THE IMPLICATION OF REPEATED READINGS OF INGREDIENT LISTS OF FOOD LABELS ON FOOD SAFETY JUDGEMENTS

by

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Abstract

The purpose of this thesis was to establish the importance of cognitive factors in the ability to follow therapeutic diets by examining participants' reading behaviours when shown food labels. In two laboratory experiments, 64 undergraduate students were asked to repeatedly make decisions about the safety of foods that did or did not contain specified allergen targets. Mock food labels were presented in randomized and intermixed orders, with each of 30 products being presented 15 times. At each presentation students were able to make their safety judgement with or without consulting the food ingredient list on the label. With repetition of products, participants traded the certainty of verification for the facility of using memory. Mean target accuracy did not reach 100% implying limitations to people's reading accuracy, learning, and judgements about that learning. The findings from this study suggest that people probably choose not to read food labels as often as they should and miss seeing target ingredients when they are consulting the label.

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1.0 Introduction

Specific therapeutic diets are central to the management of many medical conditions. The diets can be as simple as eliminating or reducing one food item. For instance, in the case of a food allergy, the only treatment is to avoid that item. There are diets that are much more complicated. Celiac disease is an autoimmune disorder affected by the consumption of gluten. The only treatment for this condition is a lifelong gluten-free diet. This entails the exclusion of about 26 foods and ingredients. Exposure to foods not permitted by the diet can cause serious health problems. These are just two examples of special diets. Approximately 50% of the population will experience health conditions that require changes to eating habits (Statistics Canada, 2012).

One of the key sources of information used to decide if processed foods are suitable under a given diet is the food label. Food labels are an important food safety tool providing consumers with information needed to make informed purchasing decisions. The primary way of knowing a product's contents is by consulting the ingredients list. Instead of taking the time to find the ingredient list and read it every time, an imposition of a time cost, people may decide to rely on their memory from previous encounters with that item. Relying on memory can be a useful heuristic when grocery shopping unless: 1) there was a mistake in the learning; 2) the learning was correct, but the memory trace has been compromised; or 3) a product was to change its ingredients for some reason. In these cases, the consumer may be unaware of the product's contents. This is a leading cause of accidental exposures to problem ingredients (Sheth et al., 2010). These exposures cause low compliance and potentially negative physical outcomes.

In this thesis, an analog of food label reading behaviour was examined in two laboratory tasks. The purpose was to investigate reading behaviours and abilities of people to read food labels. More generally, the goal was to consider the role capacity plays in following a therapeutic diet. Capacity was believed to be a factor in complying with special diets that dieticians and nutritionists had not yet considered.

2.0 Literature Review

2.1 Therapeutic diets

Therapeutic diets are meal plans that control the intake of certain foods or nutrients. Sometimes referred to as nutrition therapy, special diets can be ordered by a physician or recommended by other health professionals, for instance, a dietician or nutritionist. For example, allergies, cancer, chronic kidney disease, renal failure, diabetes, digestive diseases, heart disease, high cholesterol, and metabolic syndrome all require various restrictions of eating habits (Campos, Doxey, & Hammond, 2011; Satia, Galanko, & Neuhouser, 2005). There are even diets designed to prevent particular diseases, including multiple sclerosis and cancer (Munger, et al., 2004; Munoz de Chavez & Chavez, 1998).

Therapeutic diets can be as simple as reducing or eliminating one food, as in the case of a food allergy or intolerance. The therapeutic diet in these cases is to avoid the consumption of the allergen. For celiac disease, the only treatment is a strict gluten-free diet for life. Following the gluten-free diet involves avoiding 26 items including grains which may be contaminated (e.g. oats) as well as others that may be derivatives of wheat sources (e.g. maltodextrin) and hence include the wheat protein. People with heart disease will likely be prescribed a diet low in sodium and fat. Diabetic diets mandate increased intake of fiber and reduced sugar and modified carbohydrates. Regardless of the medical condition or therapeutic diet, by following the prescribed diets, afflicted individuals can reduce the risk of adverse health events.

The potential adverse effects of not following a therapeutic diet range in severity depending on the condition, the diet, and the individual. In the case of allergies, consuming an unsafe food can result in itching or swelling of the mouth, hives, trouble breathing, dizziness, abdominal pain, diarrhea, nausea, vomiting, and in severe cases anaphylaxis which could lead to coma or death if not treated. These symptoms can occur within minutes of exposure and up to a couple hours after consumption (Sicherer, 2011; Woods et al., 2002). When celiac patients are exposed to gluten, their symptoms can include gas, diarrhea, constipation, headaches, and irritability and begin within a couple hours of consumption. Diseases such as cancer, heart disease, diabetes, and kidney disease all require therapeutic diets however there are often no immediate symptoms of eating unsafe items. The effects are slower but still very severe. These four conditions rank amongst the 10 leading causes of death in Canada. It is therefore important to study and improve treatments for these conditions, including the compliance to therapeutic diets.

Complying with a therapeutic diet can be challenging. There are generally rules to learn and behaviours to change. Once armed with the tenets of the prescribed therapeutic diet, people must make adjusted food safety judgements. In order to decide whether an item is acceptable by the standards of the diet, they are either going to remember things about specific foods (safe or unsafe) or remember the rules of the diet - checking all foods against those rules. These options carry with them a balance of cost and benefit in terms of effort, time, and verification of food safety.

2.2 Low compliance

Compliance has been defined as the extent to which a person's behaviour coincides with medical or health advice (Haynes, 1979). The benefits of following therapeutic diets are clear, however compliance is often low. According to Fedder (1982), approximately one-third of patients always comply, one-third never comply and one-third sometimes comply. This is relatively true regardless of patient population, disease state, or compliance measurement used (Stockwell Morris & Shulz, 1992). Long term therapies including dietary regimens consistently have problems with non-compliance with compliance rates converging at 50% (Glanz, 1980; Sackett & Snow, 1979).

Dietary compliance has been shown to be low in patients with diabetes, celiac, and cardiovascular disease, to name a few. For instance, only 21% of type 1 and 8% of type 2 diabetes patients were judged as compliant (Peyrot et al. 2005). Within celiac disease, physicians judge only 49% of patients to be compliant with the gluten-free diet (Fera, Cascio, Angelini, Martini, & Guidetti, 2003). Although there is some disagreement between definitions and assessments of compliance (Osterberg & Blaschke, 2005), there is a general consensus that compliance is a challenge in following a therapeutic regimen.

Low compliance to therapeutic diets can be attributed to a variety of factors including psychological, social, and practical influences. There have been over 200 variables examined in the study of compliance. Among the psychological factors: cognitive functioning, self-efficacy, readiness to change, personality, and motivation can all play a role. Social factors that can influence compliance include spousal social control, social support, demographics, physician-patient interaction, and lifestyle (eating at home versus restaurants or with friends). Lastly, there are significant practical issues with following medical diets: high cost, poor availability, poor palatability, and inaccurate or inadequate content information on the labels of food and drugs. Unfortunately, most variables examined, especially demographics, are inconsistently correlated with compliance and therefore provide little direction for improving compliance.

2.3 Health Belief Model

The Health Belief Model was one of the first theoretical models to explain and predict compliance (Rosenstock, 1966). The model outlines variables that help predict the likelihood of someone taking medical action. This social cognition model was derived from the work on "value-expectancy" approaches of decision-making by Lewin and colleagues (1944) and Atkinson and Feather (1966). The concept of predicting behaviour based on an individual's predictions of an outcome and the desirability of that outcome helped shape the Health Belief Model. The original elements of the model were, "(1) the threat posed by illness, comprised of the likelihood of its occurrence… (2) belief in the efficacy or value of a behavior in reducing the threat… and (3) estimates of physical, psychological, financial, or other costs involved in the proposed action…" (Becker, Maiman, Kirscht, Haefner, & Drachman, 1977, p. 350). Through evaluating an individual in these areas, the model was to predict the likelihood of that person taking recommended health action.

Originally the model focused on *health behavior*, meaning it was to be used in predicting likelihood of a healthy individual seeking preventative health services. It was not used to predict behaviours of people who are already sick and who have been prescribed a therapeutic intervention. In the years that followed, amendments were made to include general health motivations and to modify existing factors allowing the model to work with *sick role behavior*, meaning behaviors of people who are already sick and in treatment (Becker & Maiman, 1975; Kasl & Cobb, 1966). Becker and Maiman (1975) concluded after extensive review of research that the model was generally reliable and that, there were interpretable relationships between compliance and perceptions of susceptibility, severity, benefits, and costs. They developed a hypothesized model for predicting and explaining compliance behavior. See Figure 1.

