TRIANGLE SENSORY TEST WITH OREO COOKIES

Background

The following experiment was prepared as part of the University of Maine's NSF GK-12 project by NSF Fellow Beth Calder, Mary Ellen Camire, and Susan Brawley.

Sensory science is a scientific method used to "measure, analyze, and interpret human responses to products as perceived through their senses of touch, taste, sight, smell, or sound." Sensory science is often used to improve existing products or to test people's views on new products, such as the softness of tissues, the crunchiness of an apple variety, or the aroma of air fresheners. It is also used to test the taste and color acceptance of new products, such as purple ketchup, or the sound characteristics of products, as in the crunch of snack foods.

There are many different types of sensory tests. Attribute Difference tests ask: How does a certain quality or trait differ between samples? Affective sensory tests ask: What is the consumer acceptance of a product(s)? Overall Difference tests ask: Does a sensory difference exist between samples? A Triangle test is a type of Difference test to determine if there is a sensory difference between two products. For example, a researcher may want to see if changing one ingredient in a recipe to make a certain food product will affect the taste of the final product. Three coded samples are presented to each panelist, and each panelist is asked to pick out which sample they feel is different from the other two. There are also sensory tests which panelists have to be trained to detect taste thresholds (such as determining the concentration of a flavor which can be identified by the panelist when introduced into a food product) or to have trained panelists describe certain characteristics that researchers are interested in studying.

Sensory tests have to be conducted under controlled conditions to reduce bias (prejudice or influence) on how panelists view the product(s). The sensory room has to be free from distractions (sound, odors) to not influence people's decisions of the product. Sensory testing laboratories are able to adjust the lighting, air regulation, and individual booths according to the needs of each sensory test that is conducted. Samples also have to be presented in a random order and assigned product codes, such as three-digit sample numbers, to keep food products anonymous to further reduce influencing the panelists' decision. The sensory test measures if any differences detected are truly significant by analyzing the sensory data for statistical significance. After statistical analysis, the researchers can make a meaningful interpretation from the results of the sensory data.

References

Meilgaard, M, Civille, GV, Carr, BT. 1999. Sensory Evaluation Techniques. 3rd ed. Boca Raton: CRC Press LLC.

TRIANGLE SENSORY TEST WITH OREO COOKIES
Administrator's Guide

The following experiment was prepared as part of the University of Maine's NSF GK-12 project by NSF Fellow Beth Calder, Mary Ellen Camire, and Susan Brawley.

Grade levels: 2-10
Estimated Preparation Time: 30 minutes
Estimated Activity Time: 1 class period (45 minutes to 1 hour)
Standard Addressed: Content Standard A (Science as Inquiry)

Mathematics is essential in scientific inquiry. Mathematical tools and models guide and improve the posing of questions, gathering data, constructing explanations, and communicating results.

Reference:

Lawless, HT and Heymann, H. 1998. Sensory Evaluation of Food: Principles and Practices. New York: Chapman & Hall.

Meilgaard, M, Civille, GV, Carr, BT. 1999. Sensory Evaluation Techniques. 3rd ed. Boca Raton: CRC Press LLC.

Objectives:

- To introduce sensory science to students
- To have students voluntarily participate in a sensory test
- To learn more about hypothesis testing and statistical significance

Materials:

- Low-fat Oreo cookies with normal cream filling (total should equal 1.5 times the number of students)
- Original Oreo cookies with normal cream filling (total should be 1.5 times the number of students)

Example: If there are 12 students in the class you will need at least 18 Low-fat Oreo cookies and 18 regular Oreo cookies

- Small white paper plates
- Marker
- Sensory ballots (samples are provided)
- 6-8 oz. plastic cups (one for each student)
- Water

(Other products that could be used include regular and low-fat cheese or regular and low-fat graham crackers. Be aware that some students may have food allergies, sensitivities, or dietary restrictions.)

