Exploring “Stealth Health:”

Testing the Effects of Information and Healthy Ingredients on Expectations, Taste Perceptions, and Consumption

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Abstract

When healthy ingredients are added to foods, does knowledge of those ingredients negatively influence taste perception and consumption? In order to examine the effects of adding healthy ingredients and providing information about those healthy ingredients, 68 undergraduate students at Hofstra University participated in a taste test of a new brownie recipe. Half of the participants tasted brownies that contained a puree of spinach and blueberries, and the other half tasted plain brownies. In addition, half of the participants were told that the brownies contained spinach and blueberries, and the other half were given no such information. Participants rated their expectations prior to the taste test and rated how much they liked the brownie after tasting it. The amount of the brownie consumed and whether or not the participant took an additional, wrapped brownie were also recorded. Results revealed that expectations were significantly lower when information about the healthy ingredients was given than when participants were not informed. There was no effect of actual brownie type on expectations. Despite the lower expectation ratings, liking ratings were significantly higher for participants tasting brownies with healthy ingredients when they were informed than when they were not informed. The opposite pattern was true of participants tasting plain brownies. There were no observed differences among the groups in amount eaten or in likelihood to accept an additional brownie. These counterintuitive findings suggest that it is better to inform people about healthy ingredients to increase their enjoyment of the food than to stealthily sneak these ingredients into familiar foods.

Keywords: nutrition, health, eating behaviors, perceptions

The World Health Organization (WHO, 2008) has reported that a majority of Americans are currently overweight or obese, as indicated by national studies. Interestingly, the report indicates that the population is also suffering from problems of malnourishment, as diets are commonly dominated by foods that are high in fats, sugars, and carbohydrates. It is important to discover ways to improve eating habits nationwide to address this paradox of being overfed, yet undernourished, to improve society’s health and wellbeing.

People often consider the physical health benefits of consuming a proper diet, but eating well is important for mental health as well. Studies have shown that children who do not get a balanced diet are more likely to have social and behavioral problems, such as not getting along well with others and being suspended from school. These problems may dovetail with the problems associated with being overweight, as some (Murtagh, Dixey, & Rudolf, 2006, as cited in Bromfield, 2009) speculate that suspension could result from retaliation because of weight-related bullying. Malnourished children also have a higher chance of needing to see a psychologist for behavioral, emotional, or other mental issues (Alaimo et al., 2001a, as cited in Pyle, Hyder, Haddock, & Poston, 2009). In contrast, students who eat a healthy breakfast every morning are less likely to have psychosocial problems, have fewer school absences and latenesses, and have higher math scores (Pyle et al., 2009). Problems related to nutrition and weight that begin at a young age are likely to affect an individual well into adulthood. Therefore, success in school and in the social realm later in life can be closely linked to good nutrition and healthy weight.

Still, knowledge of the benefits of consuming nutrient-rich foods may not be enough to actually promote healthy eating, especially among young adults. When students reach college, they are faced with a new environment that can affect their health and weight status, for better or

for worse. There is a higher academic workload, more chances to meet new people, and overall greater senses of freedom and responsibility. The college environment for some students enables healthy eating and physical activity, but for others it provides multiple barriers to these practices. One survey (American College Health Association, 2010) showed that only 6% of students at multiple colleges report consuming the recommended five or more servings per day of fruits and vegetables. Meanwhile, 64% of students surveyed report that they consume two or fewer servings per day. This alarming majority is the target of the present research. How can we get people, especially young adults, to increase their daily intake of fruits and vegetables? These foods provide vital nutrients to our bodies. However, this survey did not address the reasons behind the students’ eating habits.

Another study, by Greaney and colleagues (2009), demonstrated that most students surveyed reported eating close to the recommended daily servings of fruits and vegetables. Participants’ responses indicated an average of 4.2 cups (*SD* = 2.4) of fruit and 3.6 cups (*SD* = 2.1) of vegetables consumed each day. While this study utilized a smaller sample and represented only students at a single university, the survey was more expansive in scope and asked students about more issues surrounding their eating behaviors. They conducted online focus groups to explore these factors related to college students’ health. Common barriers mentioned by participants were such issues as lack of motivation to exercise, not enough time in their daily schedules, few healthy food options provided on campus, and social situations that encourage unhealthy eating. These social situations include dining out with friends, or indulging in late-night snacks after drinking, both of which generally involve foods that are high in fat and calories and low in desired nutrients (Greaney et al., 2009). However, these perceptions of barriers were not universal. Interestingly, other students believed that they were involved in

social situations that encouraged healthy eating behaviors and that the college campus did provide healthy food options. These participants enjoyed going to the gym with friends and understood that balance and moderation are the keys to a healthy diet. Through the use of their knowledge of what foods are good to eat and which are not, they were able to recognize the healthier selections available in campus eateries and in regular restaurants. Generally, though, participants all reported eating close to the recommended daily amounts of fruits and vegetables, and many students identified “lose weight” as a goal for the year, both of which are promising for attempts to improve young adults’ diets and health (Greaney et al., 2009).

As explained above, there are several barriers to healthy eating, especially among college students. To answer the question of how to increase consumption of fruits and vegetables, it is important to identify and understand the factors that may prevent people from eating these healthy foods. Previous research has indicated that lack of access to fruits and vegetables, preferences for convenient "junk foods," and more negative perceptions of healthy foods are problems commonly associated with low consumption of such products, and each is described next.

