SPECIFIC AIMS

Although a major goal of nutritional labeling on food packages is to help consumers make healthy food choices, traditional labeling practices have been criticized because they do not attract attention [1-3], are not easily understood [4-8], and do not promote easy cross-product nutritive comparisons [9, 10]. To address these shortcomings, several organizations have recently suggested a number of new designs for nutritional labeling. Examples include the Guideline Daily Amount (GDA) format introduced by the Food and Drink Federation in the European Union, and the United Kingdom’s Food Standards Agency’s Multiple Traffic Light (MTL) system. However, there is limited research informing the development of these labels and most of the research investigating their effectiveness has relied on survey methods [5], subjective reports [11, 12], focus groups [13, 14], or quasi-experimental observational methods [15]. Here we apply basic research in visual cognition and attention to the development and objective evaluation of the effectiveness of varied nutritional labeling designs to attract attention, promote encoding into memory, and promote comprehension. To do so we will employ eye tracking, change detection tasks, tests of implicit memory, and tests of usability.

Aim 1 - Evaluate the attentional priority of different front of package (FOP) label designs.

Attending to a label is a necessary precondition for the encoding and comprehension of the label contents; thus in order to be effective a label must first attract attention. We will use a flicker change detection task to evaluate the attentional prioritization of four proposed FOP nutrition labels. The time taken to detect the change will be used to determine how effective each label is at attracting attention.

Aim 2 - Evaluate the effectiveness of an FOP label in guiding attention to nutritional Information.

The recent push toward FOP nutritional labels is based on the belief that they will increase the likelihood of attending to and the amount of time spent attending to nutritional information [16]. However, there is little objective evidence to support this claim. In addition, it is unclear whether the presence of an FOP label would encourage or discourage people from looking at the more complete nutritional content that appears in the traditional Nutrition Facts Panel (NFP) [17, 18]. To investigate these questions participants will inspect real 3-D packages of mock brands of foods while their eye movements are tracked. The total time spent viewing nutritional information for FOP labeled products and non-FOP labeled products will be compared to evaluate the claim that FOP labeling increases the likelihood of attending to and amount of time spent attending to nutritional information. The number of fixations and the total amount of time spent on the traditional NFP will be used to evaluate whether the FOP label encourages or dissuades people from accessing more complete nutritional information.

Aim 3 – Evaluate incidental encoding of nutrition information for different label designs.

To determine how well the different types of label designs promote incidental encoding of nutritional information, participants will interact with packages while judging the aesthetics of the packaging. After viewing a series of products, participants’ memory for the nutritional content on the packages will be assessed to determine whether different types of labels result in better encoding of nutritional information when one’s goal is not directly related to processing the nutritional content of the products.

Aim 4 – Evaluate the ease of use of the different label formats.

To evaluate how well different labeling techniques can be used to make between-product comparisons on the basis of nutritional information, participants will be asked to rank-order sets of packages based on a specific nutrient (e.g., fat, calories, or sodium content). The speed with which people can complete the tasks with different types of nutritional labels will be used to assess how well different label types promote cross-product comparisons when one’s goal is specifically related to the nutritional content of the products.

Aim 5 - Generate pilot data for future studies to optimize label designs so they target at-risk populations.

We will investigate whether the effectiveness of different labeling techniques varies systematically as a function of individual differences in diet, health histories, or demographics. These pilot data will be used to inform future research investigating label designs that are best able to target specific at-risk populations.
SIGNIFICANCE

Obesity is a clear and growing public health crisis in the United States. The rate of obesity has grown steadily over the past 30 years [19, 20] to the point that, as of 2008, an estimated 68% of all US adults were overweight or obese [21]. Based on current trends, it is estimated that over 86% of US adults will be overweight or obese by 2030 [21]. Given the increased morbidity, mortality [22] and health care costs associated with obesity [23-25], curbing the obesity epidemic is likely to result in substantial health and economic benefits.

