives or would have a very limited impact. Another possible solution is to extend the color design to more nutrients, by colorizing more nutrients using similar or new criterion. In that way, respondents may not be "directed" to focus only on

the colorized part of the label while may pay more attention to the entire label as a whole picture. The new rules of coloring design for different nutrients need further investigations before such a plan is to implement. Based on the current study, the TL label increases the overall attention to the unhealthy food category, attracts more attention to the specific highlighted part, while leads to some reduction of attention to other unhighlighted parts. Even though the TL label still increases the overall attention efficiency, the magnitude of changing relies upon both specific food categories and actual changing of directions in the nutrition levels.

2.3 Study 2 - Impacts of Colors on Final Purchase Decisions

2.3.1 Study Design

In this study, the best-worst choice method is used to estimate the consumer decision making of the products differed by nutrition levels indicated by NFP labels. The study has three NFP label formats (black/white, traffic light, and grey). The study uses the same two products as before, chips and salad kits. Each product has the same three nutrition levels as in Study 1. In this study, there are three versions of NFP for the consumers to evaluate, the black/white version of the current modified NFP, the traffic light version of the modified NFP, and the grey version of modified NFP. The traffic light version of the modified NFP uses the same Color of Traffic Light (TL) by the UK Food Standards Agency (FSA). It uses colors of red, amber, and green to indicate the level (high, medium, and low respectively) for nutrients of total fat, saturated fat, sodium, and total sugars in food products (Sack et al., 2009). The grey system uses a similar criterion system, but uses a different color system of dark grey, grey, and light grey, replacing the TL color panel of red, amber, and green correspondingly.

In each of the choice tasks, there are three alternatives, each representing one nutrition level. Within the choice set, the three nutrition levels are using the same label format, one from the three formats: black/white, TL, or grey system. The consumers are asked to indicate the

alternative that they most and least likely to purchase based on the NFP labels given, assuming all the other characteristics are the same. The results are compared across the three formats of NFP labels and the two products to indicate whether the color formatting and product categories would change the consumer decision-making of healthy or less healthy alternative.

2.3.2 Dependent measures

There are two major dependent variables in this study. The time needed to answer each of the questions is recorded using the Qualtrics built-in timer, in the unit of the second to indicate how quickly respondents can finish the task. The second variable is the rate of making the healthier choice (nutrition level high) as the most likely to purchase and the rate of choosing the least healthy option (nutrition level low) as the least likely to purchase are also recorded.

2.3.3 Results

The results and distribution of the average time spent in the three cases for both products are presented in Figure 3-5. The average time for the respondents to make the purchase decisions using black/white, TL, and grey NFP labels are 28.1, 23.1, and 28.9 seconds for the case of chips, respectively. When the TL label is applied, there is a significant drop in the time needed to finish the question (p-value<0.001). The grey does not change the time needed for the case of chips. For the case of salad kits, the average time to make the decisions for black/white, TL, and grey NFP labels is 20.4, 19.5, and 20.3 seconds. There are no significant differences among the average time needed for the case of salad kits when colors are applied. In general, salad kits are easier to make the purchase decisions for respondents (19 to 20 seconds), while they would need 23 to 28 seconds to decide for the case of chips. When the grey color system is applied, there is no significant difference in the time needed for both products. However, the TL labels significantly decrease the time needed for the respondents to make the decisions in the case of chips and slightly decreases the one for the salad kits, which is not significant.

Respondents are asked their most and least likely to purchase among the three alternatives for the two products. The results for chips are indicated in Figure 3-6. In general, respondents have the highest likelihood to purchase the healthiest option when facing the TL version of the NFP label, which is 64.1%, followed by grey system 61.0%, and no color of black and white 57.8%. Meanwhile, the same pattern of three NFP formats applies to the answers of least likely to purchase the least healthy products. When respondents are given the TL formats of the NFP, around 75.3% of the respondents claim they least likely to purchase the least healthy alternative among the three, followed by the grey system (70.4%) and black and white version (65.2%). The increase in the likelihood to avoid the least healthy alternative is slightly significant at the 10% level (p-value=0.07), when TL is applied to the NFP label, compared with the no color (black/white) version for the case of chips. Based on these results, it seems that the color-coding system is more effective in notifying respondents of the least healthy option so that they would find it easier to stay away from the unhealthy option. Although the colored systems, including both TL and grey, increase the likelihood of choosing the healthiest option as the alternative that most likely to purchase, the magnitude of change is not significant in the current study. Thus, when respondents are facing different formats of NFP labels, there is even a more significant increase in the likelihood to avoid the least healthy option among the alternatives. Among the three formats of labels, the TL version is more effective in improving the likelihood to purchase the healthier and avoid the less healthy compared with the grey and no color versions in the case of chips.

For the case of salad kits, there is no significant difference in the likelihood to purchase the healthiest option when the respondents are facing black/white, traffic light, or grey system (Figure 3-7). However, when the respondents are facing traffic light and grey systems, there is a

higher possibility for them to choose the least healthy alternative as the least favorite alternative to purchase compared with the black/white version of NFP label. It indicates that it is relatively easier for the respondents to figure out the healthiest one to purchase (over 80% of the respondents) and find the least healthy option to avoid (around 80% of the respondents).

2.3.4 Discussion

In this study, in each choice set, respondents are evaluating the products at three healthy levels using the same format of NFP label, assuming the rest of the characteristics are the same. The only difference comes from the nutrition level. Color-coded NFP labels are not effective at the same level in reducing the time needed for the respondents to make the decisions. For unhealthy food, the color NFP turns out to be effective than in the healthy food case in the current study. Similar results are concluded when comparing the results of the final purchase decisions using three different formats of NFP labels. The TL NFP label increases the percentage of least likely to purchase the least healthy alternative for the case of chips. For the healthy product, it indicates a very limited impact of the TL NFP label on the final purchase decision when compared with the current black/white version of NFP label, with an even smaller impact when compared with other color formats such as grey system. One potential explanation is that it is relatively easier for the respondents to figure out the healthiness of the products already so that the colorized panel does not help too much as compared with the healthy food representative.

2.4 Study 3 - Effects of Colors on Product Nutrient Evaluation Accuracy

2.4.1 Study Design

In this study, respondents are tested about the accuracy of perceiving the nutrition information using the NFP labels in different formats of Color. The respondents are asked to indicate the healthier one between the two alternatives, and an option of "I am not sure" is included as well in case they are not sure about the answer. The study uses the design of pair-

wise comparison for 3 health levels, least healthy (low), less healthy (medium), and healthy (high). As a result, there are three comparable choice groups (low vs. medium, medium vs. high, and low vs. high). The three comparable groups were using the same format of NFP labels and presented in random order. In this study, three NFP formats were used, and these 3 pair-wise comparison questions were asked in each of the three label formats (black/white, traffic light, and grey) in a random order as well. Respondents are randomly assigned to one of the two products, either chips or salad kits. After entering the block of one specific product, respondents are presented a total of 9 pair-wise comparison questions, with three color formats, each with three comparable choice groups using the same format. The products, NFP designs, and nutrition levels are the same as before in Study 2.

2.4.2 Dependent measures

There are two major dependent variables in this study. The time needed to answer each of the choice sets is recorded using the Qualtrics built-in timer, in the unit of the second to show how quickly respondents can distinguish the difference in healthy levels. The second dependent variable is the correct perception, in the unit of the percentage of how much proportion of the respondents are successful in figuring out the healthier alternative as asked. The higher correct perception means the label is more effective in helping the respondents obtaining the correct perception of the healthiness of the products.