Lack of access to healthy foods is especially challenging for those with low socioeconomic status (SES). Poor people are more likely to evidence the paradox of co-occurring obesity and malnourishment, noted above. The food options available to people who are poor or near the poverty line are very limited, forcing a focus on cost over quality. Not being able to afford enough food can lead to malnourishment, but cheaper foods are usually filled with carbohydrates, fats, and sugars, which can lead to obesity. Such foods may slake hunger and cravings, but they do not provide much nutritional value to these individuals (Pan American Health Organization [PAHO], 2002). Surprisingly though, one study found that a significant

portion of lower and lower-middle socioeconomic status people strongly supported alternative food practices, such as eating non-processed and/or organic foods (Robinson-O’Brien, Larson, Neumark-Sztainer, Hannan, & Story, 2007). Unfortunately these people do not have the means to actually engage in these practices. Millions of Americans report that they would like to eat healthfully, but they are not able to achieve the proper balance of nutrients in their diets because they do not have access to healthier or more nutritious options.

Though poverty and lack of access are serious barriers to consuming fruits and vegetables, other people do not adopt healthy eating habits because of taste preferences for less healthy foods. They dislike the tastes of nutritious foods like broccoli and apples, and prefer the tastes of foods like chips and chocolate cake, which are saltier, sweeter, and contain more fat. Adolescents in particular view healthy foods as tasteless or gross-tasting, and often unappealing in appearance (Stevenson, Doherty, Barnett, Muldoon, & Trew, 2007). Fast food and junk food are made all the more appealing by the ubiquity and salience of advertising for such products. Paired with the strong cultural messages suggesting that being thin is more desirable, these conflicting messages permeate the minds of adolescents and young adults. They may feel guilty for eating junk foods, but say it is too hard to eat healthfully, especially away from home (Stevenson, et al., 2007).

Unfortunately, adolescents and adults now eat more meals someplace other than in their own home, particularly as compared to the 1960s. These eating patterns reflect a desire for convenience, but at the cost of health, as home-cooked meals tend to have more nutritional value than those eaten elsewhere (Neilson et al., 2002, as cited in Lessard, Greenberger, & Chen, 2010).

Whether at home or elsewhere, dietary habits may benefit if nutritious alternatives are made more appealing so that people will want to select these foods. Researchers, marketers, and public health advocates have begun to explore avenues to make healthier options more appealing and accessible to consumers (e.g., Wansink, 2007). One option to do this, explored in the present study, is to incorporate fruits and vegetables into healthier versions of common comfort foods.

Furthermore, negative expectations about novel foods, and especially healthy novel foods, can lead to decreased consumption. Researchers have explored people's perceptions of healthy foods, and what specific factors in food and drinks affect how people perceive them. Both children and adults seem to believe that the words “healthy” and “tasty” are completely incompatible. Wardle and Huon (2000) asked participants, young children, to rate how good they expected a new drink or a new healthy drink to taste. They were then given the chance to taste the drink, and have as much of it as they wanted. The children’s expectations for the healthy drink were lower than for the new drink. Because the only difference between the drink labels was the word “healthy,” it stands to reason that people believe a product that is healthy cannot also be tasty. Horgen and Brownell (2002) demonstrated a similar effect in observing people’s choices of what foods to purchase at a deli. The results showed that “low-fat” labels applied to certain menu items often led to a decrease in sales for that food. People assume it will not taste as good as the regular version so they do not want to buy it. The importance of taste expectations has been further explored by other researchers.

Lee, Frederick, and Ariely (2006) experimented with expectations and taste perception by using beer. Two samples of beer were used, one of which contained a few drops of balsamic vinegar, and one that was unmodified. Prior to conducting the actual experiment, Lee and colleagues (2006) surveyed an independent sample of pub patrons to rate how they would expect

beer to taste if it had balsamic vinegar added to it. The majority of these participants believed the beer would taste worse. Though this added ingredient sounds unappealing, it in fact slightly improved the flavor of the beer. Prior to tasting, some participants were told that one of the beers contained balsamic vinegar, and which one it was. Other participants were not aware that one of the samples had been altered. The participants who were informed of the vinegar expressed a preference for the unaltered beer sample, while the uninformed participants expressed a preference for the beer sample with the vinegar. These findings support the popular idea that knowledge of unappealing ingredients can lead people to reject that particular food/drink, and so it is better to secretly sneak these ingredients into foods. However, the few drops of balsamic vinegar that Lee and colleagues (2006) used actually *improved* the taste of the beer, while healthy ingredients, like vegetables, that may negatively affect the taste of familiar foods, are more often used in the real world (and in the present experiment).

Wansink (2007) conducted a study to examine how being informed about a healthy ingredient could alter taste perception. His study utilized samples of a protein granola bar. Half of the participants received the bar in a wrapper that said “contains protein,” while the other half saw a wrapper that said “contains soy protein.” In reality, there was no soy in the bars, but the participants who believed there was soy present rated the flavor and texture of the bar as significantly less enjoyable than the participants who were not led to believe this. These results indicate that thoughts can affect taste perceptions, even when the healthful ingredient is just a “phantom ingredient” (Wansink, 2007).