Current understanding assumes that obesity is the result of a confluence of individual, social, and environmental factors [19, 26, 27]. However, the fact that obesity rates have increased for all age groups, regardless of genetic predisposition, highlights the pivotal role of the obesigenic environment [28]. Indeed, expanding portions, the ubiquitous nature of foods high in sugar, fat, sodium and high-fructose corn syrup, as well as the promotion of these foods, have significantly contributed to the obesity epidemic. It then follows that any attempt to mitigate obesity and its effects on society should target regulation of the environment as a high priority. Legislative and regulatory actions for this purpose include: subsidizing healthy foods, restricting marketing and/or advertising, limiting the sales of nutrient empty foods in places like schools, taxing nutrient-empty foods [29] and changing labeling requirements (e.g. the required listing of trans-fat [30]).

Using nutritional labels as a potential means of curbing obesity in the US has a long history. The 1988 Surgeon General’s Report on Nutrition and Health suggested that food labeling offered an opportunity to inform people in order to facilitate healthful dietary choices [31]. This report led to the enactment of the Nutritional Labeling Education Act (NLEA), requiring foods to have a standardized Nutrition Facts Panel (NFP). The expectation was that providing people with nutritional information would empower them to make more healthful food choices [32, 33]. It was thought that this labeling system would prevent many deaths associated with diet and would save up to $26 billion in health care costs over a period of 20 years [33].

The rising rates of obesity suggest that current NFP’s are not fulfilling their projected potential impact. However, research investigating the relationship between NFP usage and diet finds that the labels have a positive benefit when used [34]. While people with health conditions such as high blood pressure or high cholesterol are significantly more likely to use nutrition labels [35-38], the overall percentage of consumers who assess the nutritional information in the NFP when making food purchasing decisions is low [39-41]. Thus, it seems that the labels are capable of achieving the desired effects, but fail to do so because too few consumers access and use the information. This pattern led the FDA’s August 2003 obesity working group to conclude that “...it is clear that consumers would benefit if they were to pay more attention to and make better use of information...on food labels. Providing encouragement and making it as easy as possible for consumers to do so are worthy public health objectives.” [3].

The foregoing suggests that simply providing information within a label is inadequate. Many people fail to attend to and comprehend the information and, as a result, the label is unable to influence their food choices. Instead, an effective label must be designed so that it garners attention and is easily encoded, comprehended and used in decision-making. When one approaches label design from this perspective, it becomes clear that a great deal of basic research on visual cognition and perception can be used to inform the design and evaluation of more effective nutrition labels. Here we propose to apply these basic research findings and techniques to the design and evaluation of a more effective nutritional label.

Although the ultimate goal is to demonstrate that effective labels impact people’s nutritional choices and reduce obesity, the proximal goal is to develop a label that is likely to successfully convey nutritional information to the greatest number of people. Identifying optimal label techniques so that the nutritional information is attended, encoded, and comprehended is a necessary prerequisite to evaluating the extent to which nutritional labeling can impact dietary choice. That is, if people fail to attend to, encode, or comprehend the information in a nutritional label, it cannot have the desired impact on people’s behavior.

INNOVATION

Our overall approach is innovative in that we apply a commonly accepted model of information processing [42] to the design and evaluation of labels. According to this model, for a label to be effective it must successfully complete three stages of processing; namely, it must be noticed/attended by consumers, encoded into their memory, and comprehended. If a label fails at any one of these processing stages, it will be unable to successfully impact behavior. The application of this type of model to the design of labels is novel and represents a translational bridge between basic research on visual cognition and the applied problem of designing effective nutritional labels.

The information processing model suggests that a given label design might promote or retard processing at any of the three distinct stages of processing. Basic research on visual cognition provides specific methods for evaluating the processing at each stage of the model. These methods, although common in visual
cognition research, are novel in the nutrition labeling literature. For instance, we are among the first to apply 
the technique of change blindness to evaluate attention towards nutritional labels [43]. Our use of an 
incidental memory task, one that evaluates the encoding of information when one’s goal is not explicitly 
related to nutrition, is also novel within the field. We will also be the first to use eye tracking technology to 
evaluate how people interact with real packages. To our knowledge, only one study has used eye tracking to 
evaluate nutrition labels; that study presented stimuli on a computer monitor [44] which requires the 
packages to be flattened so that all surfaces are visually available. This is an important distinction because the 
traditional NFP does not appear on the package front, and can only be revealed upon physical manipulation of 
the package to expose its sides. As such, we believe the current approach is more ecologically valid in a critical 
way.

