HOW FAST ARE YOU?

Published: August 2017

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Overview of Lesson

Each student collects 20 reaction-time data values using an online tool for testing reaction times to a visual stimulus. Students display and analyze data via a free online tool, Tuva. Students first characterize their own reaction times and then compare the results informally to a peer's in order to determine who is typically faster and more consistent. Secondly, students engage with formal statistical measures to further refine their arguments. Students choose appropriate measures of center and variation based on their data, and reflect upon the validity of results in terms of measurement error, sample size, and other experimental design factors.

GAISE Components

This investigation follows the four components of statistical problem solving put forth in the *Guidelines for Assessment and Instruction in Statistics Education (GAISE) Report*. The four components are: formulate a question, design and implement a plan to collect data, analyze the data, and interpret results in the context of the original question.
This is a **GAISE Level B** activity.

Common Core State Standards for Mathematical Practice

1. Make sense of problems and persevere in solving them.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.

Learning Objectives Alignment with Common Core and NCTM PSSM

Learning Objectives	**Common Core State Standards**	**NCTM Principles and Standards for School Mathematics**
After an exploration activity, students will be able to graphically display a set of data and select an appropriate	CCSS.MATH.CONTENT.7.SP.A.2 Use data from a random	Select and use appropriate statistical methods to analyze

measure of center and variation based upon visual inspection of the data distribution. In addition, students will be able to compare two sets of data and identify differences in central tendency and variation. Lastly, students will gain insight to design considerations, such as sample size and measurement error.	sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. CCSS.MATH.CONTENT.7.SP.B.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations.	data ● Find, use, and interpret measures of center and spread, including mean and interquartile range.

Prerequisites
Students should have familiarity with mean, median, IQR, MAD, and range prior to engaging in the activity. However, they do not need to be proficient in computations related to these measures.

Time Required
This activity will require a full 60 to 75 minute class period to complete and discuss. The closing discussions could be completed on the second day, if class periods are 45 to 50 minutes in duration.

Materials and Preparation Required

- Student activity sheets
- One computer for every pair of students with access to:
  - Excel or another spread sheet program
  - Student email accounts
  - Java-enabled Internet connection for viewing video and two programs
    - Reaction Time test tool http://ww2.amstat.org/education/cas/2.cfm
    - An online data visualization and analysis tool at http://tuvalabs.com. You can create a "class" within Tuvalabs as the teacher beforehand by loading your students' email addresses. Otherwise, students can log on automatically using a school Google or Gmail address. (note: TinkerPlots or CoreTools are viable alternatives to Tuvalabs)

How Fast Are You?
Teacher's Lesson Plan

Formulate a Question

The below text in italics is a narrative of how a teacher might motivate or launch the activity:

At the 2003 World Championships in Paris, American sprinter Jon Drummond was disqualified after a second false start in a 100-meter dash race. The reason Drummond and another man were disqualified from their heat was because their reaction times were too fast out of the starting blocks. Drummond's registered reaction time of 0.053 seconds is below the 0.1 second limit allowed in sprint races. What made this false start memorable was his protest after the disqualification. You can show the video of Drummond's heat from the link below. Only the first 3 minutes or so is necessary. https://www.youtube.com/watch?v=Cxn7yaOfEoY

Jon, other sprinters, and many fans later argued heatedly over the fairness of the 0.1 second rule. The sprinters claimed that they were too fast to be accurately measured. For more information on this historic debate see: http://condellpark.com/kd/reactiontime.htm

Discuss with your class why a limit might exist in sprinting related to reaction time. If an athlete moves less than 0.1 seconds after the signal, he or she was likely reacting or moving before the signal was heard, which is unfair to other athletes. The best reaction times recorded for sprinters are between 0.12 and 0.14 seconds. More broadly, discuss why reaction time is important in races. Ask: *What other activities require fast reactions?* Hitting a baseball, gaming, hunting, driving safely, ping pong, etc.

Framing question: *Do you think you are fast in terms of reaction time? Faster than your partner? Let's conduct an experiment to see.*

Hand out the student activity sheets and discuss the items on the first page. Before starting the activity ensure that students are in teams of two. If you have a team of three, the third person will need their own computer for the activity and will need to choose one person to compare results with as the activity is written for two sets of data, though doing a comparison among three sets of data would be fine.

