UNIVERSITY OF MINNESOTA ROCHESTER

Making Sense of the Senses

Jenny Wollschlager

Center for Learning Innovation

University of Minnesota Rochester

ABLE 2024

Touch

- Pair up
- One person will close their eyes and lay their hand face up on the table.
- The other person needs 2 mechanical pencils (lead retracted)
- Now touch the persons fingertip with one or two pens (roughly 1 cm apart) and see if the person can tell if it is one or two pencils that are touching their fingers.
  - Repeat this experiment a few times
- Are they able to accurately identify when it is one pen versus two that is touching their fingertips?
- Now try this with the persons shoulder (deltoid region)
- Are they able to accurately identify when it is one pen versus two that is touching their shoulder?

Tactile Receptive Fields

- The fingertips have significantly more neurons devoted to tactile sensation than the shoulder [1].
- Each neuron covers a smaller area of skin within the fingertips compared to the shoulder [1].
- As a result you can feel 1 or 2 pokes easily on your fingertips, but 2 pokes on your shoulder often is found in 1 receptive field making it feel like a single poke [1].

Pupillary Responses

- Pair up.
- If you are the volunteer, put your finger directly in front of your eyes near your nose. Look at it for 10 seconds. If you are the observer, watch the volunteer's eyes.
- Now, look away at something behind your finger, but on the other side of the room. You want to keep your head and eyes looking in the same general spot, just at something distant.
- Switch back to looking at your finger.
- What did you observe?
- Switch volunteers.

Constriction vs Dilation

- Constriction and dilation changes the amount of light that hits the retina mostly based on light present [1].
- Pupil Near Response [1]
  - Looking at distant objects requires a more dilated pupil (to take in more information) [1].
  - Looking at near objects requires less dilation (constriction allows better focus) [1].

Convergence and Accommodation

- Distant vision requires relaxed ciliary muscles and a stretched lens (flatter). Pupils will be more centered in the eye [1]
- Near vision requires contracted ciliary muscles and a relaxed lens (accommodation) [1]. Pupils will be medial from contraction of extrinsic eye muscles (convergence) [1].

Rick roll negative image [2]

Afterimages

- The mechanism is complex, but one part relates to the photoreceptor cells in the eyes and the bleaching reaction occurring within them [1, 3].
- Specific areas of the retina are reacting (bleaching) to the white light from the image [1, 3].
- Areas that see black do not respond/bleach [1, 3].
- Switching to a white surface will send the white light to all areas of the retina. Only the areas that “saw” black can respond, while areas that “saw” white are bleached and will take a few seconds to reset and be able to respond [1, 3].

Vision and Hearing demonstration

- Open the following video and listen without watching. What do you hear?
  - https://www.youtube.com/watch?v=XFtWOak4ZKI&list=PL2r9oIU-8q1APr8ZUDkwtl7GZ0VJkO6tx
- Now watch the video. What do you hear during each part?

- The McGurk effect
  - Auditory-visual illusion
  - We hear different things depending on what we see

- Extra fun video
  - Bill, Pail, Mayo

Taste Receptors

- What are the different taste receptors we have?
  - Salty
  - Sour
  - Bitter
  - Sweet
  - Umami

Activity

- You have 3 different types of popcorn
- Try the different types and rate them from best to worst
- Discuss with each other why one type tastes better than another type
  - Note, there is no right answer here, as it is entirely personal preference.
- https://forms.gle/JEhvYs3vCxbYT59k6

Popcorn Results Discussion

- Some of the Descriptions from 2023
  - More salt
  - More fat/buttery
  - Most flavor
  - More flav-flavor town
  - Yummy in my tummy