The proposed methods for evaluating nutrition labels constitute innovative tools that will provide 
pioneering insight into the investigation of effectiveness of label formats. Importantly, the proposed methods 
allow for experimental manipulations and provide objective and quantitative measures of label effectiveness. 
By contrast, most methods currently used to evaluate labels rely on questionnaires (see Cowburn and Stockley 
for a review [5]), subjective self-reports [11, 12, 45], focus groups [13, 14] and observational quasi-
experimental methods [15]. Thus, our proposed approach allows for more rigorous tests of label effectiveness 
and fulfills a need identified by consumer researchers employed by the Federal government for more objective 
and quantitative research methods in label design and evaluation [33, 46].

Our research is also innovative in that it evaluates the relative effectiveness of a number of Front of 
Package (FOP) nutrition labels. These FOP labels present information about a limited number of key 
nutrients on the front of the package, or Principle Display Panel, and usually include a combination of small 
text, icon, and/or color systems. While the placement of these labels and their use of icons are thought to 
make them more likely to capture attention and easier to encode, very little research has objectively validated 
how well they achieve these two stages of processing. Even so, this type of label is being employed. For 
example, important FOP designs that have gained prominence include the Multiple Traffic Light (MTL) 
labeling system introduced by the Food Standards Association in the UK, the Guideline Daily Amount 
format introduced by the Food and Drink Federation in the EU, and the “Smart Choices” icon that was used 
briefly by the food industry in the US during 2009 until the program was stopped by the FDA so that research 
regarding a standardized FOP system could be collected and evaluated [47]. Given the emergence of these new 
and varied FOP systems, it is timely to objectively evaluate the claims that they attract more attention and lead 
to better encoding of information than a traditional NFP.

We also have applied basic research to the design of a novel FOP that augments the MTL system by 
embedding schematic faces within each of the traffic-light icons (see Figure 1). As we discuss in detail in the 
approach section, basic research suggests this novel format should promote processing at each cognitive stage 
(attention capture, encoding, and comprehension). This aspect of the project is innovative in its application of 
basic research to a practical application.

Finally, the research team is uniquely suited to perform this type of investigation. Dr. Becker is an 
Assistant Professor of Psychology and part of the Cognition and Cognitive Neuroscience group. He conducts 
basic research on the processes that guide the allocation of attention and are involved with the encoding and 
conscious representation of visual information. He has recently published three papers in high-profile 
journals that investigate the influence of facial expressions of emotion on the allocation of attention [48-50], 
has employed eye tracking [49] and change blindness [51] methods to track attention, and has investigated the 
relationship between attention, encoding and remembering information [52]. Dr. Bix is an Associate Professor 
in the School of Packaging who works in the applied field of package design with an emphasis on 
consumer/package interactions. She has developed a novel technique for using eye tracking while people 
interact with real world packages. Dr. Bello is an Assistant Professor in Statistics at Kansas State University 
who works in the development and application of statistical linear models to biological problems. Dr. Bello has 
extensive experience in statistical consulting, is already familiar with the research team’s interests, and has 
been involved in the design of the experiments proposed in the Approach section. She will provide statistical 
expertise during conduction of experiments, and will be responsible for data analysis and interpretation of 
statistical results. Dr. Weatherspoon is a registered dietitian with extensive expertise in the role that dietary, 
lifestyle and ecological factors play in the risk, prevention and management of diet-related health disparities. 
She will provide the requisite nutritional expertise needed for the project. In short, the PIs areas of expertise 
complement one another and make them a strong team for this type of interdisciplinary research. Finally, the 
team has a publication record that demonstrates their ability to work effectively together using on similar 
types of projects. Drs. Bix and Dr. Bello have a long history of collaboration, and have a recent publication in 
the Proceedings of the National Academy of Sciences of the United States of America [53] that applied eye
tracking methods to the design and evaluation of warning labels on drug packaging. Additionally, Drs. Bix, Becker and Bello have collaborated successfully on a project that applied change detection methodology to the evaluation of product labels [54].

