Investigation 6

What factors affect reaction time?

What is reaction time?

The time it takes for the brain to receive information collected by the senses, process the information, and send signals along nerves to produce a response by muscles

When does reaction time matter?

Some things to keep in mind about reaction times:

- Measured in milliseconds (thousandths of a second)

- Vary widely among people

- May change with circumstances and experience

- Can be tested quickly and easily (no special training needed)

# One way to measure reaction time is with a specially designed ruler

One person holds the ruler at the top, and the person being tested holds their hand near (but not touching) the bottom edge. Then the holder drops the ruler. The longer it takes the other person to catch the ruler, the slower their reaction time (marked on the ruler in milliseconds).

Students conducting the ruler-drop reaction-time test

All of these steps must occur for the student to catch the ruler when it drops
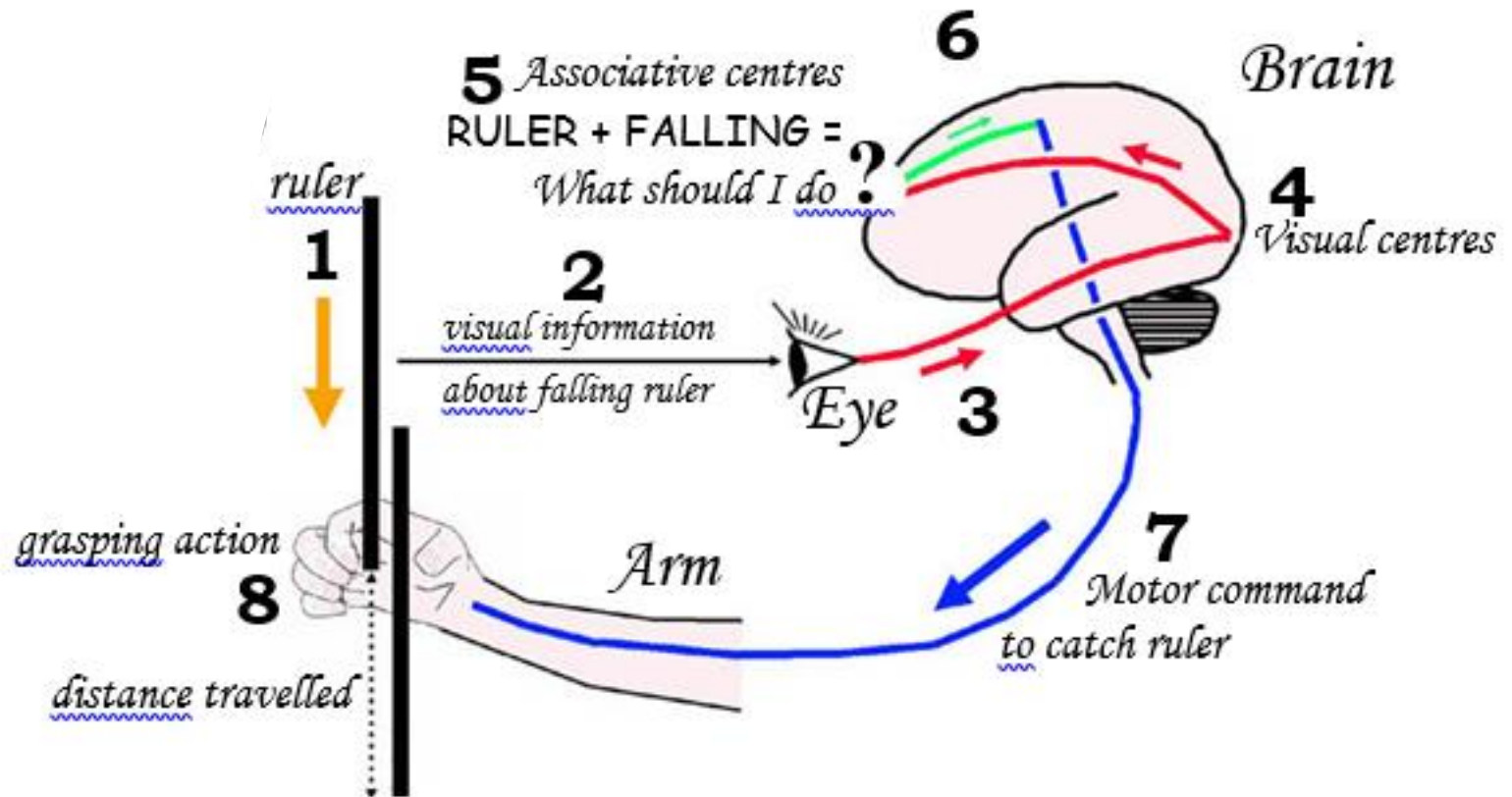
It's important to keep in mind that we are <u>not</u> investigating reflexes

Unlike reactions, reflexes are:

- involuntary
- usually simple
- much faster than reactions
- the same in all healthy people
- not capable of improvement with practice

What are some examples of reflexes?