Students will predict if they will be faster than their peer and/or more consistent in response to question #1.

Collecting Data

To pursue our question we are going to collect repeated measures of reaction times for each person. Discuss with students why doing a design involving repeatedly measuring reaction times may be better than only recording a single reaction time.

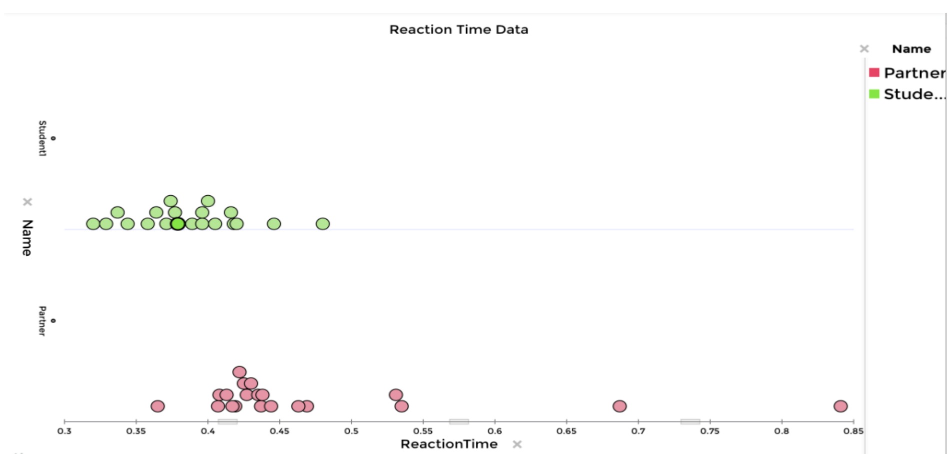
Students will use an Internet browser to access the free web site with the reaction time test that provides a visual stimulus and times a user's reaction to noticing when a color changes: http://ww2.amstat.org/education/cas/2.cfm

Before collecting data, each student should practice with the tool three to five times to make sure they understand know how it works. Once started, students should collect 20 reaction times in a row. Their partner will record the times in the table provided. **All** values should be recorded except trials that extend beyond one second, as these are likely errors. At times, students will click on "stop" and the click will not register causing times that exceed one second. Once completed, students will switch roles, so that all partners collect 20 data values.

Using a spreadsheet tool, such as Excel or Google Sheets, students should record their data in two columns. In the first row, the headers "ReactionTime" and "Name" should appear. Students should save their file when completed with a descriptive title, such as "ReactionTimeData".Once the file is saved, the students can log into Tuvalabs, https://tuvalabs.com, / a free online tool designed for visually exploring data and statistics (free account required). Data can be uploaded into Tuva (see directions and help for doing this here.)

Analyze Data

In order to compare the reaction times for each partner, they can create stacked dotplots (directions in handout).



Through an informal analysis of the visual display of data, students should answer questions 2d-2h on the Student Handout. These questions engage students in considering typical values and consistency in reaction times. These are informal ways of having students make sense of a central tendency and variability in the data. The responses should make sense to students and be intuitive in nature rather than relying upon formulas and computations. Students should refer back to these responses later in order to determine the "best" choices of statistical measures. Therefore, taking time to answer these questions in a thoughtful manner is critical and essential for students' learning.

After students have worked in pairs on these questions using Tuva, it be useful to stop and have a whole group discussion about their ideas. Ideas that should come forth in the discussion include:

Central Tendency:

Estimated typical values are central tendency measures and should be "typical" or representative of the data set. These values could be where there is a central cluster of data or the midpoint of a data set. They should not be the extremes or exceptions in the data set.

