Teacher Guide

Whose Choice is it Anyway?

Lesson Summary: Students discuss the ethics of neuromarketing after learning about an experiment conducted by the Brown Human Neuroimaging Lab at Baylor College of Medicine. This study involved fMRI imaging of participants' brains while they sampled Pepsi™ and Coke™ to study what parts of the brain register preference and how cultural influences affect preferences. Optional Activity: students can participate in and analyze a Taste Test Experiment to discover if brand name influences soft drink preference.

Grade Level 5-8

Lesson Length
1 class period

Optional Activity
1 class period

Standards Alignment

Next Generation Science Standards

- 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem
- 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
- 4-LS1-2. Use a model to describe that animals receive different types of information through their senses, process the information in their brain, and respond to the information in different ways.
- MS-ETS1-4. Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.
- MS-LS1-8. Gather and synthesize information that sensory receptors respond to stimuli by sending messages to the brain for immediate behavior or storage as memories.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- HS-LS1-3. Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
- **Framework for K-12 Science Education**: Science & Engineering Practices 4,5,6,7,8

National Science Standards – Project 2061: Atlas of Science Literacy reference

a) Scientific inquiry: Scientific investigations – kinds of investigations (p. 19, Atlas Vol. 1)

- *Research on student learning*: "With adequate instructions, it is possible to have middle-school students understand that experimentation is guided by particular ideas and questions and that experiments are tests of ideas." (p.18, Atlas Vol. 1)

b) Scientific inquiry/Avoiding bias in science – expectations and explanations (p.23, Atlas Vol. 1)

- *Research on student learning*: "Students tend to look for or accept evidence that is consistent with their prior beliefs and either distort or fail to generate evidence that is inconsistent with these beliefs." (p.22, Atlas Vol. 1)

Objectives—Students will

- draw conclusions and raise questions based on analysis of published data.
- develop opinions based upon reading an article, analyzing data from and discussing the implications of neuroscience research about human preferences.

Optional Objectives—Students may

- gather individual data and group data for an experiment.
- analyze their own experimental data by calculating percentages and developing bar graphs.

Assessment Options

- Provide participation points based on involvement during group discussion. Or, both before and after class discussion, direct students to write what conclusions they draw from the presented data. Compare whether or not their conclusions changed and, if so, why they may have changed.
- Students write a reasoned opinion paragraph on an ethical question raised in the class discussion. In the paragraph, students must cite specific experimental results or knowledge of brain function that lead them to their point of view.

Optional Assessment Options

- Collect or check Data Table 1 – Poll Preferences, Data Table 2 – Your Preference, and Data Table 3 – Class Preference.
- Collect or check percentage calculation and bar graphs of Poll Preference, as well as Tests 1, 2, and 3 for the Class Preference data.
- Collect or discuss conclusions students develop after analysis of Class Preference data.

Terms — important vocabulary that can strengthen the lesson -- select terms according to the needs and abilities of your students.

- neuromarketing – a new branch of neuroscience concerned with determining public preferences and marketing strategies based upon fMRI brain scans
- ethics – the principles of right and wrong behavior governing a group of people
- neuroethics – questions about ethics raised from neuroscience experiments

Materials

- 1 liter of Coke (per class of 30)
- 1 liter of Pepsi (per class of 30)
- 6 disposable paper cups per student
- Taste Test Data Tables – one per student
- 6 unmarked containers that will each hold 1 liter of fluid
- 6 teaspoons for measuring out drinks, one for each container of liquid

- graph paper (optional)
- calculator
- overhead transparency or image of Forbes Magazine, September 1, 2003 cover page – link on BrainU Lesson page
- overhead transparency or image of Fig. 1D, 2D, 3D, 4B, and 4D from Montague et al 2004 "Neural Correlates of Behavioral Preference for Culturally Familiar Drinks" in **Neuron** 44:379-387

Session A – Ethics of Neuromarketing Discussion

Length – One Day/45 min

Session B – Taste Testing (Optional Session)

Length – One Day/45 min

Pepsi and Coke can be replaced with a brand name versus generic juice or tap versus bottled water if drinking soda in school is discouraged.

Session A – Ethics of Neuromarketing Discussion **Lesson Length: 45 minutes**

Pre-Lesson Homework – to be completed prior to class period

- Provide students with a copy of the "Neuroscience breaks down soft drink 'battle' inside brain" article from BioEd Online and article questions.
- Instruct students to read the article and complete the questions prior to Session A class period.

Alternative

- Ask students to find a print advertisement of their choice (or one that uses the brain!) and write an analysis of how it is selling the product.
- Why is this ad appealing? Why is the product appealing? Are these the same? Do you like the product more or less because of the ad?

Engage

1. Start by asking the class the following questions:
    - How do you make choices?
    - On what do you base your opinions?
2. Through discussion, elicit answers on the order of
    - through feelings or emotions
    - through reasoning or thinking

    Different parts of the brain are involved in each of these.
3. During the discussion, raise - but don't necessarily answer - these questions:
    - Are our choices totally independent? Do we always get to make our own choices?
    - What are some influences on our choices? How do these influences affect our thinking?

Explore 1

1. Show students the image of the cover page to the September 1, 2003 edition of Forbes Magazine.
2. Ask students to study the image and write at least two statements that come to mind after viewing the image.
3. As a group, discuss the students' statements.
4. As a class, discuss student answers to the questions in the "Neuroscience breaks down soft drink 'battle' inside brain" article.