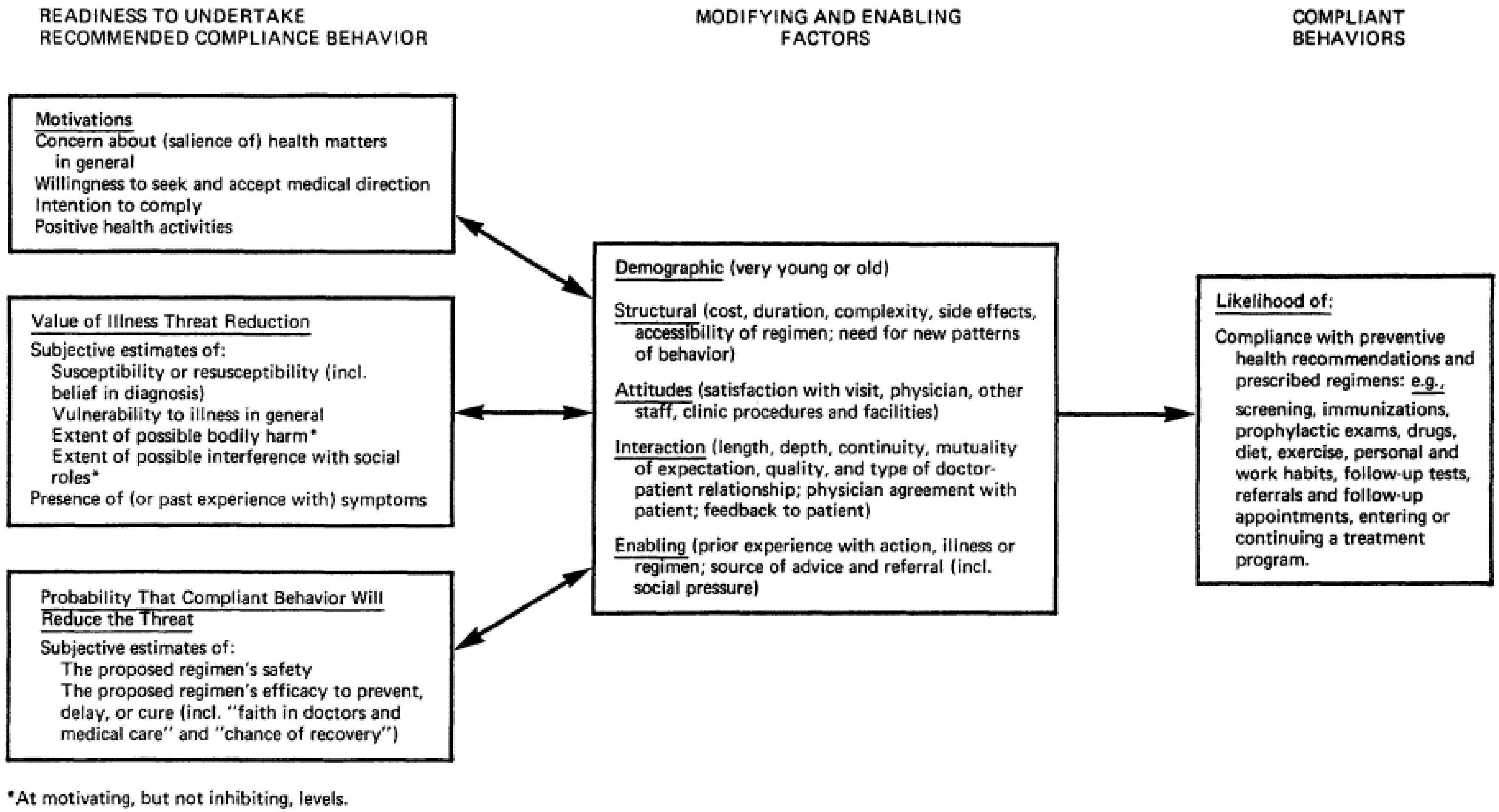

Figure 1. Model for predicting and explaining compliance behaviour. This was proposed as a hypothesized model to be used as a rubric for research on patient-related aspects of health-care and compliance. Reprinted from "Sociobehavioral determinants of compliance with health and medical care recommendations," by M. H. Becker and L. A. Maiman, 1975, *Medical Care, 13*, p.20. Copyright 1975 by Lippincott Williams & Wilkins Inc. Reprinted with permission.

The Health Belief Model became the theoretical framework for evaluating compliance in a variety of therapeutic interventions including diets. In 1977, Becker and colleagues used the Health Belief Model as the foundation for a study on juvenile obesity (Becker et al. 1977). As the experiment was on youth obesity, the parents or caregivers of the children were the respondents. The experimental groups received differing fear arousal interventions (intended to influence the motivations, perceived threat posed by illness, and perceived probability that compliant behavior will reduce the threat). Interviews and questionnaires were conducted at the beginning to gather information on variables related to: motivation, susceptibility, severity, benefits, barriers, and demographics. The outcome measures of compliance were the children's weight change on follow-up visits and on the clinic appointment-keeping ratio (a more general measure of the parent's compliance). The results supported the model. The high fear intervention had the most consistent, long term effect on the children's weight loss. Many of the variables outlined in the model were positively correlated with the children's weight loss and in keeping clinic follow-up appointments.

Another study using the Health Belief Model and therapeutic diets was conducted by Anson, Weizman, and Zeevi (1990). In this study, the parents of non-compliant children with celiac disease were interviewed on topics including: knowledge, attitudes, and dietary behavior. The results were compared to those of parents' of compliant children with celiac. Many of the variables measured in this study stem from the Health Behavior Model, including perceived threat of illness, perceived probability that compliance will reduce the threat, and the benefits and barriers to appropriately following the health action, in this case ensuring their child is gluten-free. Some of the significant results include parents of compliant patients felt sufficiently informed about the disease and were better at selecting gluten free items from a menu. This confirms the importance of knowledge and awareness of the condition is linked to compliance. Interestingly, the variable of worrying for the child's future was higher in parents of non-compliant patients. This refutes the findings from the previous study and the model's expectation that increased perceived threat leads to compliance. This may be related to the perceived barriers and benefits because the non-compliant patients' parents also found the diet to be much more difficult than the compliant patients' parents. Perhaps parents of compliant children find the diet easier and therefore are less worried about the future of the child.

Dietary compliance has proven challenging for many medical conditions. The Health Belief Model may prove to be a useful tool in predicting and explaining compliance rates of patients with therapeutic diets. The model "seems to describe satisfactorily the majority of findings" on health behavior (Kasl & Cobb, 1966, p.253). In 1984, Janz and Becker published a review of the experiments and findings related to the Health Belief Model and concluded that the review "provides substantial support for the usefulness of the HBM as a framework for understanding individuals' health-related decision-making" (p.36). More recently, Munro, Lewin, Swart, and Volmink (2007) reviewed the Health Belief Model along with other health behavior theories and found that the four dimensions of the model produced significant effects in most of the studies in the review, although there were a couple of criticisms. They describe the criticisms to be: 1) the relationship between the variables has not been spelt out and 2) there are a couple of missing factors (social influence and the positive effects of negative behaviours) that are important determinants of health behaviour.

Overall the model encourages the investigation of health behaviour change by considering the balance between barriers to and benefits of taking action. Variables including motivations (general health concerns, willingness to seek medical services, positive health activities, etc.), perceived threat posed by illness (susceptibility or re-susceptibility to illness, worry about the illness, seriousness/severity of getting sick), and perceived efficacy of the proposed health action (faith in doctors and medical system, perceptions of proposed regimen's efficacy, feelings of control) all contribute to the likeliness of taking action. The Health Belief Model provides a framework for studying health related compliance generally and should describe some of the variables relevant to compliance to therapeutic diets.

2.4 Making food safety decisions

When a therapeutic diet has been prescribed, the responsibility falls to the patient or patient's caregiver. It is up to that person to make decisions related to the medical regimen. Capacity is a necessary part of making food safety decisions. Generally speaking, capacity theory posits that we have a limited amount of mental effort to distribute across tasks, so there are limits on the number of tasks we can perform at the same time. Capacity can be considered in the areas of memory, vigilance, decision making, and reading, all imperative to following therapeutic diets.

Memory is divided into two categories: short-term memory and long-term memory. Short-term memory, or working memory, is a temporary store for information needed to accomplish a particular task. It has a limited capacity and decays quickly (Robinson-Riegler & Robinson-Riegler, 2004). Long-term memory has no capacity limits and can hold information from minutes to an entire lifetime (Reed, 2004). This information includes: semantic memory, which consists of knowledge and facts; procedural memory; priming; and memory of personal events. Long-term memory, with the help of working memory, allows for pattern recognition, language, problem solving, and decision making.

In order to follow a therapeutic diet, the tenets of the diet must be encoded and stored in order to be available for retrieval when a food safety decision is required. Attention, repetition and rehearsal are required for improved encoding and retrieval. Repetition refers to studying the diet guidelines more than once whereas rehearsal refers to how the diet is thought of or practiced internally. When a food safety decision must be made, both the working memory and the long-term memory are required. The working memory gathers information from a given product (for example the ingredient list off the product label) and holds it temporarily while the long-term memory has access to the stored guidelines of the diet for comparison.

Although long-term memory has no capacity limits, there is evidence to suggest that diets with fewer rules are easier to follow and maintain (Mata, Todd, & Lippke, 2010). Mata and colleagues found an increased risk of quitting the diet in cases where the diet was more complex (a greater number of rules). The study looked at the use of weight-management diets, as opposed to therapeutic diets, but the results may still be relevant. The more complex a diet, the more attention, repetition and rehearsal (effort) required to store the information in the long-term memory. Attention has been mentioned as an important factor to encoding, storing and retrieving information. Vigilance is a state of sustained attention used to detect and respond to certain target stimuli occurring at random time intervals in the external environment. According to Mackworth (1956), "in real life, the problem was to discover why people failed to notice and act on a signal which they were normally quite able to detect. Although they knew what they were looking for, they did not know when to expect this signal" (p.1375). This could explain why some accidental exposures occur; people know what to look for, but sometimes fail to detect it.