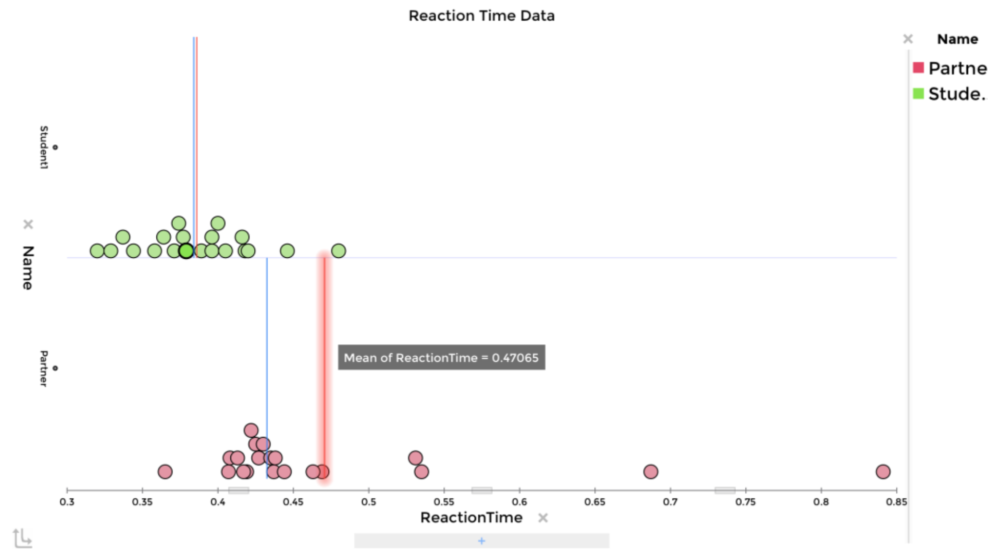
Variation:

Responses about consistency should relate to measures of variation. Is the data spread out or clustered in a certain region of values? Most students will have several longer or shorter reaction times. Some students may be more consistent though. Focus students on the trends in variation or typical spread (global reasoning) rather than attending to unique cases or outliers (local reasoning).

Measurement Error:

Measurement error is definitely a factor with this activity. Some students may have very low values, such as 0.1 or 0.15 seconds. These are likely measures where the students began clicking before the color actually changed, similar to a false start in a sprinting event. Discussing this concept with students will help those who did not "game" the system feel better and validated. Ask if students got the error message "cheater, you pressed too early!" during data collection? If so, how many times? If they got this message more than once, students were likely gaming the tool or false starting. Ask, "*What else may have impacted the reaction times?*" Students may say, the noise in the room, partner talking, mouse pad clicking challenges, etc. Ask, "*For the center of your data, are the results accurate?*" While there may be some extreme values both high and low, given 20 data values, the general trend should be fairly representative, and students should buy into this idea once all concerns are expressed and vetted.

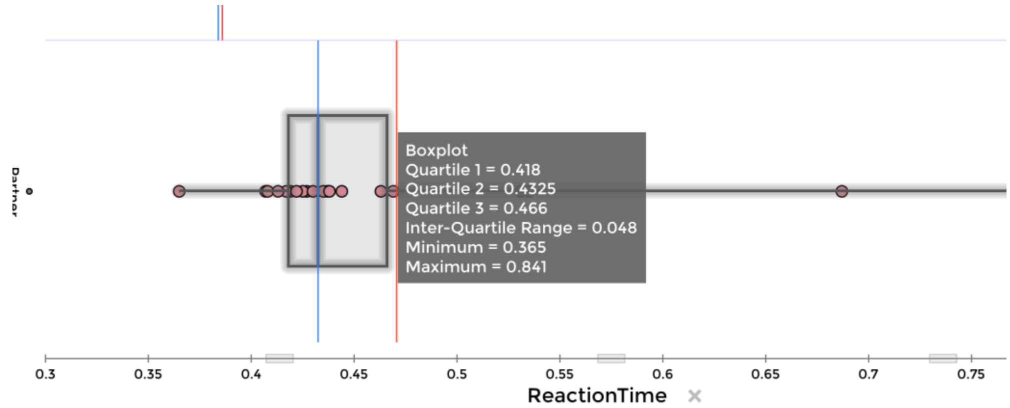
After the discussion about informally describing the trends in the data, the students can continue to work on the handout and explore more formal measures to make sense of center and spread. Students can insert the mean, median, and mode on the graphical display. Let students explore the optional measures and displays available. To see the numerical values, students should place the cursor over each line and the value will be displayed.



To determine which measure of central tendency is more representative, students should compare the mean and median with their answer on the third page of the Student Handout in part 2. Which one is closer to what they initially thought was the center? How are the values impacted by outliers? If a student does not have outliers, then the mean is likely to be a good choice in addition to the median.

When considering who is more consistent, students can explore a few measures of variability. The range is a simple measure of variation that states the spread of the data without consideration to density of data values. This is one consideration in terms of variation, but should not be the only measure employed.