**APPROACH**

**Aim 1- Evaluate the attentional priority of different front of package label designs.**

Research investigating visual cognition suggests that one must attend to an item before becoming aware of it; as a result, an effective label is one that attracts attention. Our first experiment will test the relative ability of four types of FOP nutrition labels to attract attention (see Figure 1). To investigate this issue we will have subjects participate in a flicker change detection task. During this task an original and altered image (each appearing for 240 ms) alternate on a computer screen separated by a blank, gray frame (80ms) [55]. The sequence of images (original-blank-altered-blank) loop continuously, until the participant detects the change or “times out.” This type of change detection requires focal attention. The time required to detect the change is an index of when focal attention first reaches the changing item [55] and will be our response variable [56]. Drs. Bix, Becker, and Bello have experience using this method to evaluate the attentional priority of different parts of visual scenes [57] and package designs [54].

Tested images will be computer images of the flattened front and side panel (including the traditional NFP; see Figure 1) of the packages of three novel brands of breakfast cereal. Participants will perform 168 change detection trials, comprised of 24 “FOP trials” in which the FOP label changes, 24 “NFP trials” in which the change occurs on elements of the traditional NFP, and 120 “filler trials” in which the change occurs to non-nutritional aspects of the packaging (e.g., brand name, graphics) to keep participants from preferentially attending to nutritional information. "FOP trials” will be presented in a 3-way factorial design comprising 2 (color vs. no color; Figure 1) x 2 (text vs. facial icon; Figure 1) x 2 (healthy vs. unhealthy FOP – see aim 3 for a more detail) level combinations for each of 3 brands of cereal, thus yielding a total of 24 trials. In addition, the 24 "NFP trials” will be matched to the "FOP trials” to compare their attention grabbing ability. Order of presentation of FOP, NFP and filler trials to each subject will be randomized. We note that the designed FOPs (Figure 1) constitute variations on the MTL design that is the standard method used in the UK. We compare color and non-color version to evaluate whether the color system (that is currently used in the MTL system) is effective at capturing attention and conveying qualitative information about nutritional value. Our novel addition of schematic facial expression icons to represent high, medium, and low nutritional values is based on abundant data suggesting that face stimuli are given extremely high attentional priority and that the processing of facial expressions of emotion requires very few cognitive resources. Research indicates that facial stimuli capture attention when people are engaged in another task [58]; they are relatively immune to the phenomena of inattentional blindness [59] and attentional blink [60, 61]. In addition, facial expressions of emotion are readily evaluated in the near absence of attention [62-64]. Finally, the inclusion of pictorial icons in an FOP label may increase the ease with which the information is encoded and remembered [65].

People extract the basic meaning from pictures extremely rapidly [66] and form relatively long lasting memory of them [67], even when people are not actively attempting to form memories of the pictures [57]. These findings suggest that a face might be a particularly effective stimulus for drawing attention to the FOP nutritional panel and conveying relative qualitative information about the nutritional value of a product. We hypothesize that attention will be captured more readily by facial icons, and, as such, people will be faster to detect the change to the FOP when it appears with facial expressions.

For power and sample size calculations in this proposal, we use the concept of effect size as proposed by Cohen J [68], and further developed by Stroup [69] and Tempelman [70] namely

\[ \Delta = \sqrt{\sum_{i=1}^{k} \left( \mu_i - \mu \right)^2} / \sigma, \]