2.4.3 Results

The time needed to perceive the healthiness of the products was presented in Figure 3-8 (chips) and Figure 3-9 (salad kits). For the case of chips, it needs 10 to 14 seconds for the respondents to make the decision. When the TL label is applied, there is a significant drop in the average time needed to figure out the healthier one between the two alternatives among all the three comparable groups. The grey system does not have a significant impact on reducing the

time needed when compared with the black and white version. For the case of salad kits, when the traffic light is applied, it significantly decreases the time needed to for the case when respondents are comparing the groups with nutrition level high vs. low, and medium vs. low. The group high vs. medium was not affected by the implantation of the traffic light. Also, the grey system does not reduce the time in any case for the salad kits. Therefore, the TL version of NFP label seems to help respondents to make the decisions faster than both grey and black/white version of NFP labels. It shows that grey system does not expedite the process when compared with the current version of NFP, while the TL system may make it easier for the consumers to perceive the healthier option in some circumstances.

As for the correct perception, in the case of chips, the results are presented in Figure 3-10. When the traffic light version of the NFP is used, there is a slight increase in the correct answer rate compared with the black and white version of NFP in all the three comparison groups. However, the increase is not significant, based on the McNemar Test (p-value=0.16). The grey formatting has an even smaller increase in the correct rate of perception of the healthy alternative compared with the black/white version. In general, the TL label does not significantly facilitate the understanding of the NFP labels and contribute to the correct perceptions of the healthiness of the products, and the grey system has an even smaller of an impact.

For the case of salad kits, as indicated in Figure 3-11, it seems like the advantage of TL labels is not that obvious in making the respondents better perceive the healthiness of the products. In all the three comparison groups, there is no difference in the correct perception when the traffic light version of NFP is applied, when compared with the black/white version. For the grey system, there is no significant difference in improving the correct perception rate compared with the black/white version, either using the McNemar test. All the three formats are

almost the same in terms of affecting the correct perception of the healthiness of the products for the case of salad kits.

2.4.4 Discussion

In this study, the traffic light labels reduce the time needed for the respondents to perceive the healthiness of the products in 5 out of the 6 cases in total. The grey format of NFP label is not as effective in reducing the time needed to perceive the healthier alternative for either chips or salad kits. In terms of the correct rate of perception of the healthier alternative for both products, neither of the TL or the grey version of the NFP label increases the correct rate in any of the comparative groups for chips and salad kits. The changes brought by the new labels are not significant according to the Chi-square test in both the cases of chips and salad (F=0.93 for chips and F=0.09 for salad kits, both $p > 0.1$).

3. General Discussion

3.1 Major Results

For the first hypothesis, the traffic light nutrient facts panel does attract more attention than the black and white version of the Nutrition Facts panel in general, especially for unfavorite nutrients (fat, sodium, and sugars), which are also the highlighted part of the label using the Color. However, it seems like the label also leads to less attention paid other nutrients at the same time compared with the black and white version of the NFP. The second hypothesis is partially confirmed in this study in this study as TL NFP is more effective in inhibiting the unhealthy choice than promoting a healthy choice. Besides, the TL label is more effective for unhealthy food products in terms of making decisions easier and less unhealthy. The third hypothesis, traffic light Nutrition Facts panel does make the perception easier while it does not increase the rate of correctly perceiving the healthier alternative for either product of chips or salad kits in any of the cases comparing different healthy levels. The color label panel does

contribute to an easier time for the consumers to make accurate evaluations of the healthiness of the product, meaning it reduces the information processing cost.

3.2 Implications for Marketers

Our findings show that the Nutrition Facts panel plays a significant role in affecting the consumer attention, purchasing decision, and perception of the healthiness of the product. Food labels with colors attract more attention from consumers, facilitate the understanding of the healthiness of the product, and potentially enhances the purchase intentions of avoiding unhealthy alternatives. Most of the consumers prefer NFP labels with more colors the most. Manufacturers producing healthy food are likely to benefit more from the colorful format of the label. The colorful feature of the TL label would make the products more not only make the products more competitive by attracting more attention, but also boost the sales by making people become more aware of the healthiness of the products and facilitate their purchase decisions. It is also potentially beneficial for those manufacturers to emphasize the health benefits of the products. Not only this act would help maximize the revenue by stimulating the sales but also potentially contribute to the public good and social welfare in general. The information about healthy food has a substantial impact on attitude, perception, and final purchase decisions once consumers read them. One of the objectives of the NFP labels is to promote healthier food alternatives by having more people read the label information. This research suggests that such benefits could be further improved and extended by using the traffic light format of the label.

3.3 Implications for Public Policy

Although Nutrition Facts panel has been established in the market for the packaged food for the considerable number of years, guidelines regarding the regulations and formats of the labels have been changing to make it more attractive and effective. Especially with recent year's

popularity of other comparative labels such as numerous certification labels and other nutrition labels such as Facts Up Front, it may be even more difficult for consumers to still maintain the interest and attention to the NFP label compared with the circumstances when no other distractive labels were attached. In the absence of other label information, consumers may lean toward the nutrition information to make their purchase decisions. However, it has been almost possible to limit the usage of other labels with the recent development in the food labeling system. If consumers no longer make the decisions based on the NFP labels, then the decisions made without the consideration of the nutrition information would probably be the ones less informed in terms of getting full health information. Thus, if the NFP label could be improved in terms of attracting more attention and facilitate the usage, consumers would have a higher chance of viewing the label and utilize the nutrition information when making food decisions. A scrutinization of the nutrition information may contribute to a serious consideration of the nutrition information and trigger a more favorable impression and appreciation of the nutrition value of the product, especially for the healthier alternative. When an NFP is provided, although according to the previous literature, that consumers may not necessarily read it, it is suggested in this study that the situation could be largely improved by modifying the NFP to a more reader-friendly version. Although consumers may still feel wary about the newer and unfamiliar version of the NFP labels, the findings in this study indicate that they can quickly learn the meaning of the color coding and adapt their decision making considering more of the nutritiousness and healthfulness of the food products they are going to choose and consume.

The increasing occurrence of health-related issues such as obesity caused by the overtaken of calories, high levels of fat and saturated fat has made it emergent for policymakers to consider improving the efficiency of NFP labels in terms of transferring the nutrition

information. In study 2, when TL coded NFP is provided, consumers at least tend to make less healthy decisions compared with the case when the current NFP was provided using one representative unhealthy food product. This finding indicates that consumers are unconsciously making the healthier purchase decision to limit the intake of fat, sugar, and sodium. Although the eating habits were hard to change within a short period, with the implementation of the newer TL NFP label, the lack of knowledge and misperception about the food nutrition benefits could be largely improved. From time to time, if each purchase decision could be nudged toward healthier, gradually the eating habits could be pushed towards healthier as well. In the long run, it could potentially solve the obesity issues and reduce other long-term disease risks. Based on the results of the current study, we suspect that if the TL NFP label is to implement, although it will take some time and require some extra costs, the newer format of the label would affect the purchase decision of many consumers and motivate producers to improve the nutritiousness of their packaged food products.