Inter-Quartile Range (IQR): Using Tuvalabs and the option “boxplot and dot plot”, students can find the range of the inner half of the data. Students should again place the cursor over the boxplot and the value of the inter-quartile range will be shown along with other measures. The IQR is the distance between the 75th percentile of the data and the 25th percentile of the data or the range of the middle half of the data. See below for an example:



Unfortunately, Mean absolute deviation (MAD) is not available in Tuvalabs, but it can be easily computed in a spreadsheet with some small amount of effort. Using Excel or Google Sheets, a built in formula called “AveDev” computes MAD for us. Students will need to separate their data from their partner’s as shown below and use the formula at the end of each column of data.

Remember the IQR is simply the range of the inner half of the data, whereas, MAD is the average distance that values are away from the mean. IQR is resilient to outliers as is median, but both mean and MAD can be heavily impacted by extreme values causing them to be less representative when data is skewed or outliers exist.

	A	B	C	D
1	ReactionTime	Name	ReactionTime	Name
2	0.389	YourName	0.419	Partner'sName
3	0.446	YourName	0.427	Partner'sName
4	0.344	YourName	0.841	Partner'sName
5	0.379	YourName	0.365	Partner'sName
6	0.418	YourName	0.469	Partner'sName
7	0.396	YourName	0.535	Partner'sName
8	0.396	YourName	0.417	Partner'sName
9	0.4	YourName	0.407	Partner'sName
10	0.32	YourName	0.408	Partner'sName
11	0.358	YourName	0.425	Partner'sName
12	0.371	YourName	0.437	Partner'sName
13	0.405	YourName	0.463	Partner'sName
14	0.337	YourName	0.413	Partner'sName
15	0.329	YourName	0.435	Partner'sName
16	0.42	YourName	0.531	Partner'sName
17	0.416	YourName	0.444	Partner'sName
18	0.377	YourName	0.422	Partner'sName
19	0.48	YourName	0.687	Partner'sName
20	0.364	YourName	0.438	Partner'sName
21	0.374	YourName	0.43	Partner'sName
22	=AVEDEV(A2:A21)		=AVEDEV(C2:C21)	

During analyze data phase, the goal is for students to “discover” or make sense of these measures in the context of their own data rather than being told which measures to use and why. Students should refer back to their responses in collecting data phase while reasoning about the measures and justifying choices.

Again have students share out their responses to 3i) – iii). Be sure to reinforce key statistical ideas about measures of variation during this discussion. If possible, it would be helpful for students to have printed copies of their data distributions to refer to while sharing out answers. The choices for the most representative measures of center and variation should relate directly to these distributions. An alternative would be to have students take a screen shot of the displays in order to share via email or a class website.

Interpreting Results

In the last section, students will consider the results based upon formal measures in comparison to the data distributions' shape and overall visual trends. It can be useful to have a whole class discussion about their responses to all parts of question 4 on the handout.

During this phase, there are several key ideas that could be further discussed in a whole class setting.

- Sample size: Are 20 data values enough to draw an inference or conclusion about who is likely the fastest and most consistent? If not, how many values or trials should be conducted? 30 would be better, and 50 would be even better. At some point, we have enough data. Would 1000 trials be necessary? (Not likely).
- Sample: Are the data values we collected today "random" in nature? Can we draw inferences that extend beyond the data at hand? Are you likely faster or more consistent than your partner? Are we comfortable saying that? We can never have **all** the data.
- Measurement error in data collection: What values should be included? We excluded values over 1 second. Should we lower the bar to exclude values over 0.8? Should values below 0.1 or 0.2 seconds be considered? What is the minimum considering what we learned about Jon Drummond and sprinters?
- Other considerations: Does the task favor right –handed students, as the clickers are positioned for right-handedness. Do glasses or contacts impede performance, amount of sleep during the prior night, experience with video games, prior arm and hand injuries? Other physical considerations? How could we account for these?
- What other comparisons would be interesting? Comparing genders, age, etc.?

References

Franklin, C., Kader, G., Mewborn, D., Moreno, J., Peck, R., Perry, M., & Scheaffer, R. (2007). *Guidelines for assessment and instruction in statistics education (GAISE) report.* Alexandria, VA: American Statistical Association.