whereby \( \sum_{i=1}^{k} \left( \mu_i - \mu \right)^2 \) defines the corrected sums of squares of the treatment means as per the factorial design previously described and \( \sigma \) represents the standard deviation between experimental units. As such, effect sizes capture “standardized” expected mean differences between treatments of interest in an adimensional manner that expedite power calculations. For the experimental design in Aim 1 of this
Our main goal in Aim 1 is to evaluate the effect of color and facial icons on the ability of an FOP to attract attention. To this end, we will fit a general linear mixed model to the response "time to detect change." The model will accommodate the 3-way factorial design previously described (including interactions) and incorporate the random blocking effects of subject and cereal brand to ensure appropriate scope of inference. Experimental units of differing sizes in this design will be recognized by means of additional random effects in the statistical model. We will also augment the factorial statistical model described above to compare change detection times between FOP and NFP, and determine their relative effectiveness in attracting attention. All data analyses in this proposal will be conducted using SAS statistical software (Version 9.2 or forthcoming versions, Cary, NC). We note that the proposed experimental design and modeling approach also allow for exploratory analyses that compare the effect of facial icons and color on change detection times between healthy and unhealthy labels.

Aim 2- Evaluate the effectiveness of an FOP label in guiding attention to nutritional labels.

In Aim 2 we will monitor eye gaze position, a converging measure of attention, while participants interact with novel, three-dimensional product packages manufactured for use in this research. We will test the hypothesis that the inclusion of an FOP label increases the likelihood of people attending to nutritional information. For this purpose, we will investigate whether presence of the FOP label encourages people to access the more detailed nutritional information presented in the traditional NFP [71] or, alternatively, acts as a "short cut," discouraging people from accessing the traditional NFP [16]. A new set of participants will be fit with an ASL MobileEye eye-tracking device and will then be asked to inspect realistic, novel packages under the guise of rating the aesthetics of packages. Participants will be successively handed 8 packages corresponding to a 3-way factorial experimental design consisting of combinations of 2 FOP treatments (no FOP vs. the most effective attention-attracting FOP, as per Aim 1), 2 health levels (labels indicative of healthy vs. unhealthy food) and 2 types of product (breakfast cereal vs. prepared meals). Packages will be presented one at a time in random order and subjects will be asked to view them for 10 seconds each. During the viewing period, participants will be free to manipulate the package while inspecting it.

The main question of interest is whether the total time spent looking at the traditional NFP differs with presence or absence of the FOP on the package. This comparison will allow us to evaluate whether an FOP encourages attention to the more detailed NFP, or acts as an informational short-cut, thereby reducing attention to the traditional NFP. To address this question, we will fit a general linear mixed model to the response "total time spent looking at NFP." The statistical model will accommodate the factorial design described above (including interactions) and fit appropriate random effects to recognize blocking effects and experimental units. Power calculations indicated that a sample size of ~55 subjects would be adequate to detect a conservative effect size of \( \Delta = 1.2 \) with 80% power at a 5% Type I error rate. This effect size was based on anticipated treatment differences (between 3 and 5 seconds) and variance components estimated from our previous work [53]. Furthermore, the proposed design allows for collection of additional data and exploratory analyses. Along these lines, we will also assess whether an FOP results in early attention to nutritional information by modeling the response "median time to first fixate any nutritional information" as a function of the proposed design. Finally, we will implement a generalized linear mixed model that assesses the conditions under which participants fail to fixate any nutritional information (binary response) with the ultimate intention of determining any potential effects of FOP in increasing the probability of ever attending to nutritional content. A similar type of eye tracking paradigm with real world packages has been used successfully by this research team to investigate the amount of time spent attending various label elements of over-the-counter drug packaging [53].

Aim 3 – Evaluate incidental encoding of nutrition information for different label designs.

Ideally, a label that is designed to increase attention to nutritional information will also increase the amount of the information that people encode and retain about a product's nutrition, even when people are not attempting to access and remember nutritional information. This is particularly important given evidence that most consumers do not explicitly seek nutritional information when making their purchasing decisions [2, 72]. Thus, we will compare FOP designs in their ability to promote encoding of nutritional information into memory when the participant's goal is not explicitly related to nutritional information (i.e. better incidental memory).
A new set of participants will interact with a set of novel packages under the guise of rating their aesthetics. Each subject will be allotted 20 seconds to interact with each of 6 packages. The six packages will comprise two presentations of each of 3 food types, namely breakfast cereal, prepared meals and crackers. Across subjects, these 3 food types will be combined with 3 nutritional label formats (the Facial Icon + Color FOP, the Text without Color FOP, and the NFP only control) in a replicated Latin Square design. As a result, each subject will be exposed to all 3 food types and all 3 nutritional label formats, but only 3 of the possible 9 food-type-by-label-format combinations. For a given food type (e.g. crackers), the two presentations will differ in their health information, as one presentation will be labeled to be healthier than the other based on a limited number of key nutrients (see below).