Explore 2

1. Introduce Montague's experiment by stating: "Neuroscientists wanted to understand what cultural (social) influences may affect our choices of food and drink, and how these are processed in the brain."
2. Ask the class how they might go about doing such an experiment. Elicit answers geared towards
    - choosing among similar items, some with high sugar content
    - choosing between brand-name and store-brand cereals
3. Describe the experiment and illustrate the story with the figures provided (see **Montague's Experimental Results**).
4. Discuss the main points of the experiment (see **Montague's Experimental Results**).
5. If optional Session B Taste Test experiment will be done, make sure to avoid telling the class that in one-labeled tests 2 & 3 the cups always contained the same drink.
6. In small groups, direct students to discuss some or all of the following ethics of neuromarketing questions and report back to the whole class:
    - Are our choices totally independent? Are they **conscious** decisions? Why or why not?
    - What are the influences on our choices?
    - What are the ethical (principles of right and wrong behavior governing a group of people) questions raised by the ability to pinpoint brain responses?
    - Should advertisers image our brains so that they know how to sell their products better? Why or why not?
    - Should politicians image our brains so that they know how to influence public opinion better? Why or why not?
    - When do we have the cognitive control to realize when our choices are being influenced by cultural forces?
    - Which cultural forces do we want to influence our choices?
    - Should our choices be influenced by our moods? Why or why not?
    - How do we train the rest of the thinking parts of our frontal cortex to make decisions based upon reasoning and knowledge and not emotions or cultural influences?
7. As a class or in small groups, develop a list of the pros and cons of neuromarketing.

Session B – Taste Test (Optional) **Lesson Length: 45 minutes**

Engage — Preference Poll

1. Poll students on their preference for Pepsi, Coke, or neither. Record results on the board.
2. Tell students to record results in **Data Table 1 – Poll Preference**.

Explore — Conduct the Taste Tests

Test 1: No Label Taste Test

1. Each student receives two disposable cups, each containing 1 Tsp (5 ml) of a drink. The cups are labeled A and B, respectively.
2. Cup A contains Pepsi and cup B contains Coke.

   Mix it up: change cup A to Coke and B to Pepsi between classes. The actual contents of all unlabeled cups must be kept secret.

   Pepsi and Coke can be replaced with a brand name versus generic juice or tap versus bottled water if drinking soda in school is discouraged.
3. Students sample contents of cups A and B, then they record which drink they prefer in **Data Table 2 - Your Preference** under Test 1 – No Label Test.
4. Students discard the used cups.

Test 2: Labeled Taste Test A

1. Each student receives two disposable cups: one labeled Coke and one unlabeled.
2. Students are instructed that the labeled cup does contain Coke but the unlabeled cup could contain either Coke or Pepsi. The students are not aware of this but **both cups contain Coke**. Keep contents of the unlabeled cup unknown.
3. Students sample contents of both cups and then record which cup they prefer in **Data Table 2 - Your Preference** under Test 2 – Labeled Test A.
4. Students discard the used cups.

Test 3: Labeled Taste Test B

1. Each student receives two disposable cups: one labeled Pepsi and one unlabeled.
2. Students should be instructed that the labeled cup does contain Pepsi but the unlabeled cup could contain either Coke or Pepsi. The students are not aware of this but **both cups contain Pepsi**. Keep contents of the unlabeled cup unknown.
3. Students sample contents of both cups and then record which cup they prefer in **Data Table 2 - Your Preference** under Test 3 – One Label Test B.
4. Students discard the used cups.

To help facilitate this activity, get two students to measure 1 teaspoon (or smallest amount that can be poured) of the drink per cup and two students to distribute the cups

Transfer soda into similar, unlabeled containers to prevent students doing the pouring from knowing the cup contents. For **No Label Test**: teacher should have 2 pitchers labeled A & B. For each **Labeled** test, teachers should have 2 pitchers labeled Brand Name (containing the brand) and Unknown (also containing brand), so in Test 2 the unknown is Coke and in Test 3 the unknown is Pepsi.

Explain

1. Collect and record student data on the board or overhead to create **Data Table 3 – Class Preference**.

2. Combine all student responses for each test (Test 1, Test 2, and Test 3) in **Data Table 3 – Class Preference** under the appropriate test.

3. Develop a Bar Graph to illustrate class preference for the Preference Poll and Tests 1, 2, and 3.

4. For each row in **Data Table 3**, calculate the % of students in each category. Replot the data.

5. What does the data say? Help your class interpret the data. Does knowing one brand alter your choices? Only after this first interpretation do you break the code – re-label the graphs and then reinterpret the data.

6. Compare and contrast class data to Montague's data. What are the differences? What are the similarities? Can your class draw the same conclusions that Montague did? Why or why not?

   Differences include: ability to do fMRI, random assignment of drink to cups in No Label Test, and test repetitions. Montague's subjects repeated each test 3 times or 15 times. Montague also tested carbonated versus flat drinks and found no difference.

7. Why was it important that in Tests 2 and 3 both cups contained the same drink?

8. Ask students to summarize the data and draw conclusions based on data interpretation.

   Students should discuss if they were influenced by the brand name and why/why not.

Taste Test Data Tables

Data Table 1 - Poll Preference

Beverage Type	# of Students who prefer
Pepsi	
Coke	
No Preference	

Data Table 2 - Your Preference

Test		Preferred Sample Choice Circle the sample you most preferred.	
#	Type		
1	No Label Test	Cup A	Cup B
2	Labeled Test A	Coke	Unlabeled
3	Labeled Test B	Pepsi	Unlabeled

Data Table 3 - Class Preference

Test		# of students Record the number of students who preferred each sample.	
#	Type		
1	No Label Test	Cup A	Cup B
2	Labeled Test A	Coke	Unlabeled
3	Labeled Test B	Pepsi	Unlabeled