Vigilance is linked to making food safety decisions because once someone knows the rules of a diet and has them stored in their long-term memory, they need to stay vigilant in detecting and responding to foods that are prohibited. Vigilance describes when there is not a comprehension problem but instead an attention problem. The original studies of vigilance looked at inspection tasks in mechanical and medical workplaces but the concepts are transferable to following therapeutic diets. In those early studies, failures to perceive the stimulus could lead to poor performance or accidents (Fletcher & Oldham, 1949). The same can be said for medical diets; if a target ingredient is missed there is a risk of accidental exposures and health consequences. Therefore vigilance in reading food labels is very important to making food safety decisions.

"Decision making is a process of decision selection from available alternatives against the chosen criteria for a given decision goal" (Wang & Ruhe, 2007, p.73). In terms of making food safety decisions, it is the process of selecting only the food items that are safe and consistent with the tenets of the prescribed therapeutic diet. Strategies for making decisions fall into the categories of intuitive, empirical, heuristic and rational with some of the specific strategies including: experience, consultation, maximum utility (cost-benefit ratio), availability, and preference (Wang & Ruhe, 2007). These strategies can be employed in any decision making task as well as the process of choosing safe food items.

In the real world scenario of selecting safe food items consumers must decide if a product adheres to their therapeutic diet. They may decide to rely on previous experiences with that item (information encoded in long-term memory), or they may decide to consult the product's label to make a more informed decision. This decision is often a balance of costs and benefits of selecting an item. The costs and benefits can include the time it takes to make the decision and the consequences of a wrong decision (for both incorrectly selecting an unsafe item as well as wrongly avoiding a safe item). Other influential factors include the availability, cost and preferences of the food options.

Reading food labels is a necessary part of making informed food safety decisions. Once the principles of a diet are stored in the long-term memory, and the patient is vigilant about finding safe foods, they must make the decision to read the food label. Generally speaking, reading is an exercise in pattern recognition. A pattern of stimulation is encoded in the visual system and a corresponding representation is activated in semantic memory (Robinson-Riegler & Robinson-Riegler, 2004). Reading comprehension involves both the reader and the text. The reader's knowledge will affect comprehension, as will the organization of the text.

Most reading research focuses on how sentence and discourse organization affects comprehension. However, people read lists of ingredients when using food labels to make food safety decisions. This is a specific form of reading: visual search. In a visual search task, participants determine whether a target item is present among a set of distractors (Risko, Stolz, & Besner, 2005). While reading a food label, all safe ingredients could be considered distractors; all unsafe ingredients are the targets. Individuals must find the target ingredient (or ensure none are present) to be able to make informed decisions about the safety of that food.

2.5 The food label

The food label is an important tool when making food safety decisions. The label consists of product and brand information, nutritional facts, ingredient list, and sale information (Mackey & Metz, 2009). When a consumer is deciding whether or not to purchase a product, the product information (brand, product name, images, etc.) can be enough to trigger past experiences leading to decisions. If that is not enough, the nutrition and ingredient lists may provide adequate consultation information. If the label is well-designed, the time cost could prove to be worthy of a well-informed decision (benefit).

Food label formats have been improved in recent years based on research of understanding and preferences (Kristal, Levy, Patterson, Li, & White, 1998; Lando & Labiner-Wolfe, 2007; Levy, Fein, & Shucker, 1996; Mills et al., 2004). However, they are only effective if people are reading them thoroughly and consistently. This can be one area that causes challenges for patients following therapeutic diets. Sheth and colleagues (2010), in a study that looked at accidental exposures in food-allergic individuals, attributed a considerable proportion (approximately 84% of accidental exposures) to inappropriate labeling, failure to read the label or ignoring precautionary statements. This highlights the important role that the labels play in communicating information to the consumer.

Much of the research on food labels has focused on the Nutrition Facts panels' determinants of use (Satia et al., 2005; Wang, Fletcher, & Carley, 1995), ease of understanding (Campos et al., 2011; Rothman et al., 2006), and relationship with consumers' dietary intake (Kim, Nayga, & Capps, 2000; Kreuter, Brennan, Scharff, & Lukwago, 1997; Lin, Lee, & Yen, 2004; Neuhouser, Kristal, & Patterson, 1999; Ollberding, Wolf, & Contento, 2011). There has been considerably less research on the ingredient list component of food labels. Ingredient lists are often less prominent than other information and generally written in small type. The consumer has to find the ingredient list, which is often on the back of the packaging and then read through it thoroughly (Mackey & Metz, 2009). This makes consulting the ingredient lists effortful leading to a possible challenge in following therapeutic diets.

As food labels have been improved for both usability and preference, it is impossible to satisfy the needs of everyone. The food packaging serves a variety of purposes including advertising and branding, sales information, cooking instructions, in addition to content information (nutrition and ingredients). The label may not be helpful to individuals with different needs. For example, consumers watching sodium intake have different needs than someone looking out for a specific allergen. It is important to improve food labels and manufacturing processes, but it is also important to consider the consumer's role in selecting the proper products.

2.6 Familiarity with products

As mentioned above, there are a number of potential strategies for making food safety decisions. One of those is to utilize past experiences, knowledge, and familiarity. In the context of making food safety decisions for a therapeutic diet, familiarity develops through a series of actions and behaviours such as deciding a product is safe, purchasing it, bagging it, taking it home, putting it away, cooking it, and eating it. These experiences with the product lead to greater knowledge and familiarity with it. As such, when considering that same product in the future, the consumer has an internal representation which affects the decision making process.

When considering this same product on future shopping trips, there is now a memory trace of the item. The consumer may still choose to read the ingredient list and nutrition information, or he or she may now feel familiar enough with the product to purchase and use it without consulting the label. Relying on memory traces or familiarity with the product can save time and effort. Always reading the label and checking ingredients comes at a cost of both time and effort. Food safety judgements therefore reflect a balance between people's willingness and ability to read labels and their judgement about their prior learning.

Relying on memory can be a useful heuristic when making food safety decisions except in three different scenarios. First, if there was a mistake in the learning, the memory trace formed would be incorrect. Second, if the learning was correct, but the memory trace has been compromised, then future judgements would be incorrect. Lastly, if a product were to change its ingredients for any reason, then the properly learned memory trace would be misleading.

2.7 Food label changes

Food ingredients change regularly due to changing manufacturing processes, and ingredient availability and cost. Warnings about this are common on websites like Diabetes.org saying, “Don’t forget that ingredients in food products change frequently, so always check before you buy something” (American Diabetes Association, 2013). According to a popular website for people with allergy concerns, “Just because a product was safe the last time you purchased it doesn’t mean the ingredients have stayed the same! It is very important to read all labels all of the time” (FoodAllergy.org, 2013). Even large food manufacturing companies like Campbell’s Soup remind consumers, “Please keep in mind that product recipes change frequently and ingredients are periodically added and replaced. Therefore, I advise you to check the ingredient statement on each package to be certain that the product is still gluten-free …” (Campbell Soup Web Team, 2008).

If there is a product that a consumer knows to be safe according to their therapeutic diet, and the ingredients are altered, would that consumer notice the change? Although there are reminders to check and read ingredient lists every time a product is used, do people still check the labels? Are warnings like these enough to alter the behaviours of people with allergy or intolerance concerns? Are consumers able to identify the products that have changed? Consumers following therapeutic diets probably read labels of new items very carefully. They likely put in time and effort to ensure that a new product is safe and fitting with the diet. However, the likelihood to keep reading product information likely decreases with increased use and familiarity.

3.0 Rationale

The literature in the fields of food labeling and in allergies and therapeutic diets is extensive but nothing directly answers the questions at hand. Are people looking at food label ingredient lists every time? The answer is no. For a variety of reasons, consumers make the decision to not read the food label, even if they follow a therapeutic diet of some sort. It is believed this could happen in cases where the consumer has a familiarity or internal representation of a given product and its status (safe or not safe to consume). These individuals make a cost-benefit decision to read or not to read the ingredient lists. The balance is often between time and effort versus the consequences of not looking. To better understand label reading behaviour, a laboratory task was needed that would mimic label reading behaviour and eventually lead to this type of reading cessation. Once this was accomplished a variety of questions could be answered.

Primary Goal: To develop an experimental task that mimics real-world learned confidence in products resulting in no longer reading the ingredient lists. Could a scenario be created in which participants become confident or familiar enough with a particular product (or products) that they will make decisions on items without reading the ingredient list?

Secondary Goal: To explore label reading behavior and accuracy with some of the factors of the Health Belief Model. For instance, does a warning increase reading behavior or do knowledge or demographic characteristics affect behavior?

4.0 Thesis Framework

The framework for this thesis study incorporates a conceptual model developed by Dr. Josée Turcotte in her previous work, with alterations from pilot studies. With the help of research assistants, Dr. Turcotte created a database of food products which consisted of a product name and a list of ingredients. These could be altered as needed but would become the rudimentary "food labels" used in this study. The product name and list of ingredients could be presented on the computer monitor and the participant would have to search for a target word that determined the safety status of that product. For example, wheat was the target; if it was present, that product was not safe. The first task was to create a scenario in which participants would stop checking the ingredient lists of these labels. Pilot studies were used to fine tune the task before starting the thesis experiments.