After viewing all six packages, participants will be asked to indicate which of the two presentations from each food type was the healthiest (e.g., which type of cracker was healthiest). This will be done by showing participants a computer display (excluding any nutritional information) of the two presentations for a given type of food and having participants perform a two-alternative forced choice. The subject’s choice for each food type will be recorded as correct or incorrect and used as a binary response variable. A generalized linear mixed model will be fitted to this response in order to assess the effect of nutritional label format and food type on incidental memory of nutritional information, as quantified by the probability of a correct choice in the experimental design above. Following up on the replicated Latin Square design, the statistical model will include the fixed effect of nutritional label format and the random effects of subject and food type. Power calculations indicated that a total of approximately 80 subjects would provide 80% power to detect a true effect of nutritional label format on the probability of a correct choice at a Type I error rate of 5%. The effect of nutritional label format anticipates an increase from 50% correct choice (random coin-toss chance) with the NFP-only label to 75% correct choice with the Facial Icon + Color FOP label, with the Text without Color FOP having an intermediate effect.

The labels will be designed so that the “healthier” presentation will be at least one qualitative step higher (e.g., from yellow to green in the FOP with Color label) than the less healthy presentation for 3 of 4 nutrients in the FOP. All other nutrients (including those that only appear on the traditional NFP) will be identical across paired presentations of a given food type. Overall, this design of nutritional labels specifies 2 precise and easily-defendable “health levels” for each food type. This avoids confounds that could arise if the nutrients that are most influential when making a global decision about a food’s health value differ across people.

The proposed replicated Latin Square design is well-suited for this research question as it allows for solid inference on effect of nutritional label formats across a variety of food types while limiting the number of packages that a participant is exposed to. This approach decreases the influence of memory capacity limits and interference effects. Were we to find evidence of enhanced memory associated with the Facial Icon + Color FOP, we will replicate the above experiment using a new set of participants and a new set of treatments, namely FOP labels consisting of Text + color, Facial icons + color and the text without color. The proposed two-stage approach allows us to keep memory capacity demands and interference effects low while allowing an in-depth investigation of additive and/or interaction effects of facial icons and color.

**Aim 4 – Evaluate the ease of use of the different label formats to make nutritional decisions.**

This study will investigate how well participants can use labels when their explicit goal is to make nutritional comparisons. To determine the effect of nutritional label format on one’s ability to comprehend and use nutritional information, a new set of participants will conduct speeded, nutrition-based sorts. Prior to the beginning of each trial, participants will be instructed to sort the packages from highest to lowest based on a particular nutrient (e.g., highest salt content to lowest salt content). Each participant will then be presented with a tray containing four novel brands of breakfast cereal. Participants will proceed to rapidly place the packages in order from highest to lowest along the predetermined nutrient dimension (e.g., salt). A timer will be triggered as soon as the tray is set on the tabletop and will end as soon as the participant presses a button after arranging the products.

Each participant will perform a total of 25 trials in a 5 (nutritional label format) x 5 (nutrient dimension) factorial experimental design. Each trial will consist of one nutritional label format by nutrient dimension combination. Nutritional label formats include: the FOP treatments presented in Figure 1 and a NFP-only, no-FOP control. Five different nutrients will be sorted; four of these nutrients will be the nutrients that appear in the FOP label (salt, sugar, fat, and saturated fat) and one will be a nutrient that appears only in the traditional NFP (e.g., protein). Participants’ percentage of corrected sorted trials and time to successful ranking will be the main dependent variables used to evaluate the ease of use of alternative label formats to make explicit nutritional comparisons. Generalized and general linear mixed models will be fitted to these
responses, respectively. Both statistical models will accommodate main effects of and interaction between the
2 factors of interest, namely nutritional label format and nutrient dimension. Subject will be fitted as random
component to recognize its blocking effect. Power calculations within this design indicated that a sample size
of ~75 subjects would be adequate to detect a conservative effect size of $\Delta = 0.8$ with 80% power at a 5% Type
I error rate. This effect size was based on anticipated treatment differences (between 2-4 seconds) and
variance components estimates, based on our previous work with time-based responses [53].

