Reaction Times: A POGIL Introduction to the Nervous System

Original POGIL developed during July 2011 POGIL Workshop; revised by Nancy Cripe, Minnehaha Academy

Student Content Outcomes
- Summarize the organization of the nervous system
- Trace the sensory and motor pathways from stimulus to response
- Test and analyze the effects of various distractions on somatic motor responses

Process outcome
- Information processing of factors affecting reaction times under various conditions
- Critical thinking in evaluating risk factors that influence reaction rates and decision-making

Model 1: Exploration of Stimulus-Response Time

Directions: Log on to [http://www.humanbenchmark.com/tests/reactiontime](http://www.humanbenchmark.com/tests/reactiontime). Take the “five click” reaction test and record your average reaction time in Table 1. Hit the reset button to clear results. Repeat the process with your lab partners and record their average reaction times in Table 1.

Table 1: Undistracted Reaction Rate Times

<table>
<thead>
<tr>
<th>Names ➔</th>
<th>Ave Rxn Time (ms) ➔</th>
<th>Group Average:</th>
</tr>
</thead>
</table>

Use the data in Table 1 to answer the following questions:

1. Within your group, what was the fastest average reaction time? _______ Slowest reaction time? _______

2. Calculate the **LAB GROUP**’s average reaction time: _____________________ ms. Record in Table 1.

3. Predict at least three factors that could account for the difference between the individual with the fastest average reaction time and the individual with the slowest average reaction time in your group. (What factors can increase or decrease reaction time?)

4. Which of your body structures was the sensory receptor in the reaction time test? What was the stimulus?

5. Which of your body structures was the effector in the reaction time test? What was your motor response?
1. Name the two major divisions of the nervous system; list the organs/tissues found in each.

2. Name the two divisions of the peripheral nervous system (PNS), and give the primary function of each.

3. List at least seven stimuli that would trigger sensory receptors.

4a) Choose one stimulus from Q. 3, and describe in a complete sentence how the stimulus would travel to the central nervous system (CNS).

4b) Describe in 1-2 complete sentences how the motor commands from the CNS would travel to the effector target organ or tissue. Tell if the motor command will travel via the somatic or autonomic nervous system; explain why.
5. Choose another stimulus from Q. 3 that will initiate a CNS motor response that will travel via the **other** motor division (SNS/ANS) of the peripheral nervous system (PNS) described in Q. 5. Explain your reasoning.
Model #3—Distracted Reaction Time

Directions: Return to the reaction time test at http://www.humanbenchmark.com/tests/reactiontime. Take the “five click” reaction test while singing “Happy Birthday” (or another favorite song ☺) out loud. (If you don’t want to sing a solo, your lab partner can sing along with you.) Record your average reaction time in Table 2. Hit the reset button to clear results. Repeat the process with your lab partners and record their average reaction times in Table 2.

Table 2: Distracted Reaction Rate Times

<table>
<thead>
<tr>
<th>Names</th>
<th>Ave Rxn Time (ms)</th>
<th>Group Average:</th>
</tr>
</thead>
</table>

1. Within your group, what was the fastest average reaction time? _______ Slowest reaction time? _________

2. Calculate the LAB GROUP’S average reaction time: _____________________ ms. Record in Table 2.

3. Does any individual in your lab group have a reaction time that decreased during this activity with distraction compared to the first activity without distractions? If so, predict how this could happen:

Model #4—Texting Reaction Time

Directions: Return to the reaction time test at http://www.humanbenchmark.com/tests/reactiontime.

A. Reading a Text: Your lab partner should write you a text of several sentences and prepare to send it. With one hand on the computer and one hand on your locked cellphone, you will now begin the “five click” reaction test at the same time your partner sends you a text. Read the text while taking the reaction time test. If you finish reading the text before you complete all five trials, have your partner send you another text. Record your average reaction time in Table 3. Hit the reset button to clear results. Repeat the process with your lab partners and record their average reaction times in Table 3.