National Governors Association Center for Best Practices and Council of Chief State School Officers. (2010). *Common core state standards: Mathematics standards.* Retrieved May 17, 2016 from <http://www.corestandards.org>.

Further Reading About the Topic

Bakker, A. (2004). Reasoning about shape as a pattern in variability. *Statistics Education Research Journal, 3*(2), 64-83.

Bakker, A., Biehler, R., & Konold, C. (2005). Should young student learn about box plots? Available at: https://www.srri.umass.edu/sites/srri/files/bakker-2005sys.pdf

Watson, J. M., & Moritz, J. B. (1999). The beginning of statistical inference: Comparing two data sets. *Educational Studies in Mathematics, 37*, 145-168.

Watson, J. M. (2008). Exploring beginning inference with novice grade 7 students. *Statistics Education Research Journal*, *7*(2), 59-82.

How Fast Are You? An Activity of Reaction Times
Student Handouts

In the 100-yard dash, the race is often decided by who can react the fastest from the racing blocks. To the left is a picture of runners reacting as fast as they can during the men's 100-yard dash in the 2012 Olympics held in London, England. (image from https://en.wikipedia.org/wiki/100_metres)

In game shows, like Family Feud with Steve Harvey on the right, reacting quickly with an answer could win you and your family thousands of dollars. (image from: http://www.cinemablend.com/television/1613320/family-feud-just-hit-a-huge-milestone-get-the-details)

In NASCAR racing, reaction time is critical for both winning and avoiding major injury. Shown to the left is Danica Patrick, one of the most celebrated female drivers in NASCAR history. Danica, born in Wisconsin and raised in Illinois, is one of only two females who have completed both the Indianapolis 500 and the Daytona 500. (image from: https://c.o0bg.com/rf/image_960w/Boston/2011-2020/2013/02/24/BostonGlobe.com/Sports/Images/patrick.jpg)

Question: How fast is your reaction time compared to others?

1. *Formulating a Question*
Working with a partner, make a prediction about who you think will have the faster reaction time and the most consistent reaction time. Note: You don't have to agree with your partner!

________ Fastest Reaction Time ________ Most Consistent Reaction Time

2. *Collecting Data*
2a) Go to the web site http://ww2.amstat.org/education/cas/2.cfm

Before collecting data, practice with the tool 3 to 5 times to make sure you know how it works. Then, collect 20 reactions times. Have your partner record each time in the table below for you. Discard any trials that extend beyond 1 second. Once completed, switch roles.

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
11.	12.	13.	14.	15.	16.	17.	18.	19.	20.

2b) Upload data: Using a spreadsheet tool, enter your data and your partner's data into a spreadsheet. In the first row, type the word "ReactionTime" into column A. In column B, type the word "Name". In row two, start entering the actual data. Enter one person's data first using the format shown below for all 20 values in the rows 2 through 21, with the reaction times in the first column and name in the second. Once completed, enter the other person's data in rows 22 through 41. Save your file when completed with the title, "ReactionTimeData".

	A	B
1	ReactionTime	Name
2	0.389	YourName
3	0.446	YourName
4	0.344	YourName
5	0.379	YourName
6	0.418	YourName
7	0.396	YourName
8	0.396	PartnerName
9	0.4	PartnerName
10	0.32	PartnerName
11	0.358	PartnerName
12	0.371	PartnerName
13	0.405	PartnerName
14	0.337	PartnerName
15	0.329	PartnerName
16	0.42	PartnerName

Only one computer is needed per team of two. Logon to Tuvalabs, https://tuvalabs.com/, go to "My Data Sets", and upload your spreadsheet file, ReactionTimeData. Go here for help in uploading data https://tuvalabs.com/resources/upload_instructions/.

2c) Represent data: Select a "Dot" representation for a dot plot. Drag the "Name" attribute to the y-axis and the "ReactionTime" attribute to the x-axis. Two stacked dot plots should be visible for you and your partner. Click on the text box to edit the title.

