Do Color Cues Affect Flavor Perception?

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Abstract

In this workshop, participants will test the hypothesis that vision is connected to taste. While blindfolded, they will taste five flavors of Skittles candy and then taste the candy with their eyes open. They will record their results to be added to a growing database that began with high school students in the St. Francis College Summer Science Academy. Tasters will discuss how this can be turned into an inquiry-based lab for their students. This experiment is appropriate for all levels, from non-science majors to anatomy and physiology students. It might even be included as an exercise in food chemistry and/or nutrition.

Introduction

When my daughter and her friend were eleven years old, I conducted an impromptu “Jelly Belly” taste test. I first labeled a dozen red opaque plastic cups with various Jelly Belly flavors. I next asked them to close their eyes and taste the various jelly beans and tell me what the flavors were. I was surprised at the number of incorrect matches they made. These flavors included blueberry, popcorn and root beer, as well as perhaps more common flavors such as orange and grape. I then repeated the tests with an Anatomy and Physiology class and obtained the same large proportion of incorrect results. Over the years I’ve varied the tests, sometimes using gumdrops or Skittles as well. This past summer I tried the test with the St. Francis College Summer Science Academy for High School students and recorded some of our results here. There is a whole body of literature that has studied the influence of taste by colors and other cues. Shankar et al. (2009) state that cognition also plays a factor. In applying these authors’ ideas we could say that we have been “taught” that a purple Skittle will have a grape flavor.

Student Outline

Materials and Methods

Thirty-two high school students, college students and teachers (Table 3) participated in the tasting. Five flavors of Skittles were used, and the students being tested were asked to close their eyes. (If your budget permits, you can buy those blindfolds that people wear at night to assist in sleeping.) Students are given data sheets, as shown in Table 1, which may be copied three to a page. A correct guess would receive a Y, an incorrect guess would receive a N. This could also be adapted to an Excel spread sheet in which “1’s” and “0’s” could be used for a faster tabulation. Students may work in pairs, or in groups of 3-4. A Chi-square analysis could be conducted on the values.

Table 1. Taste test - Can you taste the correct flavor?

Name		
Flavor	**With eyes closed**	**With eyes open**
lime		
grape		
lemon		
orange		
strawberry		

Table 2. Raw data are then tabulated, using the template provided.

Name	Lime	Green	Lemon	Orange	Strawberry
1.					
2.					
3.					
4.					
5.					
TOTALS	Y	Y	Y	Y	Y
	N	N	N	N	N
PERCENTAGES					

Results

Class results may be tabulated as shown (Table 2). A Chi-square could then be conducted in your science majors' classes. You would expect that all the tasters would guess the correct flavor.

The results for two classes are depicted in Table 3. The (?) was converted to an "N". Lime appeared to be the most difficult flavor to guess as there were only 47% correct guesses. More males picked incorrect flavors than females, but there were only 10 males as compared to 22 females Grape and orange were the next most difficult at 60%, and lemon and strawberry drew the most correct guesses at 70%.

When the students were able to see the color of the Skittles, their success rate was 100%.

Table 3. Results from Classes A and B.

Name	Lime	Green	Lemon	Orange	Strawberry
Class A					
1. LINDA	N	Y	N	N	Y
2. CAITLYN	Y	N	N	Y	Y
3. AILIA	Y	N	Y	Y	Y
4. STEPHANIE	Y	N	Y	N	N
5. MOYNA	Y	N	Y	N	Y
6. NICOLA	Y	Y	Y	Y	Y
7. ELISA	Y	Y	Y	Y	Y
8. HANNAH	N	Y	N	Y	Y
9. DIANNA	N	Y	N	Y	N
10. DR. N.	Y	Y	Y	Y	Y
11. NOELA	N	Y	Y	Y	Y
12. YULIYA	N	Y	Y	Y	Y
13. TIFFANY	N	N	Y	N	Y
14. ASHLEY	Y	Y	N	Y	Y
15. NICOLE	Y	N	Y	Y	Y
16. DANA	Y	Y	Y	N	Y
17. BRITTANY	Y	N	Y	Y	Y
18. JESSICA	N	N	Y	Y	N
19. HARRIET	N	Y	N	N	Y
20. MEGHAN	N	N	N	Y	N
21. BEATRICE	Y	Y	Y	Y	Y
22. JESSICA	N	Y	Y	Y	N
	12Y	**13Y**	**15Y**	**16Y**	**17Y**
	10N	**9N**	**7N**	**6N**	**5N**
Class B					
1. ERIC	?	Y	Y	Y	N
2. ANTONIO	N	Y	Y	Y	Y
3. JULIAN	N	Y	N	N	N
4. CHANDRAN	N	Y	N	Y	N
5. KENNY	N	N	Y	Y	Y
6. PASCAL	N	Y	Y	N	Y
7. STEFAN	N	N	N	N	N
8. MATTHEW	Y	N	Y	N	N
9. ERAN	Y	N	Y	N	N
10. BRIAN	Y	Y	Y	N	N
	3Y	**6Y**	**7Y**	**4Y**	**3Y**
	7N	**4N**	**3N**	**6N**	**7N**
TOTALS	**15Y**	**19Y**	**22Y**	**20Y**	**20Y**
	17N	**13N**	**10N**	**12N**	**12N**
	47%Y	**60%Y**	**70%Y**	**62%Y**	**70%Y**

Instructor's Notes

Even though they were told not to, the testers were most likely told the correct flavor when they got it wrong, which may have increased the number that picked strawberry (the student I tested picked "cherry" when she could see the Skittles; I did not tell the students I tested the true flavor).

Since the flavors are artificial, successful guesses may have been increased through experience. For example, the grape Skittles tasted less like real grapes to me than like grape soda which I am very familiar with. This might tie into the cognition ideas of Shankar et al. (2009) that were referred to in the introduction.

Ideas for an inquiry-based experiment

It would be interesting to repeat the experiment with real foods that the students are familiar with. My hypothesis is that there would be greater accuracy with real foods, but that visual cues would increase the accuracy of testing as well. Again, familiarity with the foods would probably figure into the accuracy of the tests. They could try blocking the nostrils to see if this would have an effect on taste. Gender, ethnicity, and age could also be tested. One person to whom I described this experiment suggested soaking the Skittles to remove the colored coating, and "re-dying" those different colors to "fool" the students! Other brands of candy could be tested, as well as Jelly Bellies. Students could look up the history of artificial flavors and report on this as well. They could also research the tie-in with taste and smell. This lab could be done in conjunction with case-studies of illnesses that involve a loss of taste and/or smell such as damage to the facial nerve and Alzheimer's.

In conclusion, this is a fun, easy, inexpensive and engaging experiment that lends itself to inquiry-based experimentation at all levels of biology from non-majors to anatomy and physiology.

Literature Cited

Shankar, M., Levitan, C. and C. Spence. 2009. Grape expectations: The role of cognitive influences in color–flavor interactions. *Consciousness and Cognition, In Press, Corrected Proof, Available online 13 October 2009*