3.4 Limitations and Opportunities for Further Research

There are several limitations of this study that should be acknowledged. First of all, the respondents' behaviors are examined in a hypothetical environment, using the mocked version of NFP label in an online survey environment. Therefore, consumers may behave differently in the actual grocery shopping scenario. Analysis of actual purchase data in a real store might help improve the accuracy of the label effect in the actual behavior. In addition, although online surveys are well accepted in the field, there is minimal control over the response behavior of consumers. Although the study tries to minimize the bias and control the responses by using trap questions and eliminating the responses with extremely high response time, it may be further improved in a non-hypothetical environment using experiment or auctions.

For the NFP labels, we explore the consumer responses for one label using the modified NFP as the base, with the colors being added using the criterion defined by TL food labeling system. This is one of the most prominent examples being used currently and potentially the direction for the future development of the NFP label. However, the TL label may not be a significantly better label than the black/white version in all aspects according to the results in this study. One possible reason is that there were only two products, and each product only has three levels associated. As a result, the advantages brought by the TL NFP label might be limited when compared with other formats of NFP labels. Future research could test the difference at more nutrition levels and for more products, which might give a more significant and holistic result in general. Meanwhile, other less popular labels or other color formats could be potentially the format for the future NFP labels, while the current study could not conduct an extensive analysis of all the possibilities. Future research could potentially extend the current color formatting to colorizing the other nutrients as well. This may lead to a different result such as the favorable nutrients (dietary fiber) could be encouraged, instead of only the unfavorable nutrients were emphasized and avoided. A different conclusion may be reached as well on how different criterions would make a difference and how consumers' attitudes, perceptions, purchase intentions, and preference would change accordingly.

Last but not least, the current study did not include the economic analysis of the costs of implementing the TL NFP labels and did not consider the potential barrier and resistant forces from the manufacturers against the implementation. It has been a fighting process for the manufacturers to agree upon the most recent modification of the NFP label, and there seems to be a long way to make the colorized label to happen. There is expected to be a long existing fight against obesity for the marketing researchers to achieve that goal, and this success would not be

accomplished without the help of policymakers and manufacturers. Helping consumers choose the healthier alternative, and in the long run, formal a healthier eating habit would reduce the annual deaths in the US/world directly attributable to diseases highly associated with overweight or obesity. It would also significantly help reduce the social expenditure in the annual costs caused by the dietary related disease treatment, improve the longevity of citizens life of and their quality of life of countless people.

Table 3-1. Demographics of the Sample and Comparison with the Population

Variable	Sample (2019)	Population (2017)[1]
Gender (%)		
Female	68.1	65.0
Age (%)		
18 to 24 years	7.0	9.1
25 to 34 years	21.7	18.6
35 to 44 years	19.1	16.8
45 to 54 years	18.0	17.4
55 to 64 years	18.2	17.2
65 years and over	15.9	20.9
Educational attainment (%)		
Primary school (through 9th grade)	2.1	13.0
High school diploma or GED	19.1	27.5
Some college, no degree	17.5	21.0
2-year college degree	14.0	8.2
Bachelor's degree	29.4	18.8
Graduate/professional degree	17.9	11.5
Number of kids (%)		
# of kids in the household=0	67.6	
# of kids in the household=1	16.6	
# of kids in the household=2	11.2	
# of kids in the household>=3	4.6	
Household annual income (%)		
Less than $15,000	11.4	10.7
$15,000 to 24,999	8.6	9.6
$25,000 to 34,999	10.5	8.2
$35,000 to 49,999	13.1	12.3
$50,000 to 74,999	17.2	16.5
$75,000 to 99,999	13.0	12.5
$100,000 to 149,999	10.0	14.5
$150,000 to 199,999	10.9	7.0
$200,000 and over	5.4	7.7
Sample Size	571	