2d) Looking at your data, what does a typical reaction time seem to be for you?_______________

Why did you choose this value?____

2e) Would you revise your prediction in from part 1 regarding who is faster? __Yes __No

Say why or why not:____

2f) Looking at your data, would you say that your reaction time was consistent? __Yes __No

Say why or why not:____

2g) Would you revise your prediction from part 1 regarding who is more consistent? __Yes __No

Say why or why not:____

2h) Do you think the reaction times recorded are accurate for you? __Yes __No

Say why or why not:____

CHECK POINT

3. *Analyzing Data*
3a) Typical reaction time: You can insert the mean, median, and mode by clicking on the symbol with three stacked lines, as well as other features. Explore these choices and features. To see the exact values, place your cursor over the lines. Record both the mean and median of your data and your partner's below:

______ secs (My mean response time) ______ secs (Partner's mean response time)

______ secs (My median response time) ______ secs (Partner's median response time)

Say which measure is more representative or typical of the data and why below:

____

____

Based on the measures of center that are most representative, which person is typically faster according to the data recorded?

____________ is typically faster.

3b) Variation of the data: Analyze the variation in your data and your partner's in the following ways.

3i) Range: Recall this is the largest value minus the smallest value

_________ secs (My range) ______ secs (Partner's range)

3ii) Inter-Quartile Range (IQR): Using Tuvalabs, you can find the range of the inner half of the data using the box-plot feature. Place your cursor over the boxplot and the value of the inter-quartile range will be shown. The IQR is the distance between the 75th percentile of the data and the 25th percentile of the data or the range of the middle half of the data.

_________ secs (My IQR) ______ secs (Partner's IQR)

3iii) Mean absolute deviation (MAD): Using Excel and a built in formula called "AveDev", we can calculate the MAD for your data and your partners. First, move your partner's data to a new set of columns, as show below using "cut" and "paste". Then, insert the formulas below, and save the file.

	A	B	C	D
1	ReactionTime	Name	ReactionTime	Name
2	0.389	YourName	0.419	Partner'sName
3	0.446	YourName	0.427	Partner'sName
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11	0.358	YourName	0.425	Partner'sName
12	0.371	YourName	0.437	Partner'sName
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17	0.416	YourName	0.444	Partner'sName
18	0.377	YourName	0.422	Partner'sName
19	0.48	YourName	0.687	Partner'sName
20	0.364	YourName	0.438	Partner'sName
21	0.374	YourName	0.43	Partner'sName
22	=AVEDEV(A2:A21)		=AVEDEV(C2:C21)	

_________ secs (My MAD) ______ secs (Partner's MAD)

Say which measure is more representative or typical of the variation in the data and why below:
____

____

Based on the measures of variation that are most representative, which person is usually more consistent with their reaction time according to the data recorded?

________________ is usually more consistent.

CHECK POINT

4. *Interpreting results:*

4a) Looking at the data displays in Tuvalabs, do your conclusions about who is typically faster and who is usually more consistent make sense?

Describe how the shapes of the data distributions either support or contradiction your analyses in part 3. Be sure to speak to both conclusions in your response.

Fastest:____

____

Most consistent:____

____

4b) Do you think that this analysis is representative in general of you and your partner? Would these results or similar results likely occur again if you were to repeat the activity?

__Yes __No

Say why or why not:____

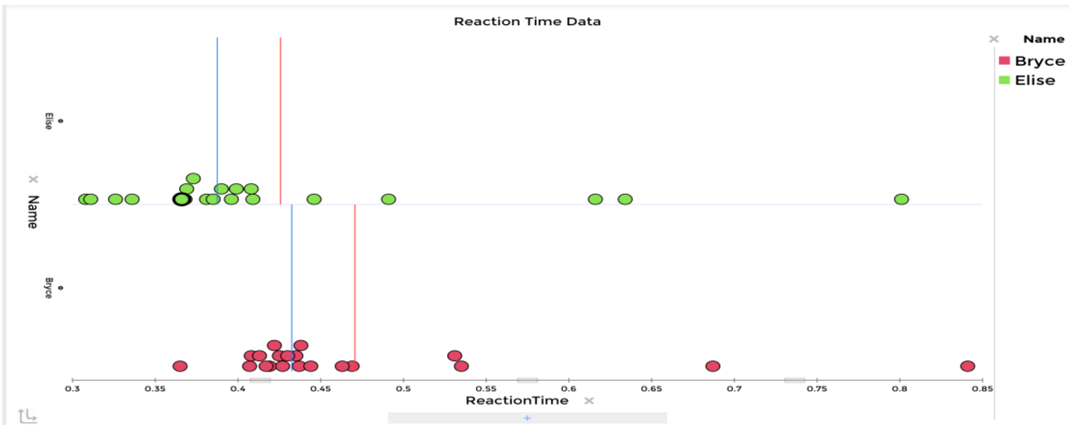
4c) What could be causing a difference between you and your partner besides your reaction times?