Another study by Wansink, Payne, and North (2007) also tested how information can lead to negative expectations and can produce a negative tasting experience. All participants tasted the same Cabernet Sauvignon, but half of the participants saw it poured from a bottle that

said “North Dakota,” and the other half saw it poured from a bottle that said “California.” Participants rated expectations before tasting the wine and perceptions of the wine after tasting it. In both scales, the California wine was rated as more tasty than the North Dakota wine. Wansink (2007; Wansink et al. 2007) concludes from both of these studies that expectations directly impact perceptions for a given food or drink. In both of these studies, however, there was nothing truly unusual about the samples that participants tasted. The effects occurred because of the information participants were provided, but no alterations to the products were made.

These results highlight that information creates expectations for taste, and these expectations are powerful. They suggest that one way to help people eat more health-promoting foods is to alter the information provided to prevent negative expectations from forming. One specific example would be to sneak fruit and vegetable ingredients into existing recipes for familiar foods without telling consumers. This idea has taken hold in popular culture, as an entire best-selling cookbook series entitled *The Sneaky Chef* promotes over 300 recipes, all of which endorse the concept of stealth health by “ingeniously disguising ‘superfoods’ in kids’ favorite meals,” (Chase Lapine, 2008). But can "sneaking" healthful ingredients into favored foods really avoid negative expectations and lead to greater enjoyment of these nutritionally enhanced recipes? To try to answer this question, Chase Lapine’s “Brainy Brownies” recipe, with a stealthy spinach and blueberry puree added, was adapted for the present study.

The present study sought to discover whether the phenomena revealed by Lee and colleagues (2006) and by Wansink and colleagues (2007), and promoted by Chase Lapine (2008) in her cookbooks, hold true when a familiar food (brownies) is altered by healthy ingredients (spinach and blueberries). Participants in this experiment were asked to taste brownies that either did or did not have a puree of spinach and blueberries added to the batter. Regardless of which

type of brownie was actually presented, half of the participants were told that the brownies contained a mixture of spinach and blueberries. The resulting four groups were as follows: information given, spinach and blueberries present (IS); information given, plain brownie (IP); no information given, spinach and blueberries present (NS); no information given, plain brownie (NP). Participants rated their expectations for the tastiness of the brownie before trying it, and rated their perceptions of the brownie (i.e. how much they liked it) after eating it. The researchers recorded how much of the brownie each participant left remaining, and also offered an additional pre-wrapped brownie for the participant to take with him or her.

The first goal of the current investigation was to examine how information about healthy ingredients affects taste expectations. A main effect of information was hypothesized, such that participants who were told that the brownies contained spinach and blueberries (IP and IS groups) would have lower expectations than participants who were given no such information, because the idea of spinach and blueberries in brownies sounds unpalatable, and previous research suggests that these thoughts will become negative expectations for taste (Wansink, et al., 2007, and Lee et al., 2006).. No main effect of brownie type was predicted. The type of brownie should have no effect on expectations because both types of brownies look and smell like typical chocolate brownies.

The second goal of this experiment was to explore how the combination of information and the inclusion of healthy ingredients would affect taste perceptions. A main effect of information was again hypothesized, such that participants in the no information groups (NP and NS) would like the brownies more than participants in the information given groups (IP and IS), as expressed by higher perceptions ratings. Similarly, a main effect of brownie type was predicted, such that the plain brownies (IP and NP groups) would be liked more than the spinach

and blueberry brownies (IS and NS groups), because the healthy ingredients do alter the flavor of the brownie. Finally, an interaction of the two independent variables was also expected, such that participants in the NP group would like their brownies more than participants in the NS group, and participants in the IP group would like their brownies more than participants in the IS group. That is, the anticipated negative effect of ingredient information should be the most detrimental when the healthful ingredients are actually present. Furthermore, if information alone can bias perceptions, participants in the plain brownie condition should have more positive perceptions if no information is given (NP) than if ingredient information is given (IP), as suggested by Wansink’s (2007) concept of phantom ingredients that lead to decreased liking.

A third goal of the present study was to determine how the two variables of ingredient information and brownie type impact consumption and likelihood to accept an additional brownie. A main effect of brownie type was hypothesized, such that participants tasting the spinach and blueberries brownies would be likely to eat less of the brownie than participants tasting a plain brownie. This is related to the expectation that participants would enjoy the plain brownies more, and would therefore choose to eat more. A smaller main effect of information was predicted for consumption, such that participants in the information given groups (IP and IS) will eat slightly less of the brownies because their perceptions of the healthy ingredients will cause them to dislike the brownie, and thus they will not want to continue eating the brownie.

A main effect of brownie type should also be observed in whether participants accept an additional brownie of the same type tasted that is offered at the end of the session, such that participants who taste a plain brownie will be more likely to take the additional brownie than participants who taste a spinach and blueberries brownie. This prediction relates to the idea that participants tasting the plain brownies will have more positive perceptions than participants

tasting the spinach and blueberries brownies, and would therefore want the opportunity to have a similar pleasurable eating experience later. No main effect of information was predicted, because the additional brownie is offered after debriefing, at which point the participants’ knowledge will have changed. Finally, it was hypothesized that there should be an observed interaction of information and brownie type, such that participants in the NP group would be the most likely to accept the extra brownie, followed by the IP group, then the NS group, and finally the IS group would be the least likely to accept the additional brownie. This was predicted because participants in the no information condition should like the brownies more, as should participants in the plain brownie condition.