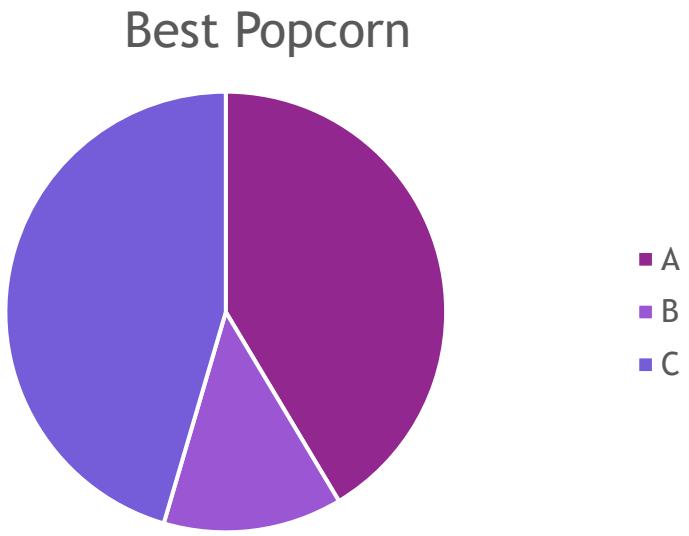
			A	B		C
Brand	Act II	Act II	Act II	Act II	Act II	Act II
Variety	Homestyle	94% Fat Free	Extreme Butter	Butter	Butter Lovers	Movie Theater Butter
Fat Content (g/cup)	1.11	0.31	1.80	1.33	1.55	1.78
Salt Content (mg/cup)	46	46	58	62	68	84
Color (artificial color added)	white	Light yellow	yellow	Light yellow	yellow	yellow
Ingredients (butter)	No butter	Butter	Butter	No butter	No butter	No butter

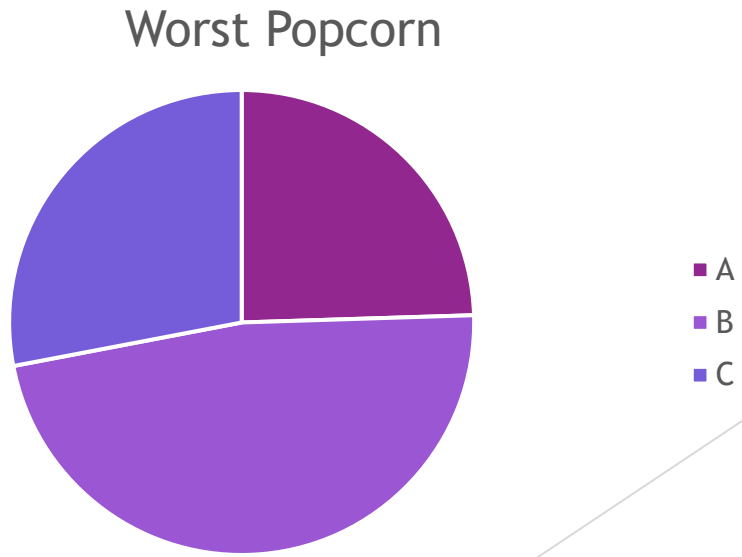
What affects flavor?

- Color matters
  - Darker yellow popcorn might taste more buttery than white popcorn
- Salt
  - Salt enhances flavor, so adding salt could make the popcorn taste more buttery
- Fat content
  - Fat Taste Receptors
    - Long chain fatty acids likely activate a GPCR in humans [4, 5, 6]
    - Not enough is known yet to actually classify it as a taste receptor [5]
    - Still need specific areas in the brain being activated by fat, independent perception of fat, and other physiological effects [5]

Past Results

- C tends to be the favorite popcorn, with A as a very close second
  - C and A have roughly the same fat content
  - C had a higher salt content
  - C is NOT the darkest yellow
- B is overwhelmingly the least favorite
  - Lowest fat content
  - Roughly the same salt content as A
  - Roughly the same color as C





Vanilla Sugar Experiment

- Everyone who wishes to participate, get a spoonful (little or lots, doesn't matter) of vanilla sugar
- The next parts we will do as a group at the same time. Instructions are below, but don't start.
  1. Plug your nose
  2. Taste the sugar for 5 seconds with your nose plugged. Note the flavor.
  3. Unplug your nose
  4. Continue tasting the sugar. Note the flavor.
- What were your observations?