Pilot 1: Originally, the computer screen presentation showed the participant the product name and coordinating list of ingredients. The participant conducted a search for the target ingredient and responded according to its presence in the list. Even after numerous repetitions, participants consistently referred to the ingredient list to make their decisions. It was decided that referring to the ingredient list was too convenient to risk being wrong. Additionally, the participants were never developing an internal representation of the product name. In many cases, the participants ignored the product name entirely and focused solely on searching for the target in the ingredient lists.

Pilot 2: In efforts to encourage the internal representations (memory traces) of the products and their statuses (presence of the target), the display was altered so that the product name would appear initially in large font, and after a short time delay the ingredient list would automatically be displayed below. Participants reported making connections between the product names and the status of the item but continued to check the ingredient lists before responding. It was still too convenient to not look at the ingredients.

Pilot 3: There was still a significant difference between the real world and the lab task; in the real world the consumer has to actively search out the ingredient lists – they are not available on the front of most products. To mimic this, the task was altered one more time. In this case, the product name was presented with the option to respond to the status of the item or see the ingredient list after enduring a brief time delay (imitating the turning over a product to find the ingredient list). The participants had these options on every repetition, for every product. Participants made strong connections between the product names and their statuses and they did eventually stop checking the ingredient lists.

These pilots and the main experiments were approved by The Research Ethics Board of Laurentian University.

5.0 Research Question

How do people perform repeated food safety judgements and what can be done to optimize their capacity to do so effectively?

6.0 Experiment 1

The first experiment focused mainly on the first two research questions: do participants stop reading the ingredient labels and do they make mistakes? Although this was investigated in some pilot work, the answers to these questions were not clear. First, the task of making food safety judgements carries an implicit demand to be accurate. On the face of it, the best way to be accurate would be to verify - to read the ingredient label. However, pilot data suggested that even people instructed to do so would have a tendency to stop. Second, the task of making a food safety judgement appears to be simple. It is clear that food labels are provided with the expectation that everyone literate in the population should be able to make correct judgements about ingredients given the label. This experiment is needed to evaluate how a university population actually behaves in this task.

Participants were told to treat wheat as an allergen. They were therefore to decide, for each food product presented, if it was safe (no wheat) or unsafe. Each product was associated with an ingredient list that could be accessed at each presentation. Participants could therefore choose, in analogy to the real world task, whether to trust memory or to consult the ingredients. It was therefore possible to study both the accuracy of food judgements and the willingness of participants to endure the time cost of rechecking the ingredient lists over repetitions.

6.1 Method

Participants. Participants for this experiment were recruited within Laurentian University by means of posters and classroom presentations (See Appendix A and Appendix B). Thirty-two undergraduate students aged between 18 and 36 years (mean age 21.2 years, *SD* 3.33) took part in this study. There were 27 women and 5 men. Subjects participated in exchange for course credit or a chance to win a raffle for a 25$ Aramark dining card for the university dining hall.

The primary component of this experiment was the computer based task. Using E-Prime 2.0, a program was created in which mock food labels were displayed on a monitor and responses were made by the participant using a standard keyboard. The E-Prime program records information on keyed response, accuracy, and reaction time.

Stimuli. The *label* was extremely basic in an attempt to keep this set of experiments simple and controlled. There were a total of 30 food labels used in this study; each consisted of a product name (for example, “Sweet Fritters”) and a coordinating list of ingredients (for example, “cinnamon, eggs, salt, caster sugar, butter, wheat, oil, milk, apple puree, allspice”). The products and corresponding ingredients are based loosely on real-world food items but simplified so only simple ingredient names were used. The product name is in large black print (bold, courier new, size 40), horizontally centred on the top third of a white backdrop. In cases where the ingredient list is shown, the product name is presented in the same way, with the ingredient list in small black print (bold, courier new, size 7) just below (See Figure 2). To counterbalance for product effects, two versions (A and B) of the program were created. For the fifteen products that were positive for wheat in version A, were negative for wheat in version B. Left handed participants had the response keys reversed so the positive responses were again made with their dominant hands.

A socio-demographic questionnaire asked of the subjects’ age, gender, handedness, and years of schooling. A health questionnaire covered the subjects’ current health status, vision, and need for therapeutic diets. Lastly, a post-experimental questionnaire asked questions about food label usage, knowledge of allergies and therapeutic diets, and their thoughts on their performance during the computer task (For examples of questionnaires, See Appendix D).

Procedure. For each participant, participation consisted of one 60 minute session. After consent was provided (See Appendix C), participants were led to the computer booth to complete the task. They were told to make decisions about safety (safe or unsafe) regarding food products for "a friend" who can't eat wheat who was coming for dinner. They were told to imagine they were cooking dinner for the 'friend' who has an allergy to wheat and that if they served the friend dinner with wheat in it, he or she would get very sick.

They were then presented stimuli showing a product name without its ingredient list, consistent with the front of most food packages. They had the option to respond with "safe," "unsafe" or "unsure" by using corresponding keys on the keyboard[1]. In order to see the ingredient list and look for wheat, the participant had to choose "unsure". This generated a time cost (1000ms). The time delay is intended to mimic the turning of a container to locate the ingredient list in a real-world situation. Following the time cost, the ingredient list would be presented under the product name and the participant would respond with "safe" or "unsafe". The process would then repeat with another product name presentation. However, if the participant chose to make their decision without looking at the ingredient list, they would respond with either "safe" or "unsafe," on the initial display (See Figure 2). In doing so, they skipped the ingredient list (and time delay) and instead were presented the next trial which consisted of a new slide with another product name presentation and the three response options. The 30 products (half positive for the target and half negative) were displayed a total of 15 times each and selected at random. Short breaks were provided after every 110 trials so participants could rest.

[1] For a right-handed participant, the letter D was "Unsafe," the letter K was "Safe" and the space bar was "Unsure." For the left-handed participants, the letter D was "Safe," the letter K was "Unsafe" and the space bar was "Unsure." The intention was to allow for the dominant hand to correspond with the same response.

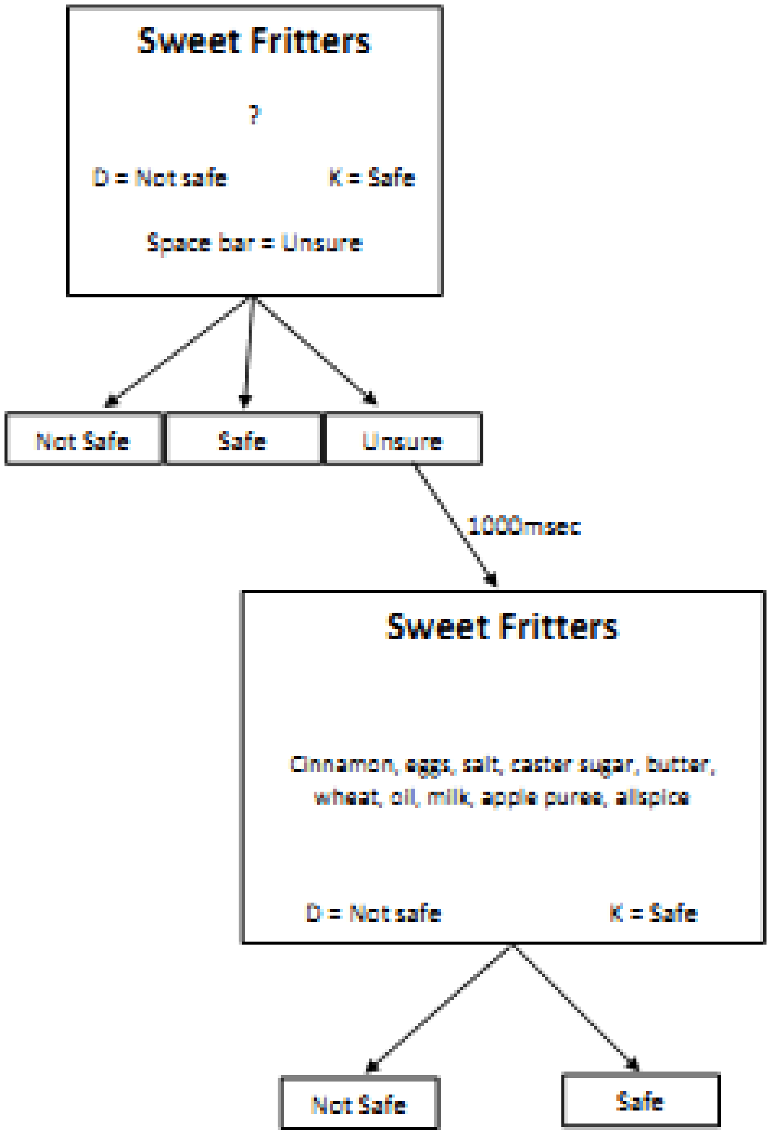

Figure 2. Examples of product displays and procedural flow. This figure illustrates how the product labels are displayed to the participants without the ingredient list and with the ingredient list. The chart also illustrates the experimental flow in responding to the product labels.

The questionnaires were completed following the computer based task. The socio-demographic, health, and post-experimental questionnaires were completed via a structured interview.

6.2 Results and Discussion

Reading Behaviour – Do participants stop reading the ingredient lists?

Reading behaviour was investigated by considering whether or not participants consulted the ingredients before making safety judgements. Presumably, participants choosing to read the ingredient list are reading for the target. When participants respond without looking at the ingredient lists, they are either relying on memory of past presentations of that item, or are taking a guess. In pilot work participants were generally willing to endure the time cost of double checking each of the products for the target ingredient.