Method

Participants

Eighty-one undergraduate psychology students were recruited from the Hofstra University research pool, which consists of all students taking Introduction to Psychology. Of these 81, 70 students arrived at their scheduled sessions at the lab, and 11 failed to attend. Two students were unable to participate in the taste-test due to food allergies. This resulted in a final sample of 68 participants. The majority of participants were female (n = 54, 79.4%) and self-identified as Caucasian (n = 47, 69.1%). Additionally, 8.8% were African-American, 10.3% were Hispanic, 5.9 % were Asian/Pacific Islander, and 5.9% identified as other. Ages ranged from 17 (with parental consent) to 29, with an average of 19.1 years. Participant demographics for the different conditions are summarized in Table 1. All 70 students received credit toward their course requirement for participation in the study.

Procedure

Participants were asked to refrain from eating for at least one hour prior to their scheduled study time. At the start of the session the researcher asked the participant when he or she had last eaten and recorded the response; all participants reported that they had complied with the instructions. One at a time, students arrived to the lab to participate in "The Taste Perception Study." The researcher invited the participant in and instructed him or her to have a seat on the sofa. The participant was then given a brief overview of the study ("We are testing some new recipes and would love to get your input on one of them today,") and asked to read over the consent form. Participants also completed an allergy checklist, which included the ingredients of the test food, but also contained multiple filler items so that they would not know which ingredients were actually being used. If a participant indicated that he or she was allergic to any of the brownie ingredients (e.g., eggs, flour, chocolate) or to the added healthy ingredients[*] (spinach, blueberries, lemon juice), then he or she was thanked for coming, but informed that they would not be able to take part in the taste test.

After signing the informed consent and allergy checklist, the participant moved to a table where a covered plate was set up, next to a single napkin and a cup of water. The researcher removed the cover to reveal the brownie sitting on a small white paper plate. At this point the researcher said, "This is one of our brownies. *It contains a mixture of spinach and blueberries.* I want you to just rate your expectations for how this brownie will taste. You can touch it, smell it, whatever, but you cannot taste it. Record your expectations on this sheet, on the scale from 1 to 10." The italicized portion of these instructions was only said to participants in the informed groups (IP and IS). Once the participant had circled a number, the brownie was re-covered and

[*] One participant did indicate an allergy to blueberries, but the participant had already been randomly assigned to the NP group (no information given, plain brownie), so the study continued as usual because there was no threat to the participant's wellbeing.

the researcher took the rating sheet away. The participant was directed back to the sofa, where he or she then filled out a demographics survey and a “campus food survey.” This survey was only given as a distraction task to prevent the participant from focusing on his or her expectations rating, and asked questions about the various eateries on Hofstra’s campus.

After completing this filler survey, the participant was directed back to the table, where the researcher said he or she could now taste the brownie. Participants were advised that they could eat as little or as much of the brownie as they wanted. After he or she had taken one bite, the researcher presented a perceptions survey, where the participant was asked to rate various aspects of the brownie. The current investigation focuses on the first item of this survey, which asked how much participants liked the brownie. Other questions were asked on this perceptions survey (e.g., “How much would you be willing to pay for this brownie?”), but they are beyond the scope of the analyses presented here. After completing the perceptions survey, participants were asked to complete a lifestyle survey (adapted from Lewis, 1992), which contained questions regarding their general health-related habits. This survey is also beyond the scope of the current analysis. After all measures were completed, participants were debriefed so that the nature of the experiment and any deception regarding the actual ingredients of the brownie were clear. Finally, participants were offered another pre-wrapped brownie of the same type they sampled to take with them. Researchers then recorded how much, if any, of the first brownie was remaining, whether the participant took the remainder, and whether the participant took the additional, wrapped brownie.

Materials

A store-brand boxed dark chocolate brownie mix was used as the basis for both brownie recipes. The plain brownies were prepared as per the instructions on the box, with the addition of

miniature chocolate chips sprinkled on top before baking. For the spinach and blueberry brownies, one cup of “purple puree” (Chase Lapine, 2008) was substituted for the ½ cup of vegetable oil indicated in the normal instructions (see Appendix). Again, miniature semi-sweet chocolate chips were sprinkled on top. The brownies were baked in a special pan with individual square cups to ensure uniformity of brownie size (2 inches x 2 inches). In the lab setting, brownies were presented on a small white paper plate, with a white napkin and a clear plastic cup of water.

Measures

Demographics. Background characteristics were assessed on a single page on which participants circled one option for each of the following three categories: gender, age, and race. An option of “other” was provided for the race category.

Expectations. Prior to tasting the brownie, participants were asked to rate, on a scale from 1 (*very bad*) to 10 (*very good*), how they expect the brownie to taste. To make this decision, participants were instructed that they could look at, smell, and touch the brownie, and use the information they had been given (e.g., that it contained spinach and blueberries).

Perceptions. After tasting the brownie, participants were asked to rate, on a scale from 1 (*hated it*) to 10 (*loved it*), how much they liked the taste of the brownie. Participants could eat as much or as little as they wanted in order to make this decision.

Consumption amount. The amount of the brownie that was consumed by the participant during the taste test was coded by the experimenter as an estimated fraction of how much of the brownie was remaining on the plate at the conclusion of the session.

Additional interest. To obtain another indicator of participants' enjoyment of the brownie, experimenters coded whether participants chose to take an additional, pre-wrapped brownie of the same type sampled during the taste test, or if they declined.

Overview of Analysis

In order to explore potential main effects of the two independent variables (ingredient information and brownie type), as well as the predicted interaction between these two variables, a Multivariate Analysis of Variance (MANOVA) was conducted for the outcomes of expectation ratings and perception ratings, described first. Potential differences in consumption amounts were analyzed with an Analysis of Variance, described next. Because the final outcome, whether or not participants took the additional, wrapped brownie, was dichotomous, the main effects and interaction were examined with a chi square analysis, described last.