4d) If we wanted to find out *for sure* who was fastest and most consistent, what additional steps would you recommend?

How Fast Are You? Exit Slip

Name: ………………………………………   Date: …………………

Below are 20 reaction times for two students, Elise and Bryce.



Elise has a mean reaction time of 0.426 seconds and a median reaction time of 0.3875 seconds. Bryce has a mean reaction time of 0.471 seconds and a median reaction time of 0.4325 seconds.

1) Based on the stacked dot plot representations of the data, who would you say is typically faster and why?

2) Again using the stacked dot plot representations, who would you say is typically more consistent in terms of reaction time and why?

3) What measure of center and variation do you think represents the data better?

Elise: ___Mean OR ___ Median ___IQR OR ___ MAD

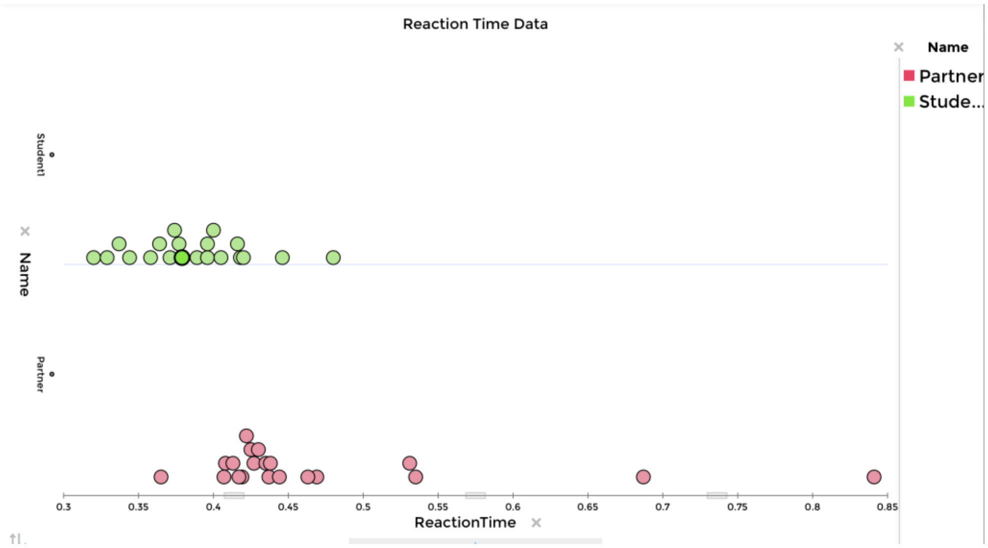
Bryce: ___Mean OR ___ Median ___IQR OR ___ MAD

Say why:____

Student Handout
Sample Solutions

1) Students will predict if they will be faster than their peer and/or more consistent in response to question #1.

2c) To create a stacked dot-plot, students will drag the "Name" attribute to the *y*-axis and the "ReactionTime" attribute to the *x*-axis. Two stacked dot plots should be visible. Students can then, click on the text box to edit the title of the graph. To "color" the dots, click on the "Name" attribute and then a dot. This will also compress the view of the screen a bit, which is helpful and will add a legend on the right hand side. At this point, the graph should look like the one below:



2d) – 2h) Through an informal analysis of the visual display of data, students should answer these questions. The responses should make sense to students and be intuitive in nature rather than relying upon formulas and computations. Students should refer back to these responses later to in order to determine the "best" choices of statistical measures. Therefore, taking time to answer these questions in a thoughtful manner is critical and essential for students' learning.

Sample answers for the previous graphical display for "Partner" are provided below:
2d) Looking at your data, what does a typical reaction time seem to be for you? 0.43 seconds

Why did you choose this value? This is where I had a lot of reaction time values.

2e) Would you revise your prediction from part 1 regarding who is faster? _X_Yes __No

Say why or why not: Sometimes I am fast, but not usually compared to my peer.

2f) Looking at your data, would you say that your reaction time was consistent? __Yes _X_No

Say why or why not: My peer had values that were all below 0.5 seconds, but mine varied from .36 to .84.