However, participants chose to respond without looking at the ingredient lists in 66.1% of the trials. On average, participants clearly stopped reading the ingredient lists. To analyze the change of behaviour over time, average reading percentages were aggregated over Blocks of 50 targets. The overall ANOVA reflecting a change over time $F(8,31)=60.94$, $p < .01$, was dominated by a linear decrease (over the subsequent Blocks of 50 trials) in the number of product ingredient lists read, $F(1,31)=137.63$, $p < .01$.

In real terms the average participant consulted the ingredients before making a food safety judgement about 70% of the time in the first Block, and this diminished to about 15% of the time by the end. See Figure 3 for an illustration of this trend.

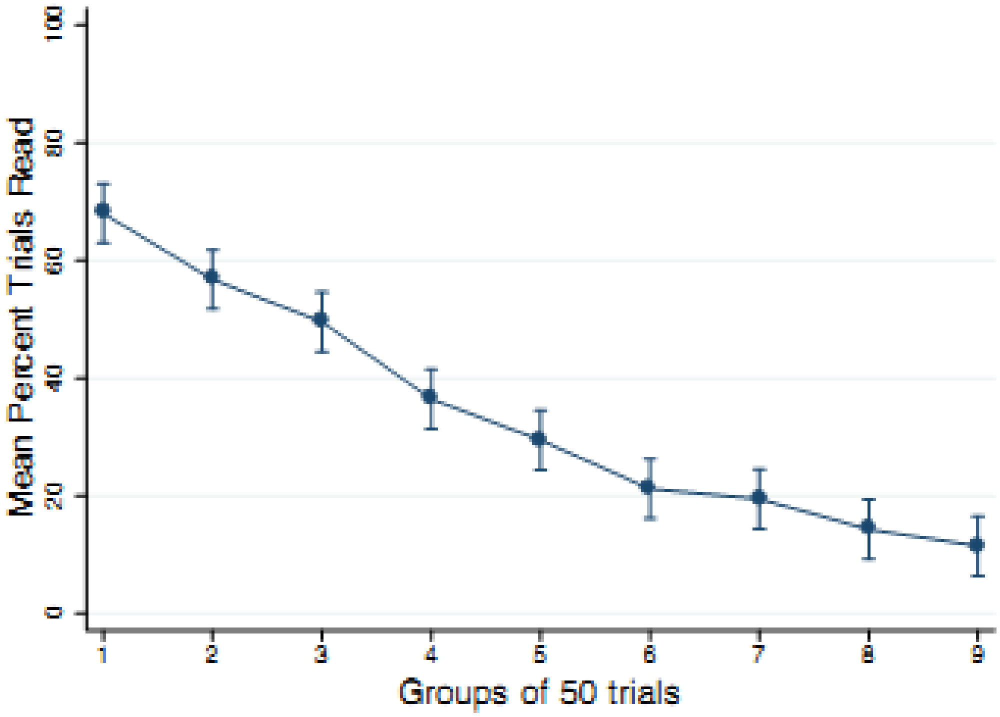

Figure 3. Mean percentage of trials read over time. The "Blocks" indicate the groups of 50 trials. For example, Block 1 is trials 1-50 and Block 2 represents trials 51-100 etc. The figure shows 95% confidence intervals.

Participants were much more likely to look at the ingredient lists (and endure the time cost) when they were shown a product for the first time whereas on the 15th presentation, the participants were much more likely to make their safety judgement without looking at the ingredient lists. This suggests that participants were either guessing, or (much more likely) relied on their memory trace of that item from the previous presentations. There was also a quadratic trend indicating that the trend does level out over time $F(1,31)=19.956$ $\eta^2=0.392$.

There are individual differences in terms of how often participants were willing to read the ingredient lists. This range is extreme with one participant reading 95.8% of the trials and another participant reading only 1.2% of the trials. These two participants demonstrate the huge individual variability in reading behaviours in this task. The distribution of average percentage of guesses is shown in Figure 4. To determine if the results were skewed due to the participants at the extreme ends of the range, analyses were done with and without them. The results did not change. As such, all of the participants' results were included for analysis.

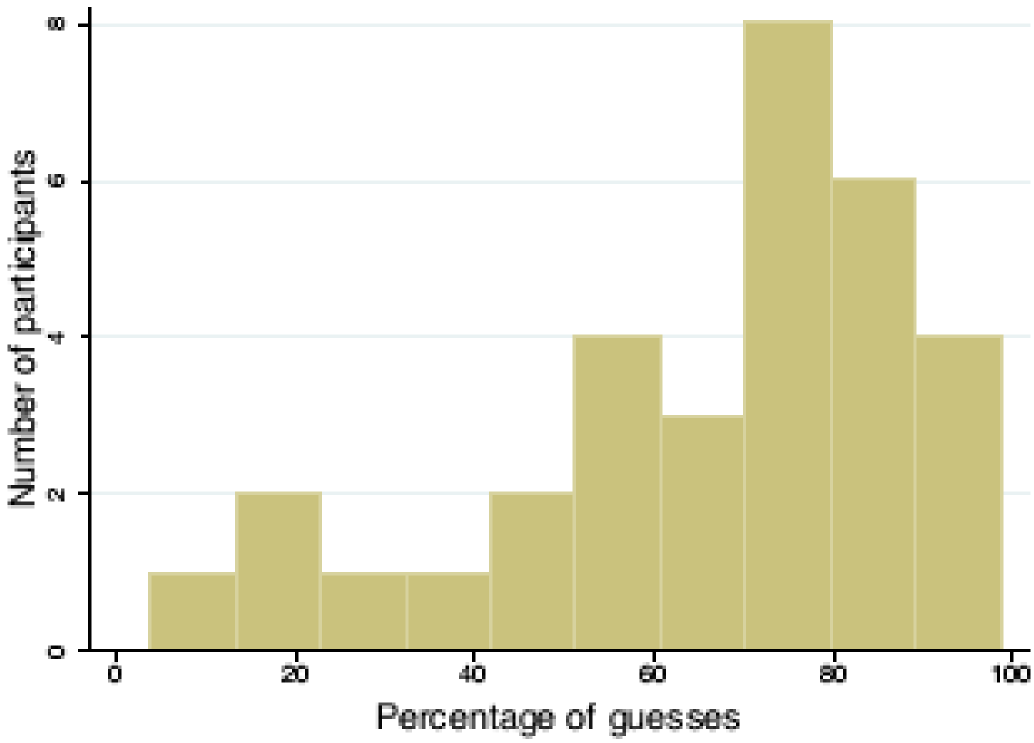

Figure 4. Food safety decision without reading (%). This figure illustrates the variability of participants' reading behaviours. On average, participants "guessed" (responded without reading the ingredient list) 66% of the trials (Std. dev. = 24.192).

Based on pilot studies, participants were expected to eventually stop reading the ingredient lists however, it was surprising to see how rarely the product ingredients were sought out. In the second experiment an attempt was made to increase this reading behaviour.

Accuracy – How good are participants at identifying the target ingredient?

One major prediction was that accuracy should be perfect or at least reach perfection by the end of the presentations. Participants always had access to the ingredient lists to confirm the safety of the product and this should have reached 100% accuracy by the last presentations of each item. It is understandable for mistakes to be made early on in the experiment but by the end, after many repetitions, accuracy at the end of the experiment should be 100%.

The average accuracy scores for the final five presentations of each product were less than 100%. Similarly to the results with reading behaviour, the accuracy scores vary among the individuals. The scores range from 59% to 99% with a mean of 90.2% with a standard deviation of 8.44%. This may mimic the real world where certain individuals are extremely cautious, carefully reading all food labels, while others rarely take the time to do that.

Reading Behaviour – Accuracy Relationship – What is the relationship between percentage of times the ingredients are looked at and final accuracy scores?

In order to gain a better understanding of how reading the ingredient lists affects the accuracy of identifying the target, a scatterplot was created showing this relationship. See Figure 5.

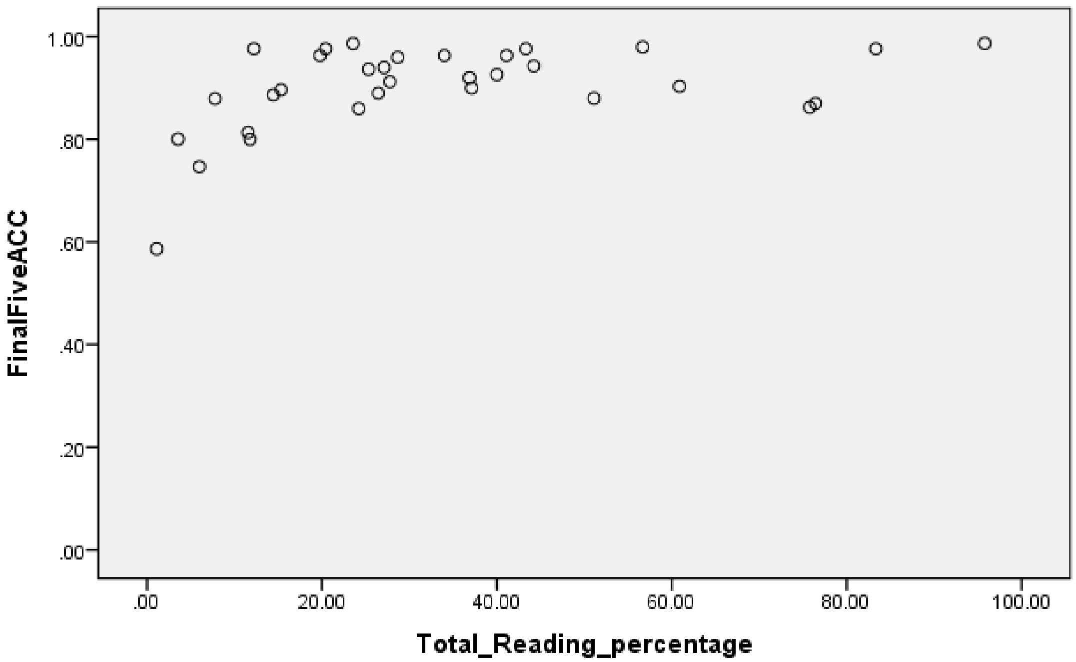

Figure 5. The relationship between participants' reading behavior and accuracy. This figure illustrates where each participant falls in this relationship. This scatterplot suggests that the percentage of trials read does not necessarily affect accuracy. Even participants reading only 20% of the trials were able to reach the same level of accuracy as someone who read 95.8% of the trials.

