TASTE:
THE NOSE KNOWS?

SARSEF 2022

Introduction

- Taste is one of our five senses, but it is clearly connected with smell.
- Tastants are the chemicals in food detected by taste buds on the tongue and palate.
- We have about 5-10,00 taste buds on average.
- Sensory signals travel via cranial nerves through the thalamus in the brain and into the caudal orbital cortex, creating the perception of taste.
- Odorants are airborne odor molecules that are sensed in the sensory cells of the nose and travel via the olfactory bulb to the primary olfactory cortex in the brain where the sense of smell is perceived.
- This area is adjacent to the caudal orbital cortex, which supports why taste and smell are linked.

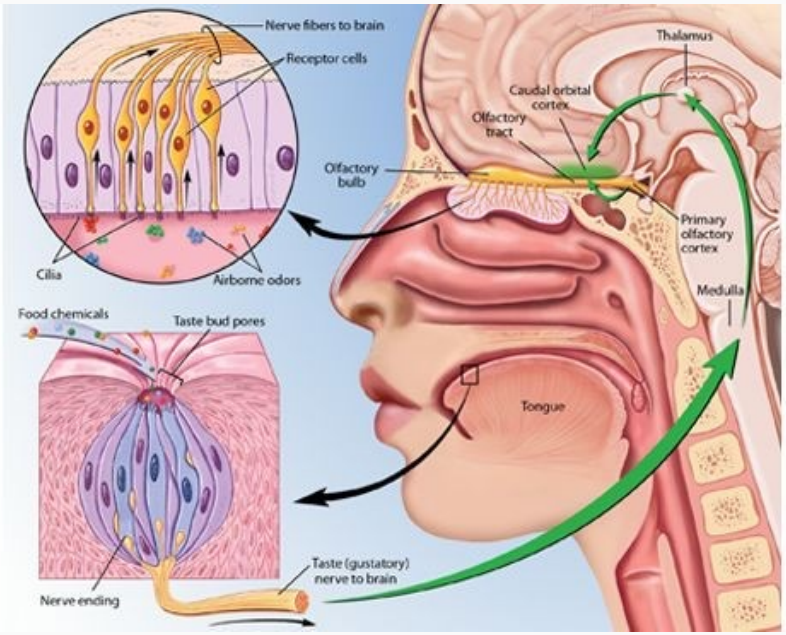
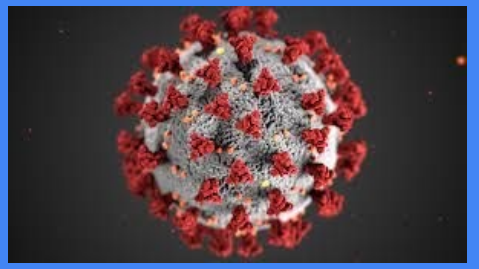


Figure adapted from BrainFacts.org



Introduction (continued)

- There are 5 taste sensations: bitter, sour, salty, sweet, and umami (Japanese for savory).
- When we chew, aromas are also released that activate our sense of smell by way of a channel that connects our throat to our nose → That is why we don't always taste food if our nose is blocked!
- Taste buds are the way in which our body determines what we should eat – it can distinguish food as sweet, bitter, or even poisonous.
- The ability to smell however, is important to this process → without it, flavor can be missed.
- This has been of particular interest during the COVID-19 pandemic since one study in the US showed people with COVID are 27 times more likely to lose their sense of smell.
- The link between taste and smell is called chemosensation.
- Our smell is critical to knowing what we are eating and helps us detect "warning" signs like sour milk before we even taste it.
- The loss of smell, or anosmia, most certainly impacts our ability to taste and would leave our life without a lot of flavor.

Now, let's test how someone can taste when we play with their ability to smell!

Hypothesis

The FUNDAMENTAL research question is:
How much does your sense of smell affect your sense of taste?

HYPOTHESIS:
If one's ability to smell is masked by peppermint oil or plugging their nose, then he/she will not be able to taste the flavor of a jelly bean.