Results

Expectations and Liking Ratings

A MANOVA was conducted to analyze potential differences in expectation and perception ratings based on ingredient information condition and brownie type. As predicted, the results indicated a main effect of ingredient information on expectations, such that expectations for taste were significantly lower, $F(1, 64) = 14.93$, $p < .001$, for participants who were told that the brownies contained spinach and blueberries ($M = 6.76$, $SD = 1.87$) than for participants who were not informed of these ingredients ($M = 8.23$, $SD = 1.17$). No main effects of ingredient information were observed for perceptions ratings after brownies were tasted, $F(1, 64) = .05$, $p = .82$, contrary to the predicted negative effect on liking. The results described in this section are displayed in Figure 1.

No main effect of brownie type was found when comparing participants' expectation ratings, $F(1, 64) = 1.58$, $p = .21$, indicating that both types of brownies appeared equally appetizing. A main effect of brownie type was found for perception ratings, $F(1, 64) = 23.00$, $p < .001$, in the predicted direction, as ratings were significantly lower for the spinach and blueberry brownies ($M = 7.14$, $SD = 1.65$) than for the plain brownies ($M = 8.81$, $SD = 1.14$), indicating that participants liked the plain brownies more than the spinach and blueberries brownies.

Examining both variables in combination, there was not a significant interaction between ingredient information and brownie type for expectation ratings, $F(1, 64) = .06$, $p = .81$. However, the analysis did reveal a significant interaction of information and brownie type for perceptions, $F(1, 64) = 4.61$, $p < .05$. The pattern of results indicated that the ingredient information may have negatively biased participants sampling the plain brownies, as predicted , as they gave slightly lower perception ratings (i.e., liked the brownie less) if they were told that the brownies contained spinach and blueberries ($M = 8.47$, $SD = 1.25$) than if they were given no such information ($M = 9.13$, $SD = .96$). Contrary to the hypotheses, the reverse pattern was observed for participants tasting the spinach and blueberry brownies, as they actually gave *higher* perception ratings (i.e., liked the brownie *more*) if they were informed of the healthy ingredients ($M = 7.56$, $SD = 1.38$) than if they were not given this information ($M = 6.74$, $SD = 1.82$).

Observed Behavior: Consumption

A univariate ANOVA was conducted to determine the effects of ingredient information and brownie type on the amount of brownie remaining after the taste test. Contrary to hypotheses, there were no significant differences in the amount remaining based on information condition,

$F(1, 64) = 1.19$, $p = .28$, or based on interaction of information and brownie type, $F(1, 64) = .20$, $p = .66$. However, there was a marginally significant trend, $F(1, 64) = 2.98$, $p = .09$, toward a main effect of brownie type, such that participants who tasted the plain brownies left slightly less remaining ($M = .43$, $SD = .29$) than participants who tasted the spinach and blueberry brownies ($M = .56$, $SD = .31$). This marginal finding is in the direction predicted.

Observed Behavior: Taking an Additional Brownie

Chi squares were conducted to analyze who was more likely to accept the extra brownie when it was offered. No support for the hypothesized differences was observed. There was no significant difference between the brownie types in terms of whether or not the participant took the extra brownie ($\chi^2(1) = .31$, $p = .58$). Participants who tasted a plain brownie were no more likely to accept the additional brownie (41.9%) than participants who tasted a spinach and blueberries brownie (48.6%). There was also not a significant effect of information on acceptance of the extra brownie ($\chi^2(1) = .26$, $p = .61$). Participants who were not informed of the healthy ingredients were no more likely to accept the additional brownie (48.6%) than participants who were informed (42.4%)

Discussion

The results of the current investigation indicate that both the information provided and the presence of healthful ingredients contributed to expectations and perceptions of the brownies that were tested. Consistent with the hypotheses and previous research, when participants were told that the brownies they were about to taste contained spinach and blueberries, their expectations for the taste of the brownie were significantly lower than when no additional ingredient information was provided.

As with Lee and colleagues (2006), in which participants’ negative reactions indicated that vinegar does not belong in beer, current participants’ lowered expectations suggest their agreement that spinach and blueberries do not belong in brownies. It is unclear then whether participants were reacting to the unusualness of the ingredients added to the recipe or to the healthiness of the ingredients. Previous research has indicated that people tend to assume that foods that are altered to be more healthful will not taste good (e.g., Horgen & Brownell, 2002). It is true that spinach and blueberries contribute additional nutrients enhancing the health properties of the recipe to a small extent, but we do not know whether the negative expectations reported by tasters solely reflect perceptions of health food. In addition to the health connotations, it is simply strange to include fruits and especially vegetables as ingredients in a brownie recipe. Additionally, vegetables are typically bitter, and blueberries are a rather bitter fruit. Rozin, Haidt, and Fincher (2009) explain that humans are evolutionarily predisposed to react with disgust to bitter tastes, which sometimes transfers to disgust at the mere mention of foods that one knows to be bitter. So while participants were perhaps confused by the odd ingredients, they were also evolutionarily conditioned to expect the brownies to taste disgusting. Therefore, it is likely that their responses were due to a combination of both the healthfulness and unusualness of the ingredients.