Individual differences are evident here. Some participants were able to get relatively high accuracy scores when reading only 20-30% of the time. The correlation up to 30 Total Reading Percentage is very high, r = .71, $p < .01$; this is quite different from the correlation from 30 to 100 Total Reading Percentage, r = .10, $p = .73$. Reading the ingredient lists every single time was not necessary for achieving high accuracy scores. At least this was the case for food products that never had ingredients change.

7.0 Experiment 2

The second experiment in this thesis allowed for the opportunity to more completely explore the research question: does the presence of a warning or reminder affect behaviour, do participants notice changed items, does nutrition knowledge affect reading behaviour and do any of the tested demographic or health questions show a relationship with reading behaviour? By keeping the general method similar to that used in the first experiment, the second experiment also provided replication for the first.

Experiment 2 followed the same procedure as Experiment 1 with the addition of a warning that products may change in order to investigate the impact of a warning in this lab scenario, with an additional Block during which some products did change their status. A nutrition knowledge questionnaire was also added.

7.1 Method

Participants. The subjects for Experiment 2 were recruited in the same way as Experiment 1 (posters and classroom presentations around Laurentian University). Thirty-two undergraduate students who did not participate in the first experiment took part in this study. They ranged in age from 18 to 28 years (mean age 21.4, *SD* 2.20). There were 24 women and 8 men.

Stimuli. The stimuli for Experiment 2 were identical to those of Experiment 1.

Procedure. The general procedure was the same as in Experiment 1 except for 2 changes. First, a warning that food products may change throughout the experiment was added to the instructions. The warning came in the form of one additional ‘slide’ in the instruction component of the computer program and it looked just like those that preceded it. Second, repetitions were added (from 15 repetitions per product to 20) in which some of the products did change (from safe to unsafe and unsafe to safe). For the added repetitions, the same 30 products were used along with the same target ingredient, wheat. This means that instead of 450 trials (15 repetitions X 30 products) as in Experiment 1, Experiment 2 had 600 trials (20 repetitions X 30 products). For the first 15 repetitions of each product, the experiment ran exactly as it did in Experiment 1. After this Block of 450 trials, the subsequent set of 150 trials ran seamlessly. Within those last 150 trials, 6 products change their status. Deciding to change 6 products came from not wanting to have too many changes at once, as it is unrealistic and would raise suspicion but not having too few to analyse either. Three products that were safe (no wheat present) became unsafe (wheat was added to the ingredient list) and three products that had been unsafe were changed to safe (wheat was removed from the ingredient lists). This provided an opportunity to see how many participants would notice the changes after having a familiarity with the products. Otherwise the instructions and procedures were as per Experiment 1.

7.2 Results and Discussion

Reading Behaviour – Do participants stop reading the ingredient lists?

Block 1

Reading behaviour was examined in the same way as in Experiment 1. The goal was to find out whether or not participants would stop looking at the ingredient lists, even when they have been warned that the products might change. The majority of participants again stopped reading ingredients. On average, participants read ingredients on only 46.59% of the comparable first 450 trials. Similar to Experiment 1, the range for reading behaviour was extreme with a participant who didn’t read a single ingredient list to someone reading 98.44% of the trials.

Block 2 - Changing items

The extended set of trials included 3 items changing from being unsafe to becoming safe, and 3 becoming unsafe that had previously been safe. The reading behaviour for this set of 150 trials is consistent with the reading behaviour at the end of Experiment 1 and the end of Experiment 2, Block 1. The average percentage of trials with ingredients being read by the participants is 16.42%.

Warning Effect – Did the warning in the instructions change participants' reading behaviour?

The warning slide addition was intended to replicate the warnings consumers, following therapeutic diets, get from their doctors, nutritionists, support groups, websites etc. In order to see if the reading trends were different as a result of the warning slide, the probabilities of reading the ingredients over time for each experiment were compared. See Figure 6.

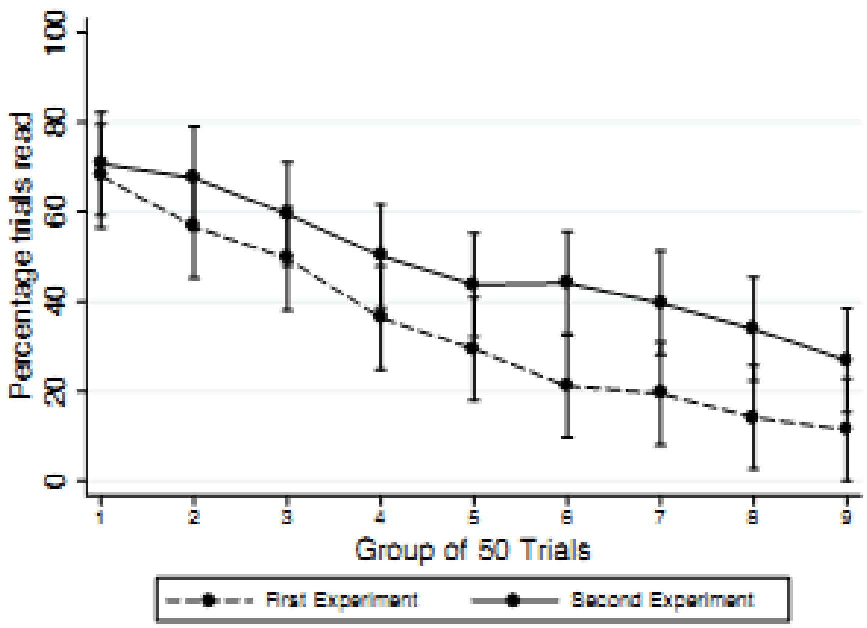

Figure 6. Reading behaviour differences caused by having a warning. This figure shows Experiment 2 (Red) as having a higher probabilities of product ingredients being read than in Experiment 1 (Blue) over the length of the experiments. The total number of trials has been broken down into 9 Blocks of 50 trials.

In Experiment 2, there is slightly more reading taking place, $F(1, 62) = 3.915$, $p = 0.052$. However, it was found that the linear trends for both experiments are the same, $F < 1$. That is, the reading behaviour is decreasing over time at more or less the same rate suggesting that the presence of an explicit warning that products might change had, at best, only a temporary effect.

Accuracy - How good are participants at identifying the target ingredient?

Accuracy for the second experiment was calculated in the same way as in Experiment 1. Only the accuracy for the final five presentations in the first 450 trials is used to be comparable. Accuracy for the remaining trials in which some items changed will be discussed in the next section as a sign of change detection. The accuracy scores varied among the individuals. The scores ranged from 61% to 100% with a mean of 85.6% (*SD* 10.87%). An independent-samples t-test was conducted to compare the accuracy scores in Experiment 1 and Experiment 2. There was not a significant difference in the scores for Experiment 1 ($M=0.90$, $SD=0.09$) and Experiment 2 ($M=0.86$, $SD=0.11$); $t(61)=1.90$, $p=0.062$. The results suggest that the accuracy scores are similar between the two experiments.

Change Detection – Were participants able to identify and correctly respond to changing products?

In order to test participants' abilities to correctly respond to changing items, accuracy scores were computed in Experiment 2, Block 2. Accuracy scores are shown in Table 1.

Table 1.
Accuracy scores for the change detection component of Experiment 2 (Block 2)

	No Change Mean (SD)	Change Mean (SD)
Reading (N=30)	.93 (.09)	.31 (.40)
Not reading (N=27)	.83 (.12)	.17 (.21)

Note. This table shows the descriptive statistics for the accuracies in the changed and not changed items in Experiment 2, Block 2. The data was split according to whether or not the participant was reading at the time of the safety judgement.

By the time Block 2 began, the probability of participants continuing to read is quite low. Additionally, there were only six changed items. For these reasons the groups are not evenly balanced making an ANOVA unreliable. Regardless, the descriptive statistics clearly show that for the items that did not change, average scores were relatively high but still not perfect. In cases where the product did change, the accuracy scores are much lower, understandably. Interestingly, even in cases where the participant is looking at the ingredient lists, accuracy is not perfect. This is especially true in cases where the participant was looking at a changed item (see the result in the top, right section of the table). The low accuracy here indicates a block to the search task suggesting that after multiple repetitions with the same item (building a familiarity), the participant may become desensitized to noticing a change even when “looking” at the ingredient list.