Materials/Variables

- 15 volunteers
- Blindfold
- 3 plates
- 15 strawberry jelly beans
- 15 grape jelly beans
- 15 lemon jelly beans
- Cotton swab
- Peppermint oil
- Pencil and paper

INDEPENDENT VARIABLES: Blindfolding participants, plugging the nose and use of peppermint oil

DEPENDENT VARIABLE: Taste/flavor of the jelly bean

CONTROL: Blindfolded participant without altering smell

Procedures

- STEP 1: Gather 15 volunteers who have no allergies to peppermint oil or jelly beans.
- STEP 2: Place 5 each of strawberry, grape, and lemon jelly beans onto three separate plates.
- STEP 3: On plate 3, dab each jelly bean with a drop of peppermint oil using a cotton swab.
- STEP 4: Blindfold volunteers one at a time, hand the volunteer a jelly bean from plate 1 and give him/her 3 seconds to identify the flavor.
- STEP 5: Put a checkmark in the results table if the volunteer identifies the flavor correctly.
- STEP 6: Now have the volunteer plug their nose and hand them a jelly bean from plate 2 and give him/her 3 seconds to identify the flavor.
- STEP 7: Let the volunteer open their nose and hand them a jelly bean from plate 3 and give him/her 3 seconds to identify the flavor.
- STEP 8: Repeat steps 4-11 for each of the 15 volunteers and record responses as above in the table.
- STEP 9: Tabulate the number of correctly identified flavors for each plate.

Results

TABLE 1: TALLY OF GUESSES

	STRAWBERRY	**GRAPE**	**LEMON**
Plate 1: CONTROL	Y, Y, Y, Y	Y, Y, Y, Y, Y, Y, N	Y, N, Y, Y
Plate 2: NOSE PLUGGED	N, Y, N, N, Y, N	N, N, N	N, N, N, Y, Y, Y
Plate 3: PEPPERMINT OIL	N, N, N, N, N, N	N, N, N, N, N, N	Y, N, Y

LEGEND: Y = PARTICIPANT GUESSED CORRECTLY
N = PARTICIPANT DID NOT GUESS CORRECTLY

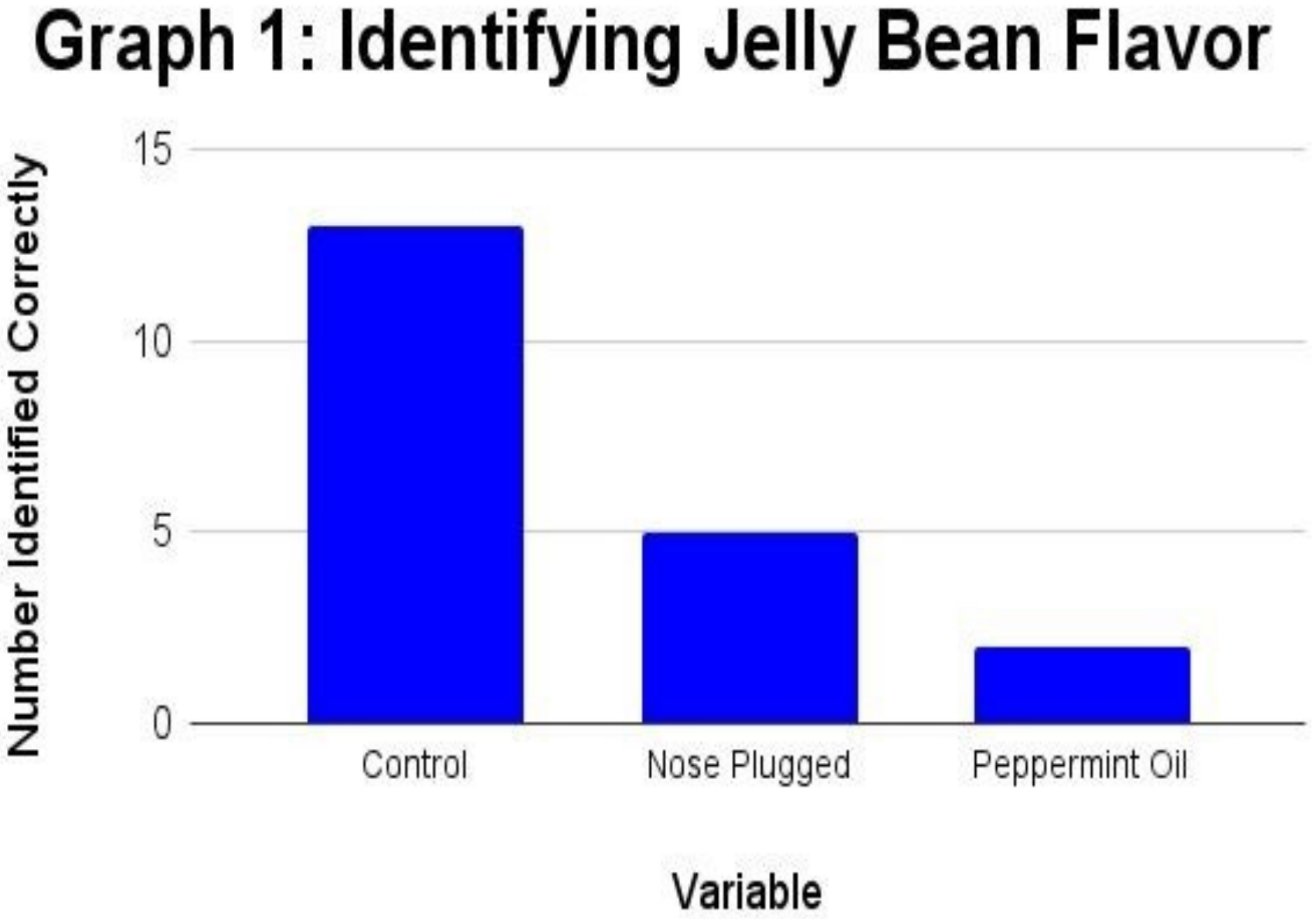
Results (continued)