[1] Census data: ACS 2017 1-year

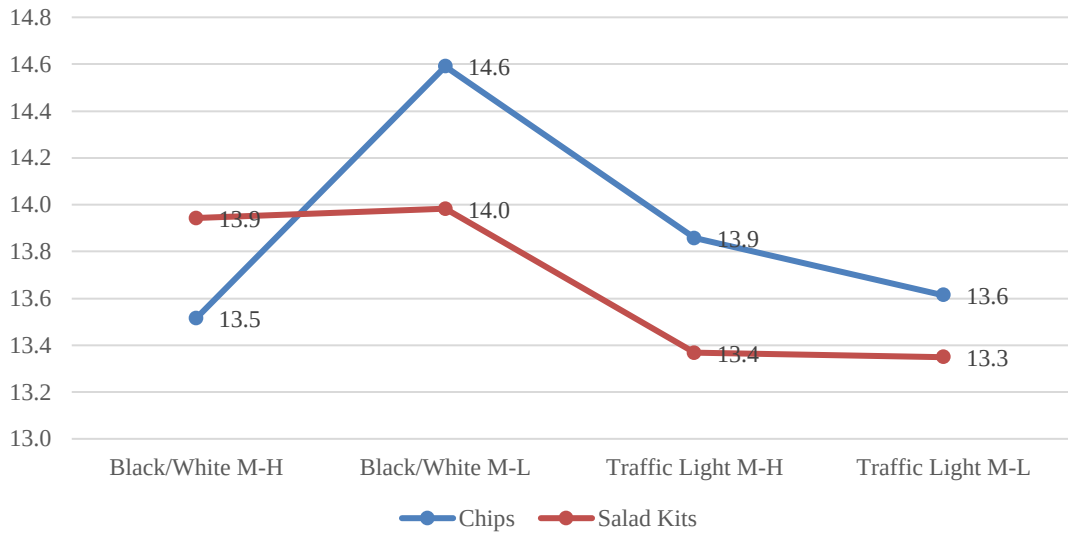


Figure 3-1. Time Needed to Finish the Attention Tasks

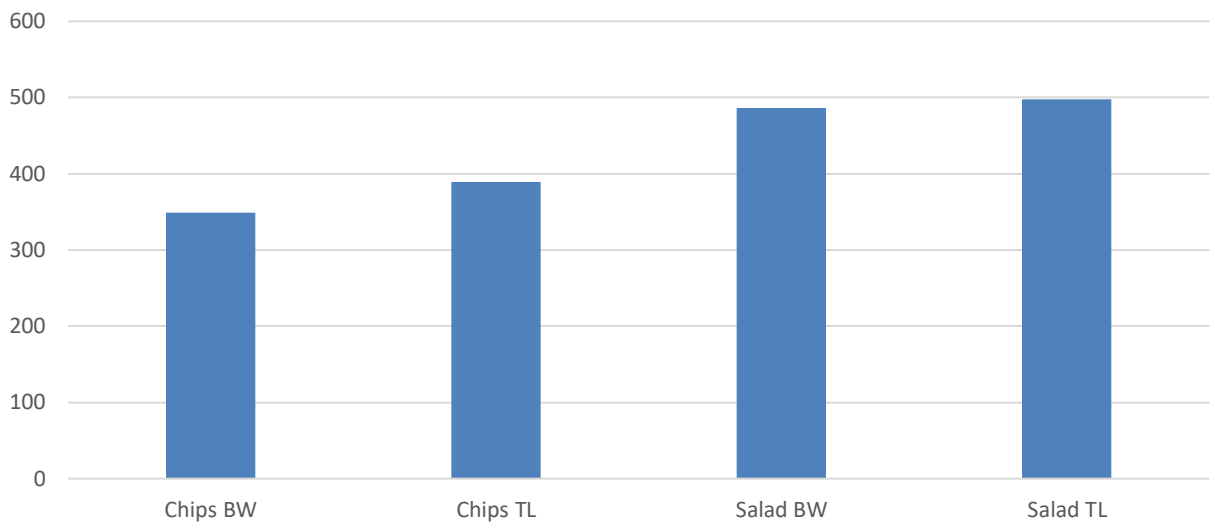


Figure 3-2. Aggregated Successful Rate of Finding the Places of Differences

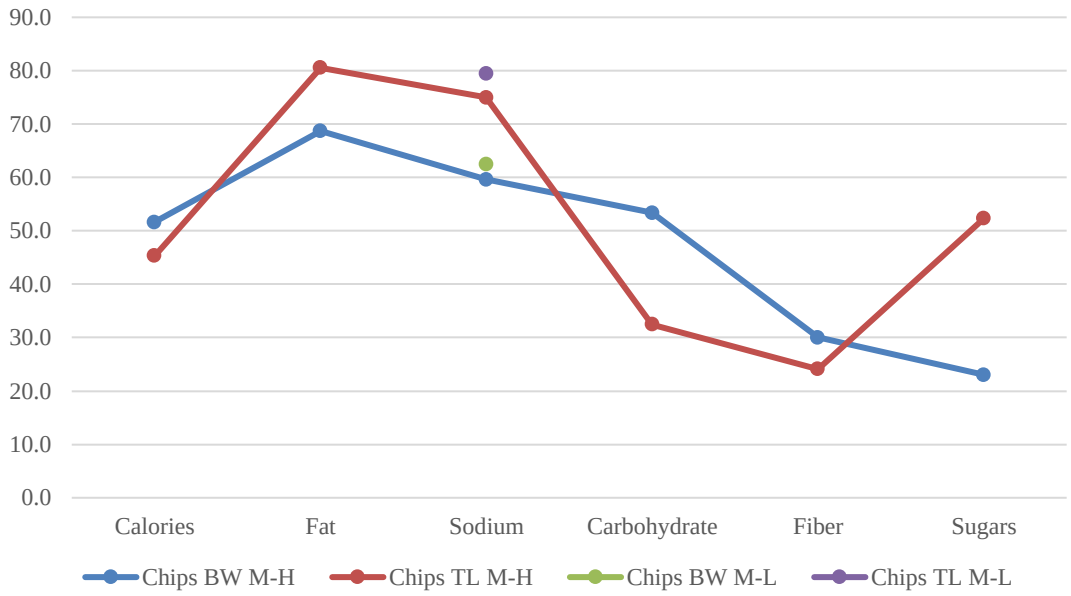
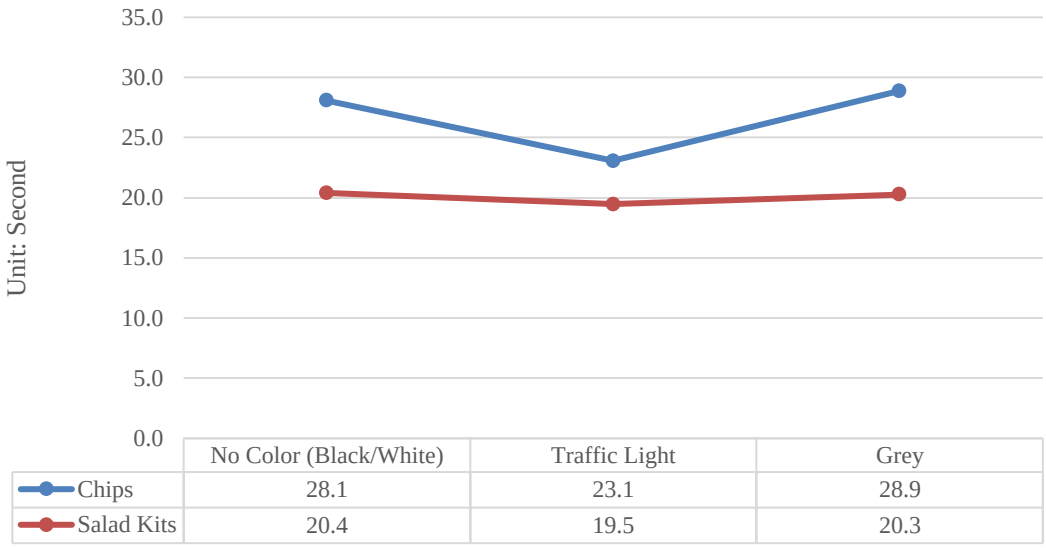


Figure 3-3. Attention Test for Chips

Figure 3-4. Attention Test for Salad Kits



	No Color (Black/White)	Traffic Light	Grey
Chips	28.1	23.1	28.9
Salad Kits	20.4	19.5	20.3

Figure 3-5. Average Time Spent on the NFP Labels to Make the Decisions

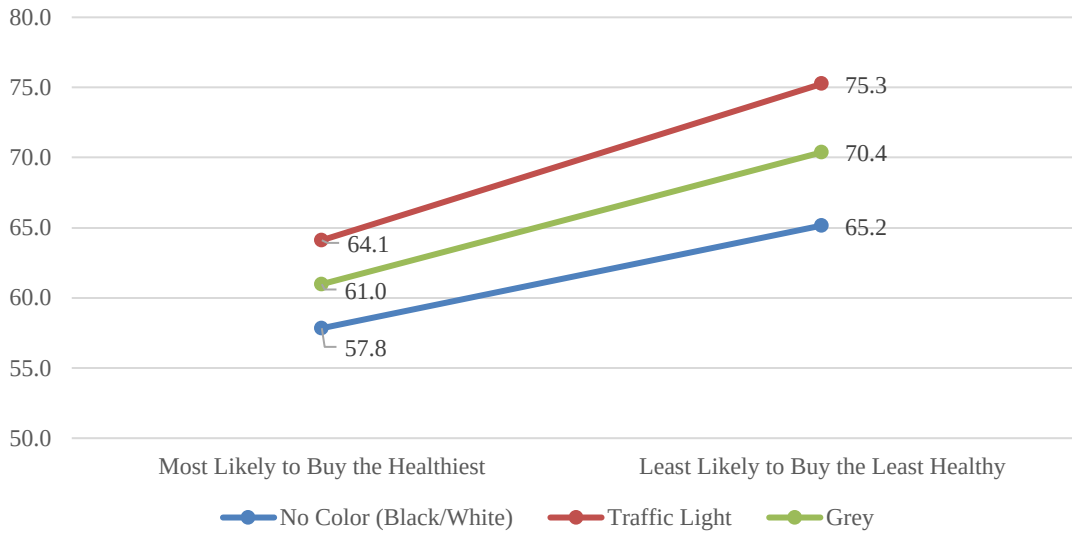


Figure 3-6. Percentage of Choosing the Healthiest and Least Healthy Alternative for Chips