Set-up Procedures:

1. Using the marker, label the small white plates with random three-digit codes (the number of plates for each code should be equal to half of the number of cookies needed).

   Example: Random three-digit sample codes:
   767 - Original Oreo cookie sample
   189 - Original Oreo cookie sample
   312 - Low-fat Oreo cookie sample
   570 - Low-fat Oreo cookie sample

   12 students need at least:
   - 18 Low-fat Oreo cookies – therefore, 9 plates should be labeled 767 and 9 plates should be labeled 189
   - 18 regular Oreo cookies – therefore, 9 plates should be labeled 312 and 9 plates should be labeled 570
2. Prepare the order of presentation for each student — half the students should receive two low-fat Oreos and one regular, and the other half of the students should receive two regular Oreos and one low-fat Oreo.

Example: Suggested balanced random code presentations:

Student #1 receives sample order: 767,312,189

Student #2 receives sample order: 767,312, 570

Student #3 receives sample order: 767,189,570

Student #4 receives sample order: 312,189,570

Student #5 receives sample order: 312,189,767

Student #6 receives sample order: 570,312,189

Student #7 receives sample order: 189,570,767

Student #8 receives sample order: 189, 570,312

Student #9 receives sample order: 189,767,312

Student #10 receives sample order:570,767,312

Student #11 receives sample order:570,767,189

Student #12 receives sample order:312,570,767

Student #13 receives sample order the same as Student #1

and so on…

3. Prepare a sensory ballot for each student.

Photocopy enough ballots for each student and write the order for each student on the blank lines as shown in the example on the previous page.

CUT

Triangle Sensory Test on Cookies

Please take a drink of water before tasting cookie samples. Eat cookie samples from left to right, and please take a sip of water between samples.

Place an "X" under the cookie which is different than the others.

_____ _____ _____

Comments:

Sensory Test Procedures:

1. Introduce the topic of sensory science to familiarize students.
   a. Try not to bias students with the introduction. Just mention to students that they will be participating in a Triangle sensory test.
   b. Students can voluntarily participate, but should not be forced to participate because all sensory tests that include human subjects must be conducted on a voluntary basis. Explain to students, if they participate, that sensory panelists have to remain silent during the taste test and cannot share answers with their neighbors. Explain that there will be a discussion after the test to share answers.

2. Introduce the experiment to the students.
   a. Mention to students that they will be given three cookies, and that they should taste the cookies from left to right. They should take a sip of water between each sample.
   b. The object of the test is to mark which of the cookies is different from the other two. Only one cookie out of the three should be marked as being different. If students have difficulty deciding, mention to them that it is acceptable if they want to go back and forth and re-taste samples to determine the different cookie.
   c. They may have to re-taste samples, so explain to students that they may not want to eat the whole cookie all at once, but wait until the test is over before eating the entire cookie sample.
   d. If they cannot tell which cookie is different, tell them to guess.
   e. Use the provided sensory ballot as a guide, if needed.

3. Begin the experiment.
   a. Pass out sensory ballots, cookies on labeled plates with random codes, and water.
   b. Allow the students to begin the sensory test. Enforce the quiet rule during the sensory test.

4. Collect the ballots.
   a. Optional: After the ballots are collected, explain the hypothesis of the sensory test.
   b. The stated scientific question is:
      i. Can the class detect a difference between low-fat and regular fat (original) Oreo cookies?
      ii. Hypothesis testing and introducing the scientific method could be used in this lesson.
      Hypothesis Testing Basics: The null hypothesis (H_0) is presumed true until statistical evidence in the form of a hypothesis test indicates otherwise – then you can reject the null hypothesis in support of the alternative hypothesis (H_a).

      For example:

      H_0: Students of the class cannot tell a difference between low-fat and original Oreo cookies.

      H_a: Students of the class can tell a difference between low-fat and original Oreo cookies.