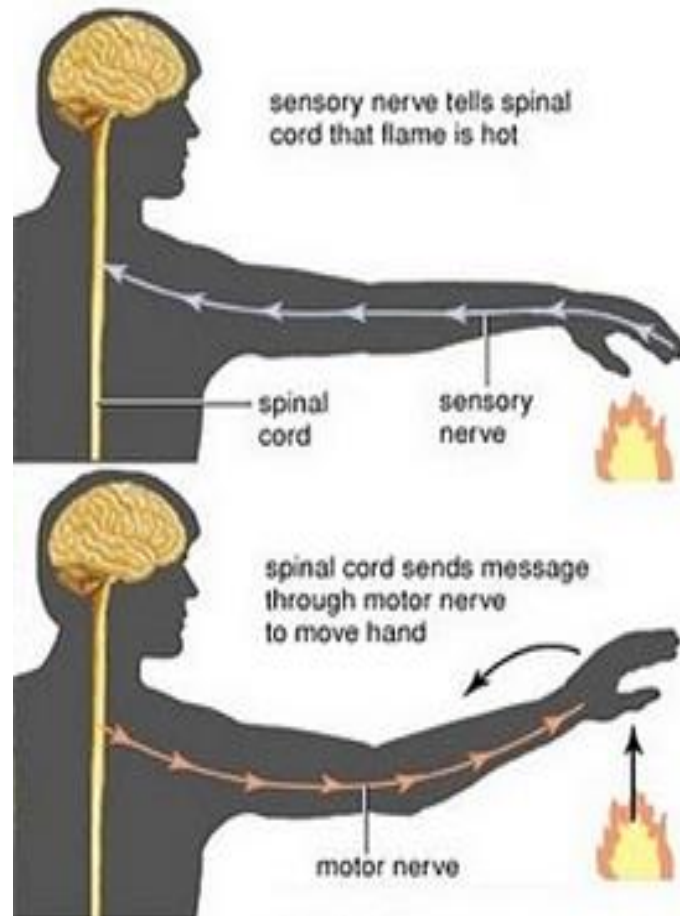Grasping reflex in babies

Knee-jerk reflex (patellar reflex)

Withdrawal reflex (from pain)

Moro reflex in babies

Reflexes are much simpler than reactions

sensory nerve tells spinal cord that flame is hot

spinal cord

sensory nerve

spinal cord sends message through motor nerve to move hand

motor nerve

Compare this reflex with the complex pathway required for a person to react in time to catch a falling ruler

Now, you're ready to try out three
online reaction timers

In a new window, open the website where you accessed this document, and scroll down to find links to the online reaction timers we will use

(see next slide)

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Human Benchmark reaction time test:

https://www.humanbenchmark.com/tests/reactiontime/

Red light-green light reaction time test:

https://faculty.washington.edu/chudler/java/redgreen.html

Auditory reaction time test:

https://playback.fm/audio-reaction-time

Student's t-test:

http://www.physics.csbsju.edu/stats/t-test_bulk_form.html

On p. 67 of your lab manual, label the blank charts "Human Benchmark," "Red light-green light," and "Auditory."

Leave the fourth chart blank
(you will not need it).

Try each of the three online reaction timers, and record your reaction times on .

For the Human Benchmark test, you can leave the "Trial 1-Trial 5" lines blank and just record your final result in the bottom row of the chart.
For the other two tests, record five consecutive results and your average.

Each test result should be written as a 3-digit number, WITHOUT A DECIMAL
(for example, you would record 331, not 0.331).

Answer Questions 1-5 on pp. 68-69 of your lab manual.

Omit parts 2 and 3 of Question 4 (they ask about other students at your lab table or in your lab section).

Now we will investigate two scientific questions about reaction times.

Question 1: Is there a statistically significant difference between average reaction times with the dominant hand versus the non-dominant hand?

In question 6 (p. 69), the first independent variable to be tested is "dominant vs. non-dominant hand."

In Question 6a, write your own hypothesis about whether you would expect a difference between students' reaction times when tested with their dominant hand vs. their non-dominant hand.

(If you're right-handed, your right hand is your dominant hand. If you're left-handed, your left hand is your dominant hand.)

Assuming that you used your dominant hand for the Human Benchmark test, record your reaction time (from p. 67) in the Google sheet ("Investigation 6 Student Data") on the page where you accessed this document.

Then repeat the Human Benchmark test with your non-dominant hand, and record your reaction time in the appropriate column in the same row of the Google sheet.

To compare average results from students' dominant and non-dominant hands, we will use a statistical test called a *t-test*. It compares the averages of two sets of data.

Return to the page where you accessed this document, and click on "Student's t-test" (at the bottom of the page).

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Student's t-test:

http://www.physics.csbsju.edu/stats/t-test_bulk_form.html

Copy 24 reaction times from the "dominant hand" column of the Google sheet into the box labeled "Data for Group A." Type a single space after each 3-digit number.