DATA SUMMARY (Graph 1):

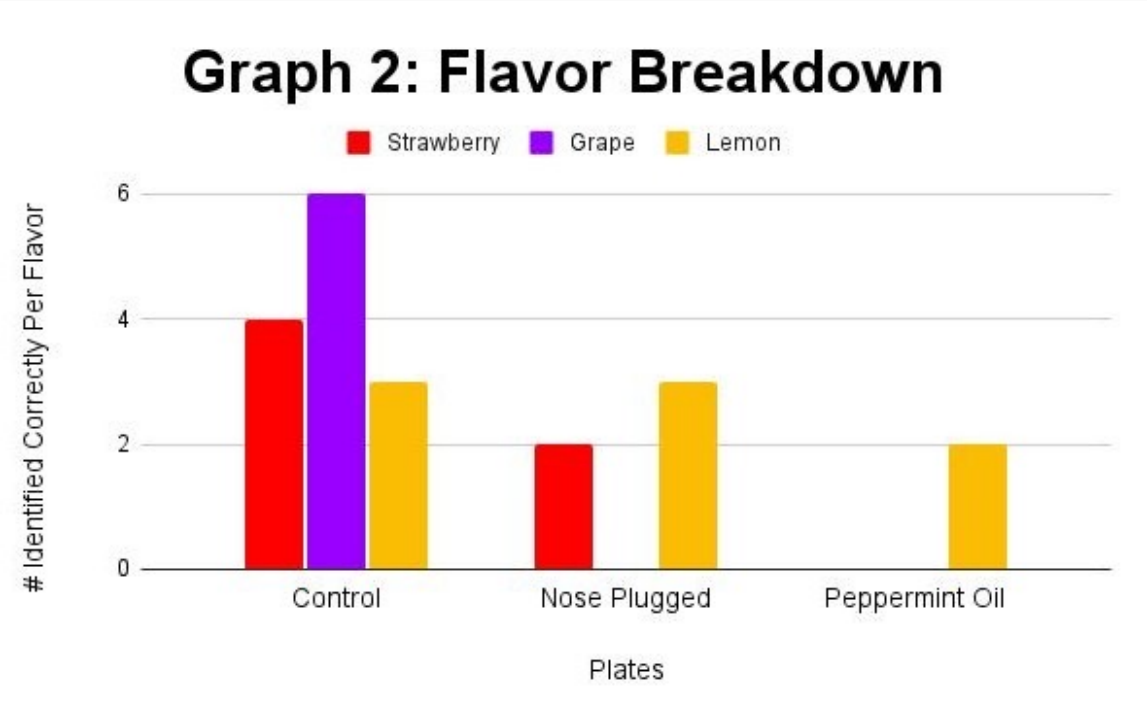
- **Plate 1, control:** 13/15 (86.7%) participants identified the flavor of jelly bean correctly
- **Plate 2, nose plugged:** 5/15 (33.3%) participants identified the flavor of the jelly bean correctly
- **Plate 3, peppermint oil:** 2/15 (13.3%) participants identified the flavor of the jelly bean correctly