It is important to note that although the expectations for brownies believed to contain spinach and blueberries were rated lower than seemingly plain brownies, they were still relatively positively perceived before tasting, with average expectation ratings above the midpoint of the scale. Furthermore, although the recipes for the two types of brownies produced slight differences in their appearance, participants did not perceive them differently when rating their expectations for taste. In the absence of information about the added ingredients,

participants reported similarly positive expectations for both types of brownies. However, as noted above, information about the ingredients did negatively affect expectations before tasting.

The results for participants' ratings of how much they liked the brownies after tasting them were not affected solely by information about the ingredients, however. Although it had been hypothesized that knowledge of the spinach and blueberries would negatively bias participants' taste experience, that was not the case. What did negatively influence taste perceptions was the actual presence of the healthful ingredients. A significant difference in liking ratings was found between the two types of brownies, as participants reported liking the plain brownies more than the spinach and blueberries brownies.

Although steps were taken to create brownies that were as similar in appearance and palatability as possible, it was not surprising that plain brownies were perceived to be more delicious than brownies following an altered recipe including spinach and blueberries, and lacking the cooking oil present in the plain brownies. Once again, it must be noted that the more healthful brownies were not disliked; they received generally positive perceptions ratings from the participants, though not as positive as the plain brownies.

The examination of interactions between the type of brownie presented and the information provided revealed no interaction effect for expectations, but a significant interaction was found for predicting liking ratings. Participants’ taste perceptions after eating the plain brownies were higher if they had not been given ingredient information, but taste perceptions were *lower* if participants tasted the spinach and blueberries brownies without knowledge of the ingredients. The surprising pattern revealed for liking was thus: plain brownies with no information were liked the most, plain brownies with ingredient information were preferred next,

followed by spinach and blueberry brownies with information given, and finally spinach and blueberry brownies with no information provided were liked least of all (NP > IP > IS > NS).

The most surprising finding was that the lowest perception ratings overall were found in the group where participants were not aware that the brownie they tasted contained spinach and blueberries, but the brownie actually contained them. This finding is inconsistent with the idea of “stealth health,” which suggests that healthy foods need to be secretly used in recipes so that people will still enjoy the food without being biased by the health information. In fact, our participants demonstrated just the opposite: participants who knew that they were tasting a nutritionally enhanced brownie (IS group) reported liking it significantly more than those who did not know the brownie was secretly more nutritious (NS group). This evidence suggests that it is better to inform people about an unusual or healthy recipe than to try to be stealthy and sneak the ingredients past them.

Beyond the lab, these results suggest that the idea of fruits and vegetables incorporated in common foods does create negative expectations, and may limit willingness to try the food. Though the current investigation focused on adults, this would be a more troubling concern in a situation where parents are trying to incorporate more vegetables into their children’s diets. Though this should be investigated specifically with children, these findings suggest that children are likely to be wary of tasting the food if unusual and healthful ingredients are identified. However, the results of this study become promising, if, as was observed in adults, the foods are perceived fairly positively, both before tasting and even more so afterwards.

When comparing the mean ratings for expectations and for liking, it becomes clear that people who are given the relevant information about the presence of the spinach and blueberries appear to be pleasantly surprised during tasting. The finding that perceptions were more positive

than expectations, especially in the informed condition, indicates that the brownies tasted better than the participants expected them to taste. In fact, the only group that showed a negative discrepancy was the no information with spinach and blueberries group (NS), because the participants were probably put off by the slightly unusual taste of the brownie. Because these participants expected to taste a regular, delicious, chocolaty brownie, and because they were unable to attribute the different flavor to anything other than poor baking skills on the part of the researcher, they reacted negatively to the nutritious recipe. In other words, they had high expectations for the brownie and felt let down after tasting it, resulting in lower perceptions ratings. In contrast, participants who were told about the ingredients reacted positively, showing lower expectations but higher perceptions. Overall, participants compensated for the incongruence between what they expect to taste and what they actually taste by adjusting their perceptions ratings accordingly.

However, while the ratings are telling of interesting and significant trends in liking, there were no significant differences in how much participants ate based on information or on brownie type. This is surprising because one would expect that people who like a food more would eat more of it than someone who does not like that food. This was not the case in this experiment though, and in fact these results are consistent with Wardle and Huon’s (2000) findings that children consumed the same amount of a “new healthy drink” as a “new drink,” despite significantly different ratings of taste. Because the goal of this study is to learn about ways to encourage people to consume more foods containing healthy nutrients, this lack of a difference in consumption is somewhat encouraging, suggesting that although ratings varied, participants' behavioral reactions to the two types of brownies were quite similar.

However, alternative interpretations of this lack of difference should be considered. One possible explanation for the similar consumption amounts is that participants presented with a spinach and blueberry brownie (and who reported liking the brownie the least) may have consumed a little more of the brownie out of curiosity. That is, these participants may have eaten more of the sample in order to try to identify the unexpected flavor of the brownie. Meanwhile, participants in the other groups, who liked the brownie more, ate a similar amount, but because they actually enjoyed it. It is also possible that significant differences would have been found if an exact measure of amount remaining had been taken, such as weight in grams, as opposed to the estimates recorded based on the experimenters' coding scheme. These estimates may not have been sensitive enough to detect small, but consistent differences between groups. Additionally, it was a rather large brownie, so very few participants ate the entire thing. Though the size of the brownie was the same for all groups, it may be that participants in the plain brownie conditions would have consumed more relative to the spinach and blueberry brownie groups if the brownies had been smaller. That is, the different groups may have stopped eating the sample brownie for different reasons, with some being full and others not enjoying it enough to continue.