Nutrition Knowledge – Is nutrition knowledge related to label reading behaviour?

According to the Health Belief Model, knowledge or perceived susceptibility and seriousness of a condition predicts likelihood to take health action. With that in mind, would there be a possible relationship between nutrition knowledge and food label reading behaviours? In order to study this, the Nutrition Survey, developed by Parmenter and Wardle (1999) was used to collect nutrition knowledge scores. The survey is comprised of four categories: dietary recommendations, sources of foods/nutrients, choosing everyday foods and diet-disease relationships. One way ANOVAs were performed to compare the components of the survey to reading behaviours throughout the experiment. Participant results were divided into those with relatively high and relatively low nutrition knowledge and excluding those with food allergies. No significant relationships were found.

Demographics – Are there personal characteristics related to reading behaviour?

Demographic variables are inconsistently correlated with aspects of compliance. One way ANOVAs were performed using the responses to the demographic questionnaire, health questionnaire, and post-experimental questionnaire along with reading behaviour. Personal characteristics (age, gender, handedness, and education) had no significant relationship to reading behaviour. Additionally, none of the health questionnaire responses were significantly related (wear glasses, have health conditions, follow a diet, know someone on a diet, everyday use of food labels).

There were however significant findings from the post-experimental questionnaires. There were three questions that correlated to reading behaviours and these questions address the participants' judgement of their task performance. The questions with significant results were:

Did you focus on accuracy, speed or a combination of both? Did you ever get to a point when you felt confident making decisions without reading the ingredient lists? And *How careful were you in identifying safe or unsafe items?*

First, when asked whether they focused on accuracy, speed or a combination of both, participants mostly said both (66%). There were 3 participants who said speed was their main focus. These responses were somewhat surprising since there were no time limits or restrictions placed on the task. Participants were encouraged to be accurate, not fast. One way ANOVAs suggest that how participants responded to this question was significant for the first 2 Blocks (the first 100 trials) of the experiment, $F(2,63) = 4.659$ $p < 0.05$ and $F(2,63) = 3.174$, $p < 0.05$. There was no difference in reading behaviour for the remaining Blocks. This suggests that, whatever the cause of this decision, it did not have a long term impact in how they actually behaved.

Second, the participants were asked if they ever got to a point in the experiment when they felt confident making decisions without reading the food label; 97% said yes, they had. Two participants said they never reached confidence in responding without looking at the ingredient lists. In both of these cases, they read in over 90% of the trials. Compared to the average of 33.9% of trials being read, these participants seem correct in their judgement. However, they did not exhibit perfect performance either.

Finally, participants were asked how careful they had been in identifying safe and unsafe items. They could respond using a Likert scale of 1 being Not Careful at all and 10 being Extremely Careful. The average response was 7.3 (Std. dev. 1.25) with the range between 4 and 9. There were two participants who responded with a 4 on the scale; one participant read in 12% of the trials and the other read in only 1% of the trials. Their reading behaviour seems to coincide with their responses to this question. Comparing those who self-identified as being more or less careful than the average, the more careful readers did read more often than the others over the first 250 trials, $F(5, 63) = 3.606$ $p < 0.01$. For the remaining trials no difference was noted, $F < 1$.

8.0 Conclusion

Two experiments were conducted to investigate label-reading behaviours in a laboratory setting. These experiments assessed how often participants would read the ingredient lists for the same products, how accurate they were at making safety choices based on a particular criterion, the effect of warning participants of changes, and the ability of participants to properly respond to changed items. These experiments represent a first attempt at exploring accidental exposures caused by changing ingredient items, a real-world problem. The major findings related to the research questions, limitations, and directions for future research are discussed below.

Reading Behaviour. In both experiments, participants tended to rely increasingly on their memory across presentations. There were participants who were reading almost every time but there were also participants who rarely read. This range is extreme with one participant reading 95.8% of the trials and another participant reading only 1.2% of the trials. There is nothing in this study which can explain this kind of range. The correlation between reading percentage and final accuracy for those reading up to thirty percent of trials suggests two things. First, that above a certain threshold of reading there are no further gains. The results for those reading more frequently establish the point that accuracy is not perfect despite additional reading. However, in the range of the correlation the improvement is dramatic. This suggests that real world nutrition education can benefit from up to about ten repetitions of looking at a food label, and that when learning, more repetitions may be more important than almost anything else up to this point. However, in the real world, the repetitions would take place over a longer period of time (with weeks passing between shopping trips and product usage). It is unclear how these results would compare to the real world in this regard. It does appear that some participants were able to form strong memory traces of the products with very few readings, others chose to read in most of the trials. Causes for increased reading could include weaker memory traces or perhaps less risk-taking in their personalities. Based on pilot studies discussed above and the variables from the Health Belief Model (Rosenstock, 1966), more reading was expected to take place than there was. Future studies may include measures of IQ or GPA for a greater understanding of how capacity affects reading behavior.

The main variables in the Health Belief Model that predict compliance are the perceived threat of the illness, the cues to action, and the perceived cost/benefit of acting. These are the areas that tend to lead to compliance (Becker & Maiman, 1975; Rosenstock, 1966). In other words, these are the factors that motivate patients to be compliant. In these experiments, the motivators may have been too weak. Due to the hypothetical nature of the dinner party with an allergic friend, the perceived threat would be low. This also relates to the perceived cost and benefit decision. Since the scenario is hypothetical, the consequences of the decision to read or not read the ingredient list are not real. Therefore the cost of using time and effort to read the ingredient lists may not have been balanced with benefit. However, there is a real world compliance problem as seen in patients with celiac disease and diabetes (Fera et al., 2003; Peyrot et al., 2005). This real world problem was the model for this task. The results from the experiments are consistent with what is happening with patients and it is not necessarily just a question of motivation.

Accuracy. The accuracy scores in these experiments were lower than one might predict based on the apparent simplicity of the task. Considering that participants always had the ability to check the ingredient lists, accuracy scores should be able to reach perfection. Practically speaking, however, people are not perfectly accurate even when making simple judgements. A 15% error rate, as seen in the second experiment, would lead to many inadvertent exposures. The question is, what is the cause of these errors? One thing to highlight is the implicit cost-benefit trade-off in the task. Participants were willing to give up accuracy to save time. This is quite likely occurring in the real world, where the time and effort of label reading could be higher. As the research indicates, accidental exposures are often linked to not reading or misreading the food labels (Sheth et al., 2010). This is certainly consistent with these results. After repetitions with a product, participants made the decision not to read the ingredient lists. This occurred even in cases where the memory trace was incorrect, so the safety judgements continued to be wrong.

This raises questions about how the clinical population would compare to these participants. Although, as discussed, the motivation may not have been strong enough to sway the cost/benefit decision to read the ingredients every time, the issue of capacity is less of a concern with students than with the clinical population. These students are good readers and learners, and are academically highly motivated. Additionally, by having only 1 target ingredient, easy access to the ingredient list, simple ingredient names, no distractions, and no time limits, the task is as easy as possible. This is not the case in the real word. On top of greater challenges to the scenario, capacity can be a problem for the clinical population who is often older, generally less educated, and who may have cognitive reductions due to their medical condition.

Warning as a Cue to Action. Physicians, dieticians, nutritionists, and support groups all stress the need to always check food labels before consuming a product. This is in response to ever-changing products and recipes. In the second experiment, a warning that products may change was used as a ‘cue to action,’ a concept taken from the Health Belief Model (Rosenstock, 1966). The idea was to remind participants it is important to always check the ingredient lists, as health care workers and support groups do in the real world.

It was hypothesized that this reminder would significantly change the reading behaviour of the participants. Although there was marginally more reading taking place in the experiment with the warning, the effect was small and temporary; reading behaviours decreased over time as they had without the warning. Clearly, reminding people to always check food labels is not a very effective strategy for increasing reading behavior and accuracy.

Changed Item Accuracy. One of the most important findings from the study is the surprising result that for products seen many times before, a change can go unnoticed, even when the participant is looking right at it. This reiterates that simply reminding patients to always read labels is not a good enough strategy to keep them compliant. Even when they are looking at a changed item, they may miss seeing the difference. This could account for some of the accidental exposures. Unfortunately, even the most diligent label checkers could be missing changes to the label as accuracy when reading is less than perfect – and there is certainly a possibility of interference from previous responses to the same item. In these cases, capacity (specifically), vigilance, and reading prove to be more important than motivation.

Nutrition Knowledge and Demographics. Questionnaires were administered to evaluate the potential relationship between participants' traits, nutrition knowledge, and their reading behaviour. There was little of significance. As is the case in other studies, "demographics have been shown to be poor predictors of compliance" (Stockwell Morris & Shulz, 1992, p. 287). However, this stands in opposition to the Health Belief Model, which would suggest that demographics are relevant. Also mentioned in the Health Belief Model was the importance of perceptions of the seriousness and susceptibility of an illness (Rosenstock, 1966). It was hypothesized that a better understanding of nutrition and food may be indicative of perceptions about food related therapies. This proved not to be the case. Perhaps a general knowledge of nutrition is too far removed from therapeutic diet knowledge to impact compliance, or in this case reading behaviour and accuracy.