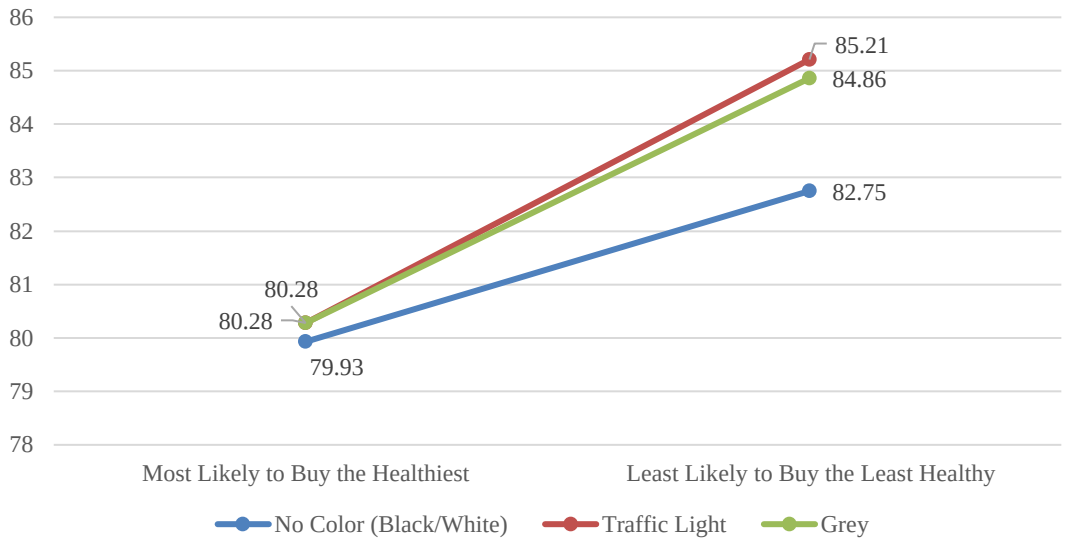


Figure 3-7. Percentage of Choosing the Healthiest and Least Healthy Alternative for Salad Kits

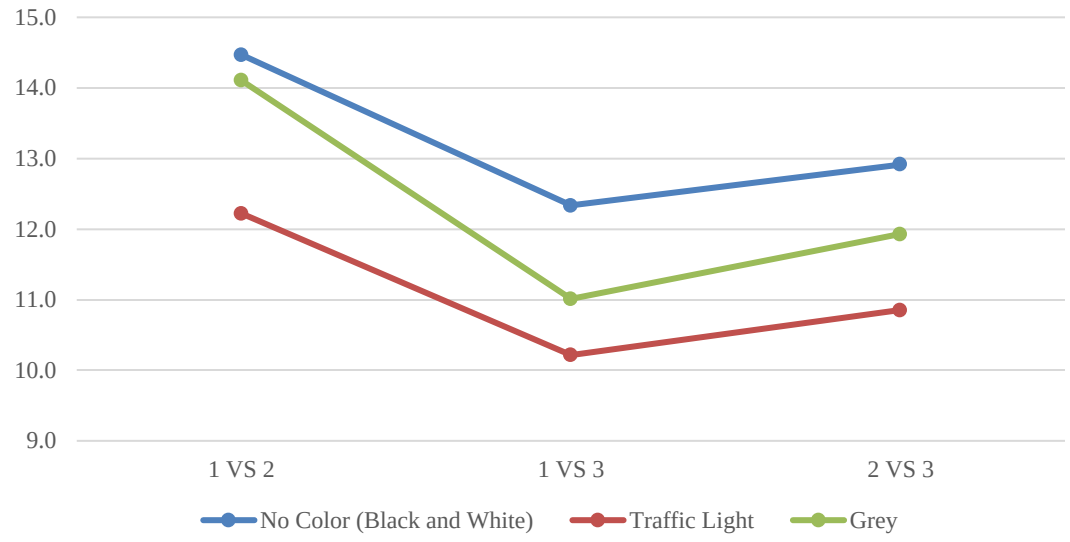


Figure 3-8. Time Needed to Perceive the Healthier Alternative for Chips

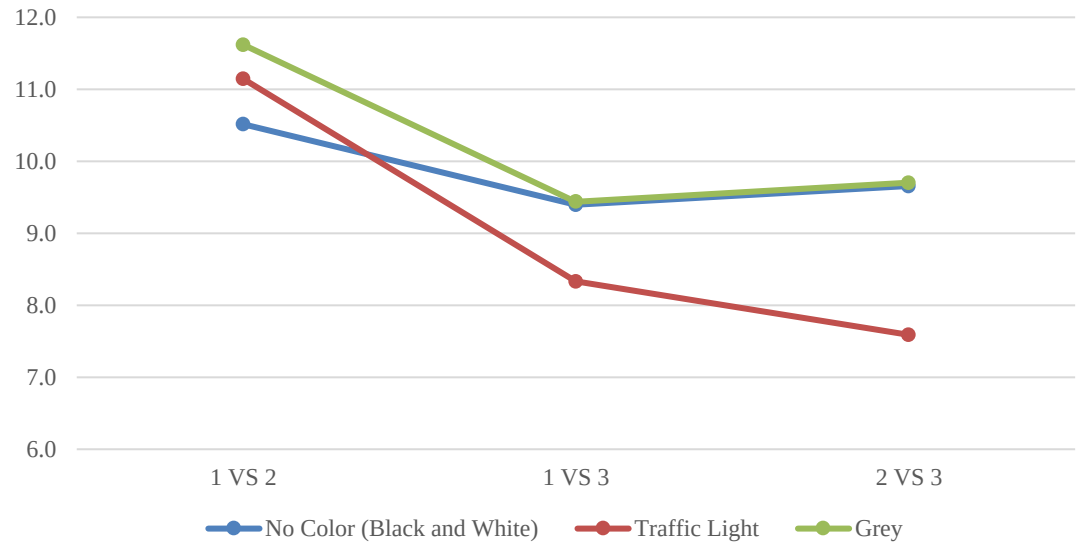


Figure 3-9. Time Needed to Perceive the Healthier Alternative for Salad Kits

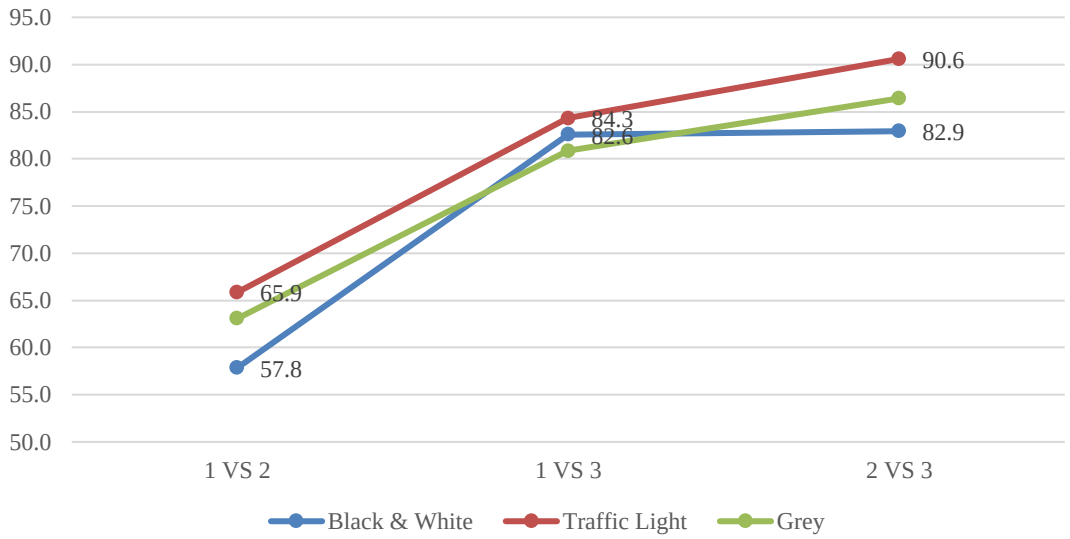


Figure 3-10. Percentage of Correctly Perceive the Healthier Alternative for Chips