Smell and Taste both contribute to flavor

- Without your sense of smell most things will taste bland [1].
- There are thousands of scents we can distinguish, but only 6 specific taste receptors (not including triggering thermoreceptors and tactile receptors in the mouth) [1].

What color is my shirt?

- Anonymous
- The form does ask your gender identity, but you can choose not to answer

- https://forms.gle/HEMCLu4tHtxsFx8S6

Results from Fall 2023

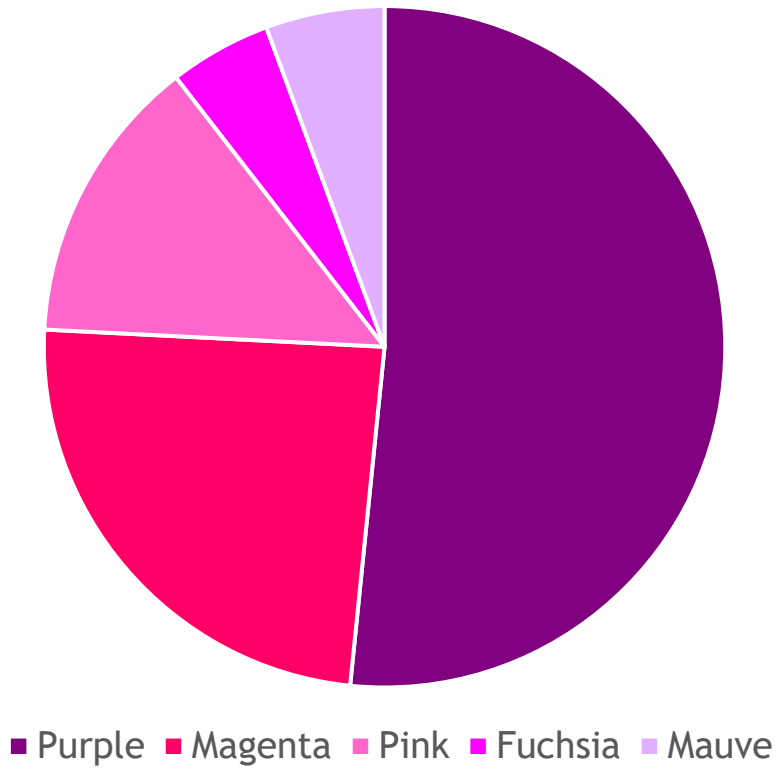


Figure 1: “What color is my shirt?” survey results from class October 11th, 2023. Colors with 3 or less responses were removed (n=124). Hex codes were used for Mauve and Fuchsia for accuracy.

- Honorable mentions
  - #D9659F →
  - Amaranth
  - Byzantine
  - Dark, dusty purple
  - Orchid
- The shirt is below

References

1. Mckinley MP, Valerie Dean O'loughlin, Theresa Stouter Bidle. 2022. Anatomy & physiology : an integrative approach. 4th ed. New York: Mcgraw-Hill Llc.
2. Optical Illusionist. 2022. *Rickroll illusion*. https://www.optical-illusionist.com/illusion/84/rickroll-illusion/
3. Loomis JM. 1972. The photopigment bleaching hypothesis of complementary after-images: A psychophysical test. Vision Research. 12(10): 1587–1594. https://doi.org/10.1016/0042-6989(72)90031-4
4. Galindo, M.M., Voigt, N., Stein, J., van Lengerich, J., Raguse, J., Hofmann, T., Meyerhof, W., Behrens, M. (2012). G Protein–Coupled Receptors in Human Fat Taste Perception. *Chemical Senses,* (37)2, 123-139. https://doi.org/10.1093/chemse/bjr069
5. Keast, R.S., Costanzo, A. (2015). Is fat the sixth taste primary? Evidence and implications. *Flavour,* (4)5, https://doi.org/10.1186/2044-7248-4-5
6. Liu, D., Costanzo, A., Evans, M., Archer, N., Nowson, C., Duesing, K., & Keast, R. (2018). Expression of the candidate fat taste receptors in human fungiform papillae and the association with fat taste function. *British Journal of Nutrition,* 120(1), 64-73. doi:10.1017/S0007114518001265