5. Tally sensory ballots to determine the number of correct and incorrect responses.
   a. Optional: There is a statistical table (T8, pg. 369 of Meilgaard et al., 1999 or T4.1, pg. 130 of Lawless and Heymann, 1998) that can be used to determine if the class was able to detect a difference between the low-fat and original Oreo cookies that was statistically significant. To use: the table should be set at 0.05 and n=to the total number of participating students.
      i. In this case since the level will be set at 0.05, the results will be statistically significant if the difference between the two products would have occurred by chance alone in less than 1 time in 20 times.
      ii. Statistically significant means that the likelihood is low that the difference found between the two products occurred by chance alone.

b. After determining final results, interpret the findings back to the students. For example: The class was able (or not able) to detect a statistically significant difference between low-fat and original Oreo cookies.

6. Have a class discussion with students and get their input.
   a. The company that makes Oreo cookies may find the results interesting that this particular grade level was able to detect (or not detect) a significant difference between the two kinds of cookies.
   b. Sensory tests can provide companies with valuable information such as the acceptability of a new cookie.
      i. If the sensory test results are promising, the company may find it worthwhile to produce the cookies.
      ii. If a company produced cookies and then sold them without conducting sensory tests, they could potentially be taking a large risk and lose a lot of money producing a food product that will not sell.
   c. If they were able to detect a difference, what sort of sensory differences were they able to perceive between the two cookies? Any texture, flavor, or color differences? (In previous sensory tests, students have mentioned that low-fat Oreo cookies have a slight coffee flavor, are slightly lighter in color, and are crunchier than the original.)
      i. Another discussion can be introduced as to what properties fat can add to cookies, for example, more flavor or softer textural qualities.
      ii. A good final question to ask the students is: How well did the food and sensory scientists meet the challenge to make the cookie lower in fat, but try to retain good flavor qualities of the original Oreos?

TRIANGLE SENSORY TEST WITH OREO COOKIES
Student Handout

Background: When a food company is offering a new product, changing ingredients, or researching potential products, it's important for them to know what the consumer reaction is likely to be and the impact of the key characteristics of the product on their reaction. Sensory science is the discipline in which food scientists develop and execute testing to evaluate attributes of food products. There are three basic types of sensory tests that are routinely used in practice:

1. *Discrimination or difference tests* are used to answer whether there are any differences between two types of products. For example, when a food company finds an alternate ingredient to include in a food product, they want to confirm that consumers cannot tell the difference between the original product and the newly formulated product. One type of discrimination test is the Triangle test, in which three coded samples are presented to each panelist, and each panelist is asked to pick out which sample they feel is different from the other two.

2. *Descriptive analyses* are methods used to quantify the perceived intensities of a product's sensory characteristics. This technique is used to assess how food products are similar or different from one another. Using the example above, if it is determined that the two products are different, descriptive analysis identifies which characteristic of the food products cause them to be different.

3. *Affective or hedonic tests* are used to quantify the degree of preference for a product. These tests measure how well products are liked or which products are preferred. Returning to our example, affective tests will assess whether the new product is liked more or less when compared to the original product. Thus, all three sensory testing methods can be used to provide different information during the development of food products.

Objective: To learn about sensory science

Procedures:

1. Please take a drink of water before tasting the cookie samples.
2. Taste the cookie samples from left to right, and please take a sip of water between samples.
3. On your ballot, place an "X" under the cookie which is different than the others. It is okay to re-taste samples. If you cannot tell which cookie is different, it is okay to guess.
4. After you choose which sample you think is different, use the table provided to describe all three of the samples.

Discussion Questions:

1. Were you able to tell a difference between the samples? If so, which sample did you choose as the different sample?

_____

_____

2. Were you correct?

_____

_____

3. If you were able to detect a difference, what sort of sensory differences were you able to perceive between the two cookies?

_____

_____

4. Which sample did the majority of the class choose as the different sample?

_____

_____

5. Were they correct? Was this statistically significant?

_____

_____

6. Do you think a food company would find these results interesting?

_____

_____