It had also been expected that participants who liked the brownie they tasted would happily accept a second brownie to take with them. This acceptance instead seemed to be more random, with actually more participants refusing the extra than accepting it, and with no significant differences among the conditions. Again, this could be attributed to the fact that the brownie was rather large, so participants may have had their fill of heavy chocolate for the time-being, and were not enticed by the offer of more. The amount eaten and likelihood to take a second brownie was also probably affected by the time of day that the study took place. Some

participants had appointments as early as 10:00am, and they had not yet eaten breakfast. Anecdotally, several participants mentioned that they would have eaten more of the brownie if it was later in the day or that they declined the additional brownie because they were on their way to eat breakfast. They did not seem to consider that they could easily save the brownie until later. Brownies may not seem as appealing in the morning, and these participants may not have been able to anticipate that their desire for a brownie could increase later in the day. Future studies should consider execute more control over the time of day so as to account for these potential issues.

As with all experiments, there are several limitations to this study. Included are those mentioned previously, namely the size of the brownies and the various times of day that the study was conducted. Another limitation was the relative homogeneity of the participants, as a majority were young, Caucasian, and female. Though the groups were well balanced in their composition, the lack of diversity in the sample may make the results less generalizable to the broader populations of college students and adults. Of particular concern, anecdotally, a number of participants qualified their denial of the extra brownie or their reason for not eating more of the first brownie by saying that they were on a diet or trying to get in shape. This suggests that different results could have been obtained if a different, less weight-conscious population had been sampled, such as children or middle-aged adults, and these groups should be included in future investigations. Lastly, the amount eaten could have been different depending on who was conducting the study (the lead researcher, a female, or one of the assistants, one female and one male). Young, Mizzaua, Mai, Sirisegaram and Wilson (2009) found that females tend to eat less when in the presence of a male stranger. Because the majority of participants in the present study

were female, their eating habits could have been affected if their timeslot was administered by the male research assistant. This possibility should be explored further.

In addition to the potential impact of the researchers’ personal characteristics on participants’ eating patterns, it is unclear whether the perceptions and behaviors observed in this laboratory study will generalize to real world contexts. However, according to Martina and colleagues (2005), eating behaviors in a laboratory setting are reliable as indicators of eating behaviors in the real world. This leads us to assert that our participants’ reactions to the brownies in the lab were externally valid and generalizable to how others would respond to the brownies in other settings, though additional field research is needed to confirm this expectation.

There are many factors that the present study did not address and that could and should be explored in future studies. For instance, one could change the timing of when the ingredient information is given, such that one group could be told about the spinach and blueberries before tasting, one group could be told after taking one bite but still during tasting, a third group could be told before being offered a second brownie, and a fourth group could be told during debriefing only after the full completion of the study. The interesting case here would be the group that is told during tasting, to see if receiving additional information after initial impressions have been formed can impact later perceptions. Lee and colleagues (2006) utilized a similar procedure in their MIT beer study, in which some participants tasted the beer samples blind, some participants were told which sample contained vinegar before tasting, and some participants were told about the vinegar after tasting but before indicating taste preference. The results of this study showed that the third group’s preferences matched those of the first group, indicating that being given information after an impression has been formed does not change the perceptions. However, what is not yet known is whether this kind of information has an effect on

subsequent consumption (e.g., when participants are still able to continue tasting the brownies), as participants in the beer study were not able to taste any more of the beer samples after being informed. Information may not have influenced perceptions after sampling, but it may influence later consumption.

Another variable to consider is the element of distraction. If participants have a secondary task to do, such as listening to music or reading sentences, does this interfere with the attention they pay to the taste of the brownie? Perhaps participants blindly tasting the spinach and blueberries brownies would be less keen to notice the unusual taste if they must divide their attention by simultaneously focusing on another stimulus. It is quite common for people in modern society to eat snacks or meals someplace other than in their home’s formal dining room, such as while driving the car or while working at a desk, and these situations provide distractions from the food itself. These distractions cause individuals to be less aware of what and how much they are actually eating, and are typically associated with poorer eating habits. However, if distractions minimize the attention paid to the health properties of foods, they may contribute to enhanced enjoyment of healthy options.

Participants might also be influenced by the presence of another person or group of people who are also tasting the brownie. This factor could be tested by using confederates, and instructing them to either act as though they enjoy the brownie or act as though they hate the brownie. This would be a meaningful situation with which to experiment because most of our daily eating takes place in the company of others. We are influenced by all sorts of environmental cues, including the reactions of the people around us. Previous research (Gellar, Schrader & Nansel, 2007) has shown some evidence for modeling behavior in shaping eating habits. If children see their parents thoroughly enjoying a particular food, they will be more

likely to willingly taste that food and perceive it positively, regardless of the healthfulness of that food. Likewise, examining "stealth health" recipes in a social context will contribute to our understanding of their value.

The current investigation only examined one representative of a wide range of “stealth health” recipes. The promising results of the present study suggest that such recipes can be a step toward helping change Americans’ diets for the better. It is important, according to our results, to tell people what they are tasting. They may be closed-minded at first, and hold negative expectations, but tasting the nutritionally enhanced version of the food may result in a pleasant surprise. These modified recipes should not be mistaken for true health food, but they offer a slightly healthier way to enjoy some favorite comfort foods without all the guilt that usually accompanies such indulgence. Ideally, these enjoyable experiences could help children and adults develop more positive attitudes toward the healthy ingredients, especially vegetables, and in turn, consume more healthful diets.