2g) Would you revise your prediction from part 1 regarding who is more consistent? __Y _X_No

Say why or why not: I expected that I would have a variety of reaction times.

2h) Do you think the reaction times recorded are accurate for you? __Yes _X_No

Say why or why not: No, sometimes the program changed colors really fast when I wasn't quite ready, and that's when I got the higher values. Sometimes the colors were faint, and I didn't realize they had actually changed. My partner was talking a lot too, and that didn't help. I think I could do better if I had a chance to work in a quiet location by myself.

3a) Typical reaction time: You can insert the mean, median, and mode by clicking on the symbol with three stacked lines, as well as other features. Explore these choices and features. To see the exact values, place your cursor over the lines. Record both the mean and median of your data and your partner's below:

_.386__ secs (My mean response time) __.471__ secs (Partner's mean response time)

_.384_ secs (My median response time) _.4325__ secs (Partner's median response time)

Say which measure is more representative or typical of the data and why below:
Either could be used for my data, but the median is better for my partner's. She had outliers, so the mean is higher than the main cluster of data and doesn't match up with the center.

Based on the measures of center that are most representative, which person is typically faster according to the data recorded?
I am faster regardless of which measure you use. Hooray!

3b) Variation of the data: Analyze the variation in your data and your partner's in the following ways.

3i) Range: Recall this is the largest value minus the smallest value

.48-.32 = .16 secs (My range) .84-.364=.446 secs (Partner's range)

3ii) Inter-Quartile Range (IQR): Using Tuva, you can find the range of the inner half of the data using the box-plot feature. Place your cursor over the boxplot and the value of the inter-quartile range will be shown. The IQR is the distance between the 75th percentile of the data and the 25th percentile of the data or the range of the middle half of the data.

0.0495 secs (My IQR) 0.048 secs (Partner's IQR)

3iii) Mean absolute deviation (MAD): Using Excel and a built in formula called "AveDev", we can calculate the MAD for your data and your partners. First, move your partner's data to a new set of columns, as shown below using "cut" and "paste". Then, insert the formulas below, and save the file.

0.03065 secs (My MAD) 0.07114 secs (Partner's MAD)

Say which measure is more representative or typical of the variation in the data and why below:
For my data, I feel like the MAD is more representative, because the central cluster of data is about 0.035 wide on each side of the mean and median. So, the MAD captures this well. For my partner's data, the center cluster is about 0.04 seconds wide, so we feel like the IQR is a better measure.

Based on the measures of variation that are most representative, which person is usually more consistent with their reaction time according to the data recorded?
I am a little more consistent according to the measures, but really the only difference is that I don't have any outliers and my partner does.

4a) Looking at the data displays in Tuvalabs, do your conclusions about who is typically faster and who is usually more consistent make sense?

Describe how the shapes of the data distributions either support or contradictyour analyses in part 3. Be sure to speak to both conclusions in your response.

Fastest: Yes, for the graphical display, you can see that my reactions times are clustered at lower values compared to my partner's.

Most consistent: Yes, my values are not as spread out across the chart as hers are either.

4b) Do you think that this analysis is representative in general of you and your partner? Would these results or similar results likely occur again if you were to repeat the activity?

_X_Yes __No

Say why or why not: Yes, I do. Some values are inaccurate, but with 20 values total, we have the general conclusions in the data. If we did it again, there might be fewer outliers, but I think the center would not change much.

4c) What could be causing a difference between you and your partner besides your reaction times? My partner might not be trying as hard as me or maybe she is not as used to using a computer.

4d) If we wanted to find out *for sure* who was fastest and most consistent, what additional steps would you recommend?
We should both practice one day, and then the next day repeat the process 100 times, just to be sure about the data.

Assessment: Exit Slip Answers

1) Elise is faster in terms of both measures, which you can also see on the graph. Her data is shifted left to quicker values than Bryce.
2) Bryce appears to be more consistent because most of his data is in one tight cluster, even though the values start at 0.36 seconds and go up to 0.84. Elise's data also has a cluster, but she has more values below and above that cluster. So, she has more variation.
3) What measure of center and variation do you think represents the data better?

Elise: ___Mean OR _X_ Median __X_IQR OR___ MAD

Bryce: ___Mean OR _X_ Median __X_IQR OR___ MAD

Say why: Because of the outliers, median and IQR would be better for both.