The CONTROL group was the most commonly identified jelly bean flavor.

Results (continued)



Results (continued)



- **Graph 2** shows the breakdown of which flavors were identified correctly per variable.
- This was an important analysis to determine if there was a trend or pattern in which flavors were more recognizable regardless of the variable.
- It seems that a lemon/citrus flavor may be easier to taste, even when a participant's nose is plugged or when the smell is altered by peppermint oil.
- This suggests that stronger flavors may not be as dependent on a strong sense of smell, but this would need to be prospectively tested and validated.

Conclusion

Based on these results, my hypothesis that taste was dependent on smell was correct. The control group that was able to smell while tasting jelly beans was most successful at identifying the accurate flavor. The ability to change the smell or to prevent subjects from smelling clearly impaired them from guessing the correct jelly bean flavor. The connection between taste and smell has been explained neurologically and this experiment is a real world test of how interdependent these two senses are.

Discussion

- The fundamental question in this science fair project was to see if the sense of taste was dependent on one's sense of smell.
- The hypothesis was that if you either took away a person's sense of smell or altered a smell, you would obscure their sense of taste. This experiment confirmed the hypothesis.
- The most accurate identification of jelly bean flavors was noted in the control group (**Graph 1**) when participants were blindfolded but were able to smell while they sampled the jelly bean. Here, 86.7% of the participants accurately guessed the jelly bean flavor.
- The variable that seemed to confuse subjects the most and make it harder to identify the flavor correctly was the peppermint oil. Only 13.3% of participants could guess the flavor in this group, suggesting that by changing the smell of a jelly bean, the subject has a harder time tasting the flavor accurately.
- When subjects were asked to plug their nose, 33.3% of them correctly identified the jelly bean flavor. Interestingly, when most of the participants unplugged their nose and their sense of smell was restored, they could then taste the flavor correctly. This strongly supports the hypothesis that you need an intact sense of smell to identify what you are tasting.

Discussion (continued)

- This experiment was conducted controlling for several variables.
- Jelly beans were used to ensure that texture and shape was similar across the different flavors.
- Participants with recent COVID-19 infections were excluded to ensure that they had a strong and developed sense of taste and smell.
- One subject did admit she has a history of allergies/asthma, but she was able to correctly identify the control flavor, so we included her in the analysis.
- Two people who did not guess the control flavor correctly were still included in the experiment as this type of random error is part of the scientific method and does not significantly impact the analysis or conclusions.
- It is also important to note that some participants could identify the taste but used broader categories like “lemon/lime/citrus/tart” or “strawberry/cherry”.
- These answers were marked as correct since they did represent the accurate flavor profile. Since they were not given a list of flavors to choose from, this was felt to be the best approach to this unexpected finding.

Implications and Future Directions

- This project clearly shows the connection between smell and taste.
- This has never been as relevant as it is now due to the ongoing COVID-19 global pandemic.
- Many people infected with COVID suffer from anosmia, a loss of the sense of smell.
- These patients often also have lost their sense of taste, which makes one hypothesize that COVID-19 affects these interconnected neural pathways.
- Future studies could focus on following people recovering from COVID-19-associated anosmia who also have documented loss of taste.
- Patients could be monitored longitudinally for them to regain their sense of smell.
- One could then determine if their recovery of taste is correlated and charts along the same time course as their sense of smell.
- This could lead to hypotheses on how to shorten the duration of this post-COVID phenomenon.

References

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