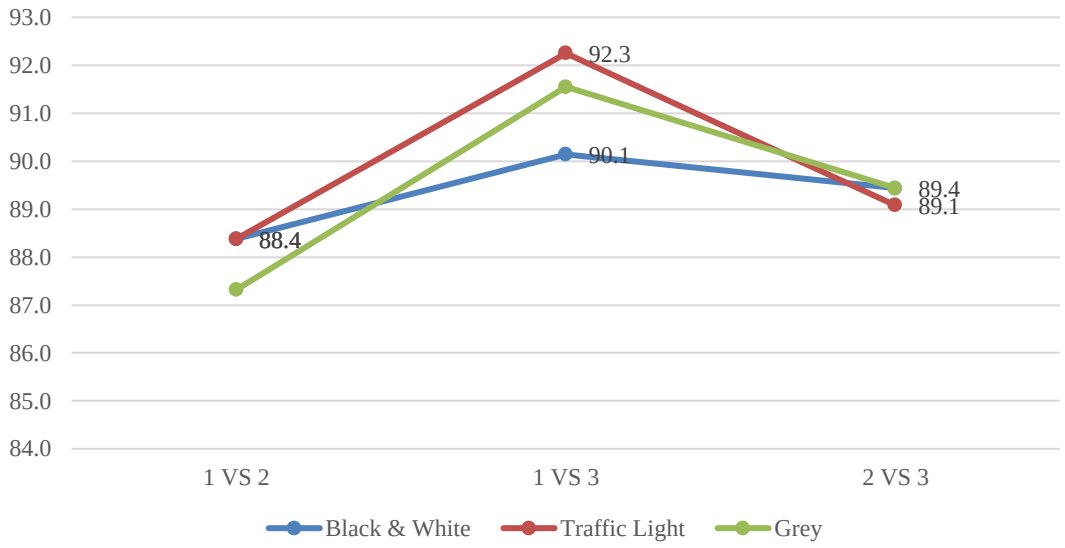


Figure 3-11. Percentage of Correctly Perceive the Healthier Alternative for Salad Kits

Appendix

Results for pretest

The frequency of viewing NFP and FUF labels when buying food products is indicated in Figure A-1. In general, over half of the respondents view the NFP and FUF. There are 30.3% of respondents who always view the NFP compared with 23.6% for the FUF. There are 27.3% of respondents view the NFP most of the time, and 25.7% for the FUF. There are about 9.3% and 12.4% of the respondents who rarely view NFP and FUF, respectively. As far as the viewing frequency of NFP labels for the two specific products used in the study, the results are indicated in Figure A-2. It indicates that some respondents (24.0%) always view the NFP label when purchasing chips while slightly fewer people (18.0%) view the label when shopping salad kits. While more respondents check the NFP (25.7%) most of the time when purchasing salad kits compared with 19.9% of the respondents' view for the case of chips. The rest of the viewing distributions are quite similar. In general, around 43.7% (18%+25.7%) and 43.9% (24.0%+19.9%) of the respondents check the NFP at least most of the time for salad kits and chips, correspondingly. The results from the Chi-square test indicate that there is no significant difference in the viewing frequency of NFP labels when respondents purchase salad kits and chips (F=5.0, $p > 0.1$).

The reasons for using NFP for salad kits and chips are presented in Figure A-3. The primary reasons for checking NFP for salad kits in a descending ordering of voting are:

> Easy to check the information on the Nutrition Facts panel, curious about the nutrition information on the back of the package, would like more information about nutrition, and the information on the front was not enough to make the decision.

In the case of chips, the reason that would like more information about nutrition outweighs curious about the nutrition information on the back of the package, while easy to

check the information on the Nutrition Facts panel is still the most important reason for using the NFP label. The results from the Chi-square test suggest that there is no significant difference between the salad kits and chips in terms of the reasons to use the NFP labels (F=0.4, $p > 0.1$).

The results for the reasons of not using NFP for salad kits and chips are presented in Figure A-4. The main factors are centralized in three major reasons. For salad kits, the reasons are spread in three major ones in descending order:

> Not curious about the nutrition information on the Nutrition Facts panel, the front of package information is enough to make the decision already, and do not need more information about nutrition.

For the chips, around 63.8% of the respondents claim they do not use the NFP because they are:

> not curious about the nutrition information on the nutrition facts panel.

Around 24.6% and 18.8% of the respondents claim the reasons for not using NFP as:

> do not need more information about nutrition, and the front of package information is enough to make the decision already.

Less than 10% of the respondents in this study consider the NFP label is too hard to understand nor too much of a bother to flip the package to seek the information. The results from the Chi-square test indicate that there is no significant difference between the two products in terms of the reasons not to use NFP.

When consumers go grocery shopping, the results of attention paid to each nutrient are presented in Figure A-5. In general, Calories (258), fat (251), sodium (210), and sugars (180) are the four essential facts that catch most attention from the respondents in descending order in terms of the total count. In the next level, protein (149), carbohydrate (149), minerals (133), and cholesterol (131) are the nutrients that attract relatively more amounts of attention. Dietary fiber

receives the least amount of attention, which is only 95 counts in total, which indicates that not many respondents care about the intake of dietary fiber that much.

Respondents' favorite colors are presented in Figure A-6. In general, blue is the most favorite Color indicated by the greatest number of respondents (370 counts), followed by black (316 counts), purple (242 counts). Pink (196 counts), red (196 counts), and green (183 counts) have quite similar counts in general. Yellow (132 counts), white (123 counts), and grey (111 counts) have over one hundred counts. Brown and orange are the colors favored by the least number of respondents, with 67 and 55 respectively.

Respondents are asked their agreement or disagreement with the statements about what changes have brought to their purchase decision for chips and salad kits by the NFP labels. The results are indicated in Figure A-7 and Figure A-8. In both cases, it indicates that the NFP labels make a choice easier for 68.3% (32.8%+35.5%) of the respondents in the case of chips, and 65.8% (39.4%+26.4%) for the case of salad kits. In Figure 3-7, over half of the respondents (53.4%) somewhat agree or strongly agree that the NFP motivates them to get more nutrition information. The NFP labels change the original purchase decision of around 37.2% of the respondents. There are only about 23.7% of the respondents who agree or strongly agree that the NFP labels make them pay less attention to other information such as other labels and price. Even fewer of the respondents, about 11.5% of the total respondents who agree or strongly agree that the NFP labels are hard to understand or they do not know the meaning of the label. In the case of salad kits, the results are quite similar except for the fact that there are more respondents (17.6% instead of 11.5%) who agree the NFP labels are hard to understand, while fewer respondents (17.2% instead of 23.7%) agree that the NFP labels make them pay less attention to other information such as other labels and price.

There are around 60.6% of the respondents who self-claim good health status, with another 17.9% of them self-claim as excellent. Around 18.7% and 2.8% of them self-report their health status as fair or poor in this study.