Copy the corresponding 24 reaction times from the "non-dominant hand" column of the Google sheet in the box labeled, "Data for Group B." Type a single space after each 3-digit number.

Do not cut data from the Google sheet!
That creates problems for other students who need to complete this investigation.

Data Entry: Student's *t*-test

You are about to enter two sets of data so that Student's *t*-test can be used to determine if the averages of your two

For each dataset, enter your data into the given box separating each datum from its neighbor with tabs, commas, or
should be able to just copy and paste that data into the appropriate area. This form is designed to handle datasets w
displaying the data as a boxplot.

Click on the **Calculate Now** button when you have entered your data. Empty boxes will be ignored.

| Calculate Now | Clear All |

Data for Group *A*

```
331 590 444 223 311
```

Type a single space after each reaction time. Do not hit enter after each reaction time.

This example shows only five reaction times, but you should copy 24 results from the "dominant hand" column and the corresponding 24 results from the "non-dominant hand" column.

Data for Group *B*

```
410 198 650 229 333
```

| Calculate Now | Clear All |

When you have entered 24 results in each box, click "Calculate Now."

Remember:
Group A=dominant hand reaction time
Group B=non-dominant hand reaction time

Use the results that appear on your screen to write the mean and standard deviation for each set of data in the chart on p. 69.

On p. 69, reaction time 1 is "dominant hand."

Reaction time 2 is "non-dominant hand."

Standard deviation measures the amount of variation in a set of data (how consistent or inconsistent the data are)

To answer question 6c, refer to the text that appears on the results screen, just above the first horizontal line.

It should say, "The probability of this result, assuming the null hypothesis, is…" (followed by a number between 0 and 1.0)

If the number that follows the probability statement is ≤ 0.05, the difference between the average reaction times for dominant and non-dominant hands is STATISTICALLY SIGNIFICANT (not likely to be due to chance).

If the number is > 0.05, the difference between the average reaction times is NOT statistically significant (there is no real difference between the average reaction times).

On pp. 70-71, you will work through the same process for a different question about reaction times.

Question 2: Is there a statistically significant difference between average reaction times with and without multitasking?

In question 7 (p. 70), the second independent variable to be tested is "multitasking."

In Question 7a, write your own hypothesis about whether you would expect a difference between students' reaction times when tested with and without multitasking.

(We will all use the same set of instructions for how to multitask.)

Assuming that you tested yourself on the Red light-Green light test without multitasking, record your result (from p. 67) in the same Google sheet ("Investigation 6 Student Data") where you entered your previous data.

Then repeat the Red light-Green light test while multitasking, and record your result in the appropriate column in the same row of the Google sheet. Multitasking instructions are on the next slide.

How to multitask for this investigation

- Begin making tally marks on a piece of scrap paper (or in your lab manual) with the hand you normally write with

- Continue making tally marks while you use your other hand to take the Red light-Green light reaction time test

To compare average reaction times of students with and without multitasking, we will use a *t-test* again.

Return to the page where you accessed this document, and click on "Student's t-test"

Enter 24 reaction times from the "no multitasking" column of the Google sheet in the box labeled "Data for Group A." Type a single space after each 3-digit number.

Enter the corresponding 24 reaction times from the "multitasking" column of the Google sheet in the box labeled, "Data for Group B." Type a single space after each 3-digit number.

Do not cut data from the Google sheet!
That creates problems for other students
who need to complete this investigation.

Data Entry: Student's *t*-test

You are about to enter two sets of data so that Student's *t*-test can be used to determine if the averages of your two

For each dataset, enter your data into the given box separating each datum from its neighbor with tabs, commas, or should be able to just copy and paste that data into the appropriate area. This form is designed to handle datasets w displaying the data as a boxplot.

Click on the **Calculate Now** button when you have entered your data. Empty boxes will be ignored.

| Calculate Now | Clear All |

Data for Group *A*

```
331 590 444 223 311
```

Type a single space after each reaction time. Do not hit enter after each reaction time.

This example shows only five reaction times, but you should include 24 results from the "dominant hand" column and the corresponding 24 results from the "non-dominant hand" column.

Data for Group *B*

```
410 198 650 229 333
```

| Calculate Now | Clear All |

When you have entered 24 results in each box, click "Calculate Now."

Remember:
Group A=no multitasking
Group B=multitasking

Use the results that appear on your screen to write the mean and standard deviation for each set of data in the chart on p. 70.

On p. 70, reaction time 1 is "no multitasking."

Reaction time 2 is "multitasking."

To answer question 7c, follow the same instructions you used for interpreting the results from the previous *t-test*.

(If the probability is <0.05, the difference is statistically significant. Otherwise, the difference is not statistically significant.)

If the difference between two averages is not statistically significant, researchers have still learned something new!

It's ok to leave the charts on p. 71 blank.
You will turn in this investigation (including the pre-lab assignment) at the **start** of your next in-person lab.