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Table 1.

Participant demographics across the 4 conditions.

	Experimental Conditions				
	No Info / Has Spinach	No Info / Plain	Info / Has Spinach	Info / Plain	Total
N	19	16	18	15	68
Mean Age	18.7	18.8	19.5	19.4	19.1
% Female	78.9	81.3	77.8	80	79.4
% Caucasian	68.4	62.5	72.2	73.3	69.1

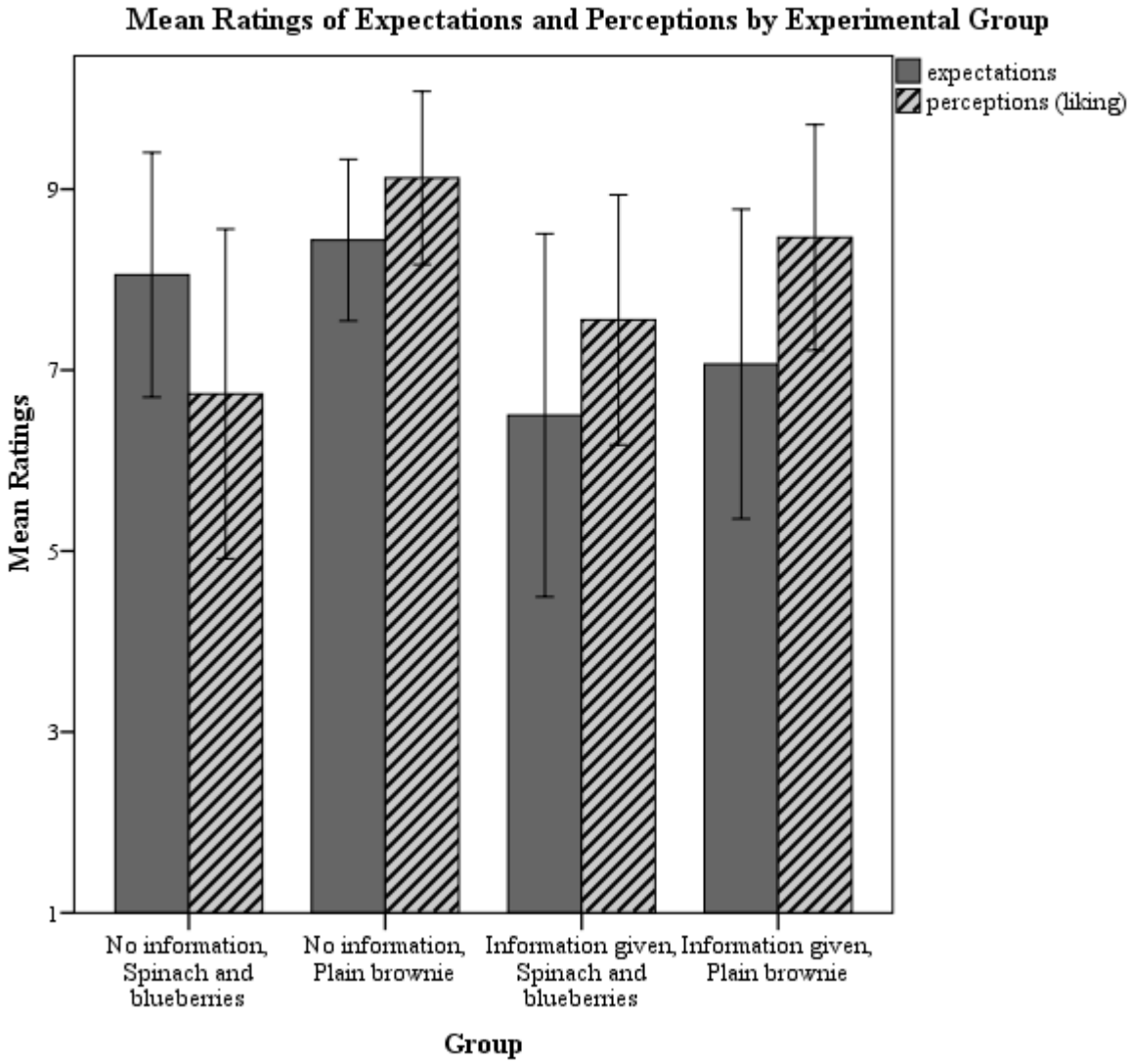

Figure 1. Mean expectations and perceptions ratings are presented for each group to illustrate the significant discrepancies between ratings. In only one group (no information, brownie has spinach and blueberries) did the ratings decrease after tasting. Error bars show +/- 1 standard deviation.

Appendix

Spinach and Blueberry Brownies

1 19.8-oz box of dark chocolate brownie mix (store brand)

2 eggs

¼ cup water

Miniature semi-sweet chocolate chips

1 cup “Purple Puree:”

- 3 cups fresh baby spinach
- 1 ½ cups frozen blueberries
- ½ teaspoon lemon juice
- 1-2 tablespoons water

1. Pre-heat oven to 350°F.
2. Blend all ingredients of Purple Puree in a food processor.
3. Combine and mix all ingredients and purple puree in large bowl.
4. Pour into brownie pan (2” x 2” square muffin pan).
5. Sprinkle on chocolate chips.
6. Bake for 25 minutes.