We emphasize that an important objective of this experiment is to determine which type of FOP label
allows for more rapid and accurate cross-product nutritional comparisons. To this end, we will construct
linear contrasts that evaluate the main effects of color and facial icons in the FOP label, as well as their
interaction on the responses. We will also build contrasts that compare the no-FOP (control) to the FOP trials
to verify that the FOP allows for more effective cross-product comparisons than the traditional NFP alone.

Our experimental design is quite flexible in that it allows for some exploratory secondary analyses that
may inform future studies of usability. For instance, sort times for FOP and no FOP formats in the trials where
the critical nutrient does not appear in the FOP will be compared to determine whether the presence of an
FOP label interferes with people’s ability to use information on the traditional NFP. If so, it would suggest that
it is important to carefully consider which information needs to appear on an FOP panel, and which does not.
In addition, it might highlight the importance of future work to investigate how much information one can
place on a FOP before it overwhelms consumers.

**Aim 5 - Generate pilot data for future studies optimizing label designs so they target at-risk populations.**

For each of the experiments outlined above, we will run secondary analyses to investigate how individual
differences in diet and health influence the relative effectiveness of the different labels. After participating in
the experiments above, participants will be asked to complete the Block Food Frequency Questionnaire [73] to
assess usual food intake. Based on the United States Department of Agriculture (USDA) definition, foods will
be categorized as nutrient dense or “energy dense” [74]. In addition to food intake data, weight status will be
assessed. The weight and height of each participant will be measured discreetly by the researcher at the lab in
a private/screened area following standard procedures [75]. Body mass index will be calculated to determine
weight status based on the NHLBI classification of normal = 18.5-24.9, overweight 25-29.9 and obese $\geq 30$.
Other data collected will include physician diagnosed diet-related diseases of self and family, as well as
demographics. The collection of these individual participant data will be supervised by Dr. Weatherspoon. Dr.
Weatherspoon is a co-investigator on this project trained in collecting and analyzing these types of data.
Individual participant data will be considered as covariates in the statistical analyses proposed in Aims 1-4 to
determine whether the effectiveness of labeling techniques differs based on an individual's health profile,
demographics, or dietary history. If these pilot data suggest that the effectiveness of nutritional label formats
vary as a function of individual demographic, health, or dietary considerations, the results will be used to
motivate future research into labeling designs that are most effective at targeting specific high-risk
populations.

**Participants**

The findings from the proposed research will inform policy decisions about effective product labeling. As
such, it is important that the results generalize to the US population as a whole. Given that even basic
cognitive processes can be influenced by factors like socio-economic status (SES), education level, and cultural
heritage [76], the ability to generalize these results requires that our samples be heterogeneous and
representative of US demographics. Because obesity and its associated health problems tend to be over
represented among specific minority groups and in lower SES groups, we will attempt to oversample these
groups to achieve our target population estimates, which were derived by weighting US population
demographics [77] by the prevalence rates for obesity within each demographic [78]. To achieve this sample
we will recruit subjects with the help of three organizations (see attached letters of support). Recruiting
through the Secretary of State offices in Michigan (the equivalent to the Department of Motor Vehicles in
other states), should allow us to sample the population broadly. Recruiting through MSU Extension’s
Supplemental Nutritional Assistance Program (SNAP) and Expanded Food and Nutrition Education Program
(EFNEP) should allow us to oversample low SES participants and minorities. We emphasize that our
statistical approach will allow for comparisons within individuals; i.e. the relative performance across label
formats can be evaluated using each subject as its own control (blocking structure) without compromising
statistical power due to variability between individuals.