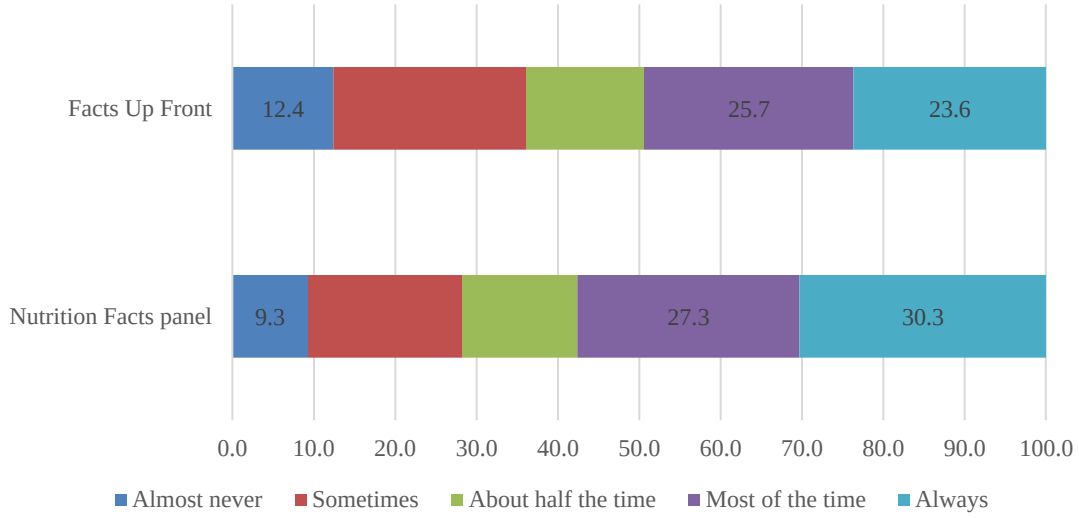


Figure A-1. Frequency of Checking Nutrition Information from Nutrition Labels.

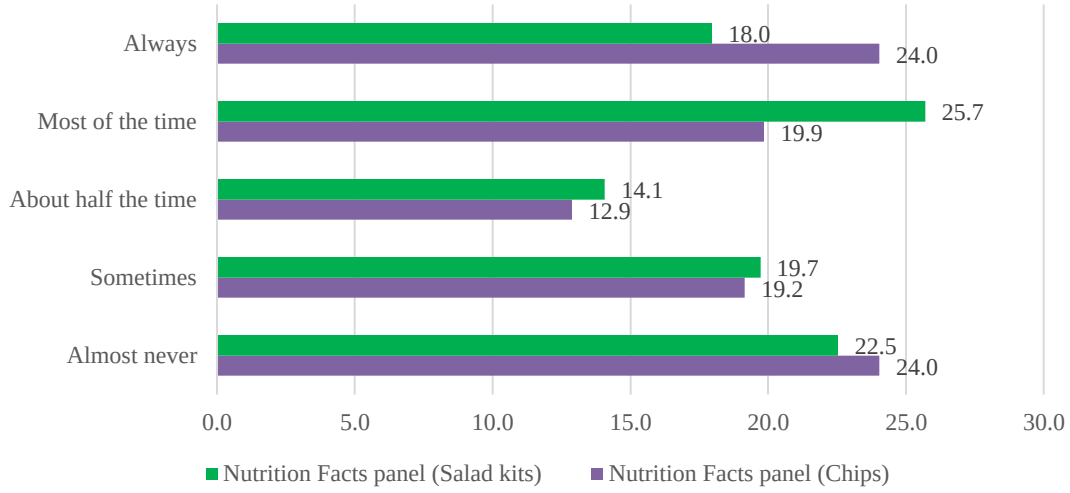


Figure A-2. Viewing Frequency of Nutrition Facts Panels for Salad Kits and Chips.

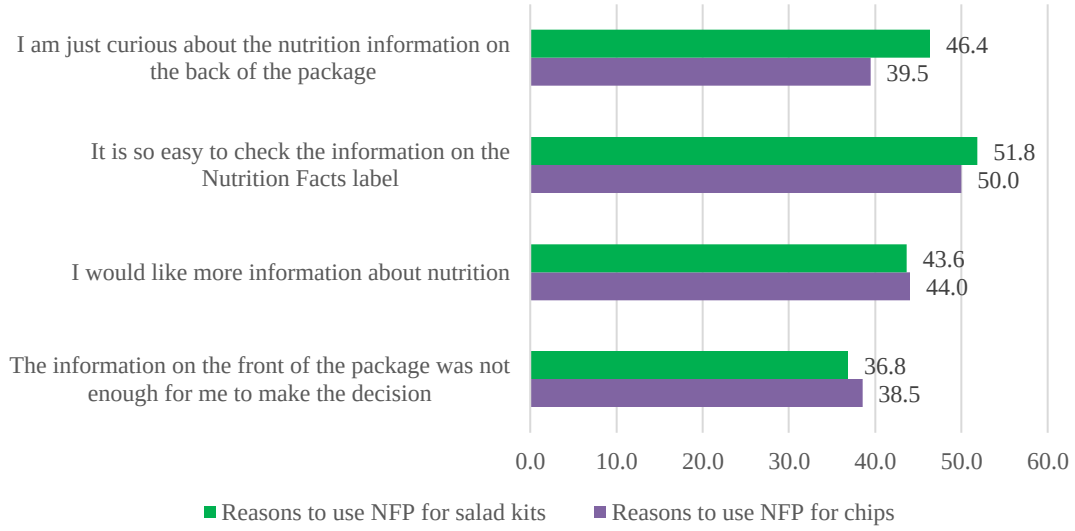


Figure A-3. Reasons to Use NFP for Salad Kits and Chips.

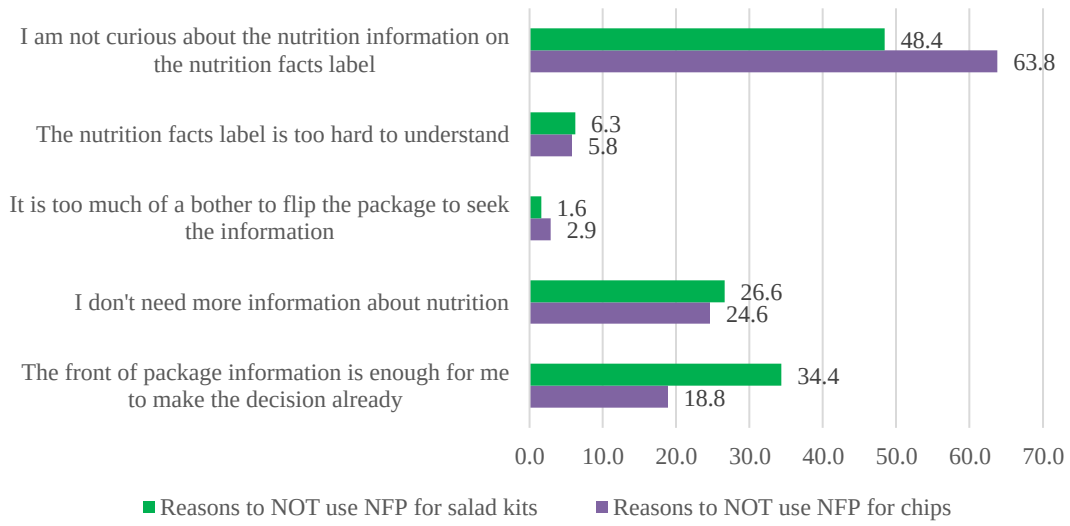


Figure A-4. Reasons to Not Use NFP for Salad Kits and Chips.