The only items that showed some significance were related to the participants' self-report of care for accuracy and judgement of their learning the experiment. Participants were asked to reflect on how they performed in the experiment – 'How careful were you at identifying safe items?', 'Did you ever reach a point in the experiment when you felt comfortable making decisions without reading?' and 'What did you focus on: speed, accuracy or a combination of both?' The responses to these questions speak to motivation and judgements of learning. The responses to these questions were related to the participants' results in accuracy and reading behaviour. The participants' judgement of their performance on the experiment was somewhat accurate. One can then suggest that as new education programs are being developed, a focus should be on encouraging appropriate and beneficial attitudes about food safety verification.

Future Directions. The findings in this thesis raise new areas of interest for future investigations. First, running these experiments with a clinical population could prove informative and valuable. Using participants who follow therapeutic diets will provide a better understanding of the reading behaviours in the actual population of interest. Although motivation may be higher in this population, capacity may prove more influential and therefore, the clinical participants are likely to read less often and, potentially, have lower accuracy scores than the student population used here.

Second, it is important for doctors, nurses, nutritionists, dieticians, support groups etc. to understand that simply reminding patients/clients to always read food labels is not enough. Even the most motivated label readers have shown to be limited by capacity. New strategies should be developed and utilized that are more effective. Whether increasing fear-arousal to improve compliance as Becker and colleagues (1977) did or developing a smart phone app to scan product labels would be more useful, new approaches are needed. The observation that accuracy was well below ceiling even when ingredient lists were read suggests that depending on motivation to read labels is not enough.

Finally, there may be other participant traits and characteristics worth studying in relation to compliance and willingness to re-read food labels. For example, the lab is currently exploring the relationship between risk-taking behaviours and food label reading behaviour. To study the effect of motivation in this task, one proposal has been to reward correct judgement responses and penalize incorrect ones, financially. Lastly, developing an experiment that compared judgement of learning and label use could prove insightful. Using the Health Belief Model as a guide, there are many areas to study in the endeavor to improve reading behavior and accuracy in food safety decisions.

These experiments represent a first attempt at exploring accidental exposures caused by changing ingredient items. The goal was to mimic the real world scenario of label-reading cessation through product familiarity. These experiments provided insight into how often participants would read the same ingredients, how accurate they were at making food safety decisions, the effect of warning about changes, and whether participants notice a changed item. Future research opportunities have been identified and a framework for those studies has been outlined. Since this work was done with a specific population and a particular food safety challenge the results should not be expected to specifically generalize to all food safety situations. For example, highly specific rare allergens like peanuts may lead to different patterns of results. Highly complex cases, such as sodium limited diets (adding calculation rules on top of a large list of potential targets) probably have even worse outcomes. However, the basic findings of less than ceiling accuracy and a strong tendency for people to stop reading ingredient lists over time should be a concern for those designing education programs for therapeutic diets.

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APPENDIX A – Recruitment Poster

Centre for Research in Human Development
Centre de recherche en développement humain

PARTICIPANTS NEEDED!

Repeated Readings of Ingredient Lists of Food Labels

Conducted by Dr. Turcotte and Jessie Gardiner

As a participant in this study, you would be asked to :
1) read and respond to ingredient lists presented on a computer screen
2) complete 1 short questionnaire

The experiment takes less than 1 hour of your time.

At the end of each study, a dining card of 25$ for the Laurentian facilities will be raffled off.
(Only available to those not receiving course credits for their participation.)

Would you be interested in participating in this study and maybe win the gift certificate?
Contact us to get more information!

This study has been reviewed by and received ethics clearance through the Research Ethics Board, Laurentian University.

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APPENDIX B – Classroom Recruitment Script

Hi, my name is XXX. I'm a research assistant / graduate student in the psychology department at Laurentian University. I am working with / doing my Master's Degree with Josée Turcotte and we are currently conducting a research project on reading labels. I am here today to recruit participants for this study. The experimental session will last about 1 hour during which we will ask you to complete a computerized task. The main objective of this experiment is to mimic real-world behaviours in reading food labels.

By participating in this study, you can receive bonus marks for one of your classes (if this is available) OR if your class does not have this option, you will have a chance to win a gift certificate of 25$ for the Laurentian dining facilities. At the end of each study, this will be raffled off to one of the volunteers who did not receive class credit.

Would you be interested in participating in this study?

More details about the actual experiment will be given when you come to the lab to do the experiment. Do you have any questions?

I will circulate a sheet of paper on which you can write down your Laurentian e-mail. I will contact you to give you more information and to make an appointment if you are still interested in taking part. If you would prefer, you can copy the e-mail address for the Cognitive Health Research Laboratory and contact us. Please be sure to ask about the "Food Label Reading" experiment.

Appendix C – Consent Form

LaurentianUniversity UniversitéLaurentienne

Centre for Research in Human Development
Centre de recherche en développement humain

Study Purpose: An Investigation of Memory Processes involved in Reading Ingredient Lists

Main Investigators: Josée Turcotte, Ph.D., Jessie Gardiner (student)
Other Investigators: Bruce Oddson, Ph.D.

I am a student in the Department of Human Development at Laurentian University. I am particularly interested in examining the relationship between memory and reading behaviours while looking at ingredient lists of food labels. When following diets for therapeutic or medical purposes, reading ingredient lists becomes very important to staying safe and healthy. Therapeutic diets may be prescribed in response to a number of health-related conditions including allergies, diabetes, or autoimmune diseases like celiac disease. There is a lot of research being done to develop optimal food label formats to improve consumer understanding and satisfaction. So far, very little research has been done on how memory and reading behaviours affect detection of harmful ingredients.

This study has been designed to investigate this relationship. A computer program has been developed to aid in this investigation. If you choose to participate in the experiment, you will be asked to execute tasks on a computer. You will be shown a target ingredient (wheat) which is a common food allergen and asked to make decisions about various food products. You will have to decide if the products are safe or unsafe for someone allergic to wheat. After the experiment, we will ask you to complete a short questionnaire pertaining to your health, your education, your knowledge about therapeutic diets and your impressions of the study. If you have any questions, the experimenter will tell you more about the study at the end but will not present your results to you.

Your participation in this study is strictly voluntary and will take less than an hour of your time. Please be aware that you are free to withdraw from this experiment at any time without penalty; moreover, you may refuse to answer any questionnaires without penalty. Participation in this study poses minimal risk and every effort has been made to ensure your comfort in this study. If you find the task too tiring the experimenter can arrange a break. During the entire experiment, we ask you to do your best.

Any personal information acquired during this study will be confidential and this information will be secure at all times. You will be identified with a code. Individual results will not be identified in any reports, publications or presentations of this study; only group results will be presented.

Study results will be made available as of January, 2013. If you are interested in obtaining these results, you may contact Josée Turcotte at (705) 675-1151, ext. 4238. Data will be kept for 7 years locked in the lab.

I agree to participate in this project and confirm that I have received a copy of this consent form.

Name: ____________________ Signature: ____________________ Date: ____________________

If you have any questions or concerns about the ethics of this study, you can call the Research Officer, Jean Dragon, at (705) 675-1151, ext. 3213 for information.

APPENDIX D – Post Experimental Questionnaire

SOCIO-DEMOGRAPHIC QUESTIONNAIRE

Subject number : _______________

Today's Date: ________________________________ (Day/Month/Year)

Age: _____

Sex: ( ) Female ( ) Male

Are you right or left-handed? ( ) Right ( ) Left

Number of completed years of Education: _________

SHORT HEALTH QUESTIONNAIRE

Please check the appropriate box regarding the following health conditions:

Indicate if you are bothered by any of the following:

( ) Colds/flu ( ) Depression ( ) Feeling generally run down

( ) Headaches ( ) Difficulty sleeping ( ) Difficulty eating ( ) Nervousness/tenseness

Do you follow a therapeutic diet for health reasons (such as diabetes/celiac/allergies)? ( ) Yes ( )No

-- If yes, could you please specify?_________________________________

Do you have any other health problems? ( ) Yes ( ) No

-- If yes, could you please specify?____________________________

Vision problems: ( ) Yes ( ) No

--If yes, do you wear glasses? ( ) Yes ( ) No

--Is your vision corrected to 20/20 with glasses? ( ) Yes ( ) No

POST-EXPERIMENTAL QUESTIONNAIRE

In this experiment, did you focus on **accuracy** or **speed** or **both**? Please elaborate:

Did you read all of the ingredients every time? ( ) Yes ( ) No

--Why?

Was there a point when you felt confident in making decisions without reading the ingredient lists?

--If yes, after how many repetitions? 1-2 3-4 5-6 7-8 9-10 more than 10 never

How careful were you in identifying safe or unsafe items?

1 2 3 4 5 6 7 8 9 10

Not careful Somewhat careful Extremely careful

Do you think the above would differ if it was you with a deadly allergy? ( ) Yes ( ) No

--If yes, could you please specify:

Do you have anything to add or say about the experiment?

In the Real World

Do you have to avoid eating any kind of foods or additives? ( ) Yes ( ) No

--If yes, could you please specify:

Do you or someone you know follow a therapeutic diet? ( ) Yes ( ) No

--If yes, could you please specify:

Do you read food labels carefully in the real world (at the grocery store etc)? ( ) Yes ( ) No

--If yes, could you please specify (nutritional facts/ingredients etc):

How often do you read food ingredients in the real world?

1 2 3 4 5 6 7 8 9 10

Never Sometimes Always

Once you`ve bought a given product a number of times, do you re-read the ingredients? ( ) Yes ( )No

--If yes, could you please specify: (after how many purchases?)