Table 3: Reading a Text

<table>
<thead>
<tr>
<th>Names</th>
<th>Ave Rxn Time (ms)</th>
<th>Group Average:</th>
</tr>
</thead>
</table>

1. Within your group, what was the fastest average reaction time? _______ Slowest reaction time? _________

2. Calculate the LAB GROUP’S average reaction time: _____________________ ms. Record in Table 3.

B. Sending a Text: With one hand on the computer and one hand on your locked cellphone, begin the “five click” reaction test. At the same time you begin the test, type and send your partner a text. If you finish sending the text before you complete all five trials, send another text. Record your average reaction time in Table 3. Hit the reset button to clear results. Repeat the process with your lab partners and record their average reaction times in Table 4.
3. Within your group, what was the fastest average reaction time? _______ Slowest reaction time? _________

4. Calculate the **LAB GROUP’S** average reaction time: _____________________ms. Record in Table 4.

5. Construct a bar graph (on a separate piece of graph paper or on Excel) comparing the four **GROUP** average reaction rate times (undistracted, distracted/singing, reading a text, sending a text).

6. Based on your graph, what conclusions can you draw about the effect various distractions have on reaction rate times?

**Critical Thinking and Application**

1. List as many factors as possible that could alter the reaction time of an automobile driver when required to brake suddenly. **Circle** all of the listed factors that you have experienced when driving a car.

2. Minnesota Arrest Data for 2009 records 26,240 drivers of all ages were arrested for driving under the influence of alcohol in that year (Century Council statistic). According to the National Highway Traffic Safety Administration (NHTSA), 33,808 people died in traffic crashes in 2009 in the United States, including an estimated 10,839 people who died in drunk driving crashes, accounting for 32% of all traffic deaths last year.

   - Predict which increases the reaction time more for drivers required to brake suddenly: driving under the influence of alcohol or driving while texting:

   **Possible graphics to insert (funny but oh those copyright issues!)**
3. Check your prediction by going to the link below; scroll to the bottom of the article and view the three minute video (Note: the video cannot be made full screen, but on a Mac if you hold down the control key and do the “two-fingered scroll up” the entire screen will enlarge.)

http://jalopnik.com/5302414/drunk-driving-safer-than-texting-while-driving

After viewing the video, was your prediction supported or disproved?

The following data chart shows the results of two separate drivers under various driving conditions. The two drivers performed the tests at 35 mph (miles per hour) and at 70 mph. Use the following data to answer questions below:

<table>
<thead>
<tr>
<th></th>
<th>35 mph</th>
<th>70 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Driver I</td>
<td>Driver II</td>
</tr>
<tr>
<td>Baseline:</td>
<td>.45 sec.</td>
<td>.57 sec</td>
</tr>
<tr>
<td>Alcohol impaired</td>
<td>.46 sec.</td>
<td>.64 sec</td>
</tr>
<tr>
<td>Reading text message</td>
<td>.57 sec</td>
<td>1.36 sec</td>
</tr>
<tr>
<td>Texting:</td>
<td>.52 sec.</td>
<td>1.44 sec</td>
</tr>
</tbody>
</table>

(Source: Car and Driver. June 25, 2009)  
Note: “Baseline” represents reaction times under normal driving conditions.

4. Summarize the reaction times of Driver I at both speeds, comparing baseline reactions to alcohol impaired, reading a text, and texting reaction times:

5. Summarize the reaction times of Driver II at both speeds, comparing baseline reactions to alcohol impaired, reading a text, and texting reaction times:

6. Explain possible reasons for differences in reaction times between Driver I and Driver II.

“But the [reaction times] don’t tell the whole story. Looking at Driver I’s slowest reaction time at 35 mph, he traveled an extra 21 feet (more than a car length) before hitting the brakes while reading a text and went 16 feet longer while texting. While reading a text and driving at 35 mph, Driver II’s average baseline reaction time of 0.57 second nearly tripled, to 1.44 seconds. While texting, his response time was 1.36 seconds. These figures correspond to an extra 45 and 41 feet, respectively, before hitting the brakes. His reaction time after drinking
7. Should the laws for texting while driving be as severe as the laws for driving under the influence of alcohol? Support your position with anatomical and physiological evidence from your test data in addition to the data above.