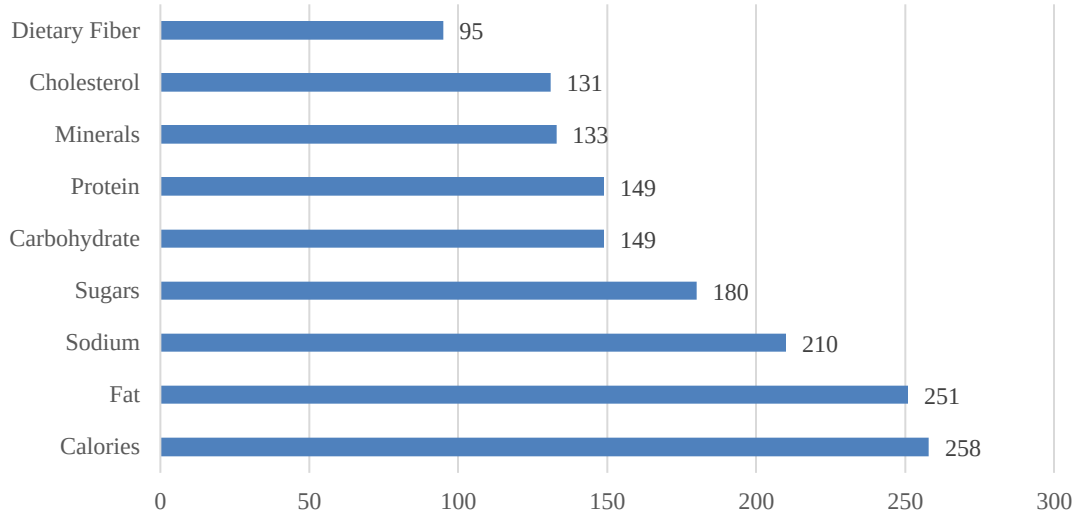


Figure A-5. Attention Paid to Nutrients in General Grocery Shopping

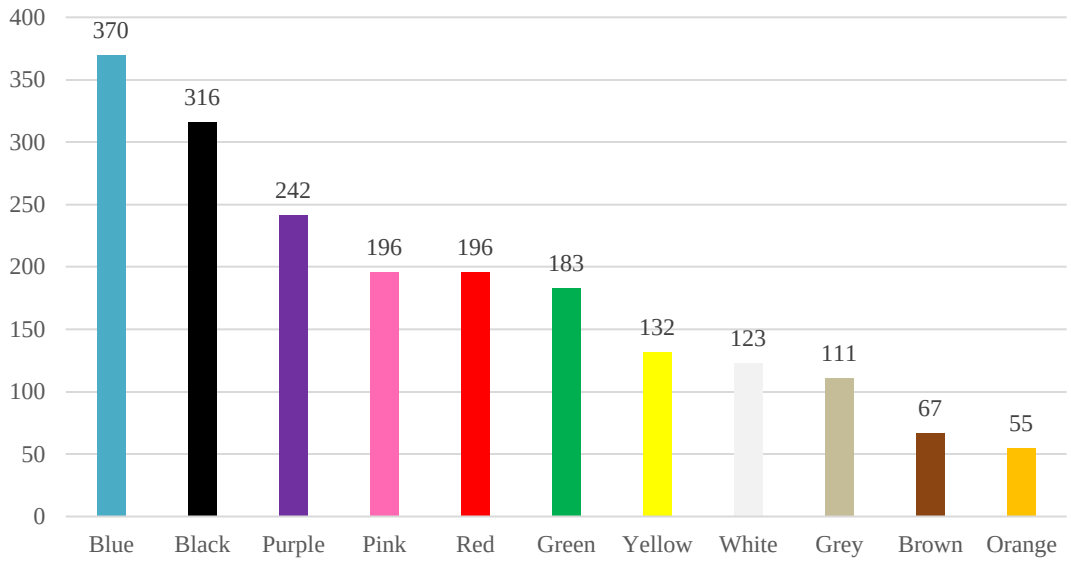


Figure A-6. Favorite Color(s)

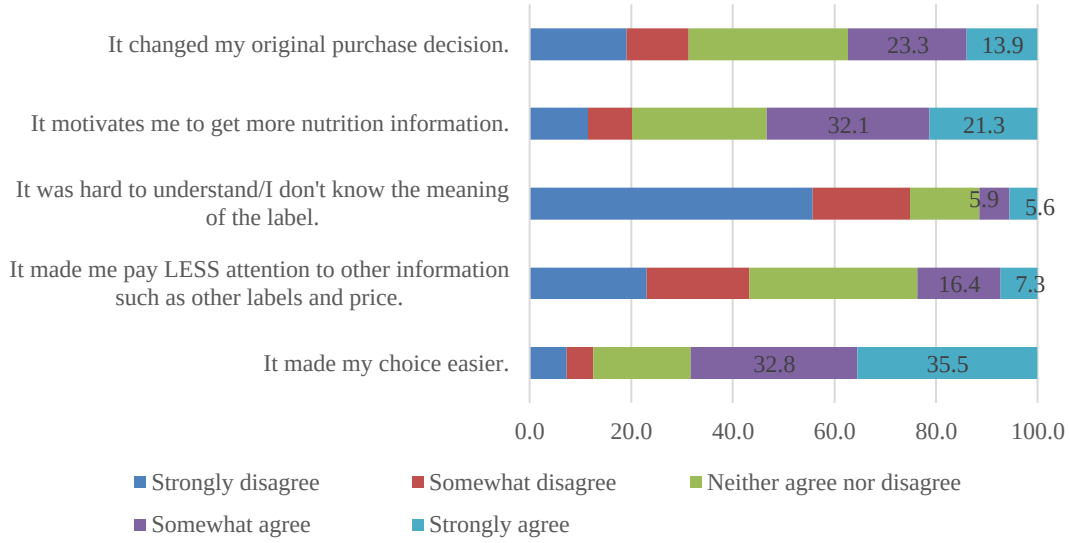


Figure A-7. Reasons to use NFP for chips.

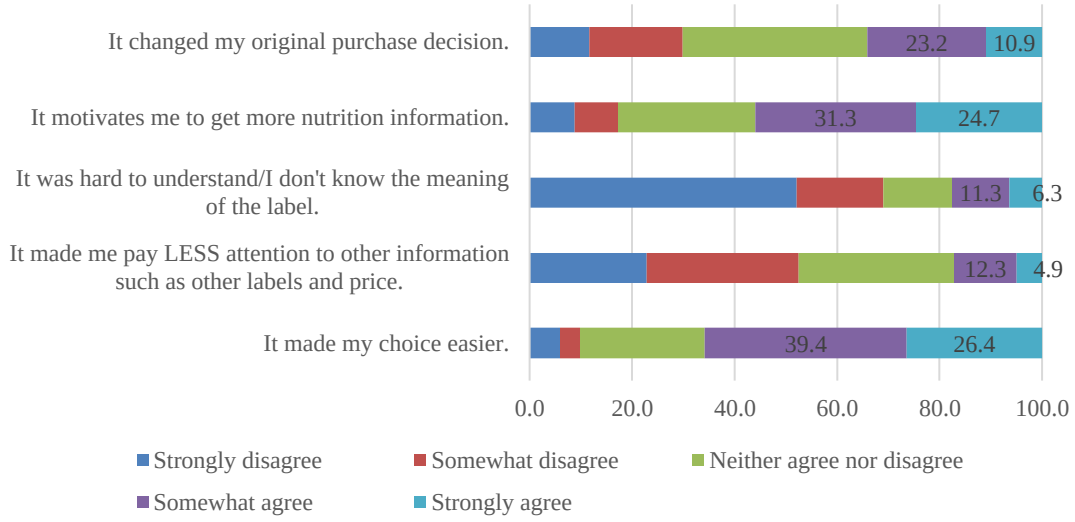


Figure A-8. Reasons to use NFP for salad

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