260-2017-04-24-speed-lab

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Today's topic

- Measuring the speed of nervous system conduction
- And a tiny lesson in open, transparent, reproducible data science

Question

- How fast does the nervous system conduct information?
- Prior evidence
  - Proprioception vs. touch

Prediction

We predict that average speed of conduction will be …

Scheme

- Speed = Distance/Time
- Chain of participants to make distance larger
  - If typical person ~ 1.5 m, then
  - at s=30 m/s, t = d/s -> 1.5/30 = 0.05 secs.

Condition 1 (ankle)

- Squeeze ankle
- ankle_shoulder + shoulder_brain + brain_decide + brain_shoulder + shoulder_hand

Condition 2 (shoulder)

- Squeeze shoulder
- shoulder_brain + brain_decide + brain_shoulder + shoulder_hand
- Condition 1 - Condition 2
- ankle_shoulder + ~~shoulder_brain~~ + ~~brain_decide~~ + ~~brain_shoulder~~ + ~~shoulder_hand~~

Measure

- sum(ankle_shoulder) for all participants -> Distance
- mean(time(Condition 1)) - mean(time(Condition 2)) -> Time
- Speed = Distance/Time

Materials

- Stop watch
- Tape measure

Decisions

- Same hand or dominant?
- Alternate ankle/shoulder or one condition before the other?
- How many trials?
  - Fixed number?
  - When reach asymptote?

Data files

- Data file with body measurements
  - participant, ankleshoulder (cm)
- Data file with reaction times
  - trial {1…n}, condition {ankle, shoulder}, time (s)

Measuring distance

```
psych260 <- gs_title("psych-260-spring-2017")
```

```
## Sheet successfully identified: "psych-260-spring-2017"
```

```
psych260 %>%
  gs_read(ws = "distance") ->
  distance
```

```
## Accessing worksheet titled 'distance'.
```

```
##
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```
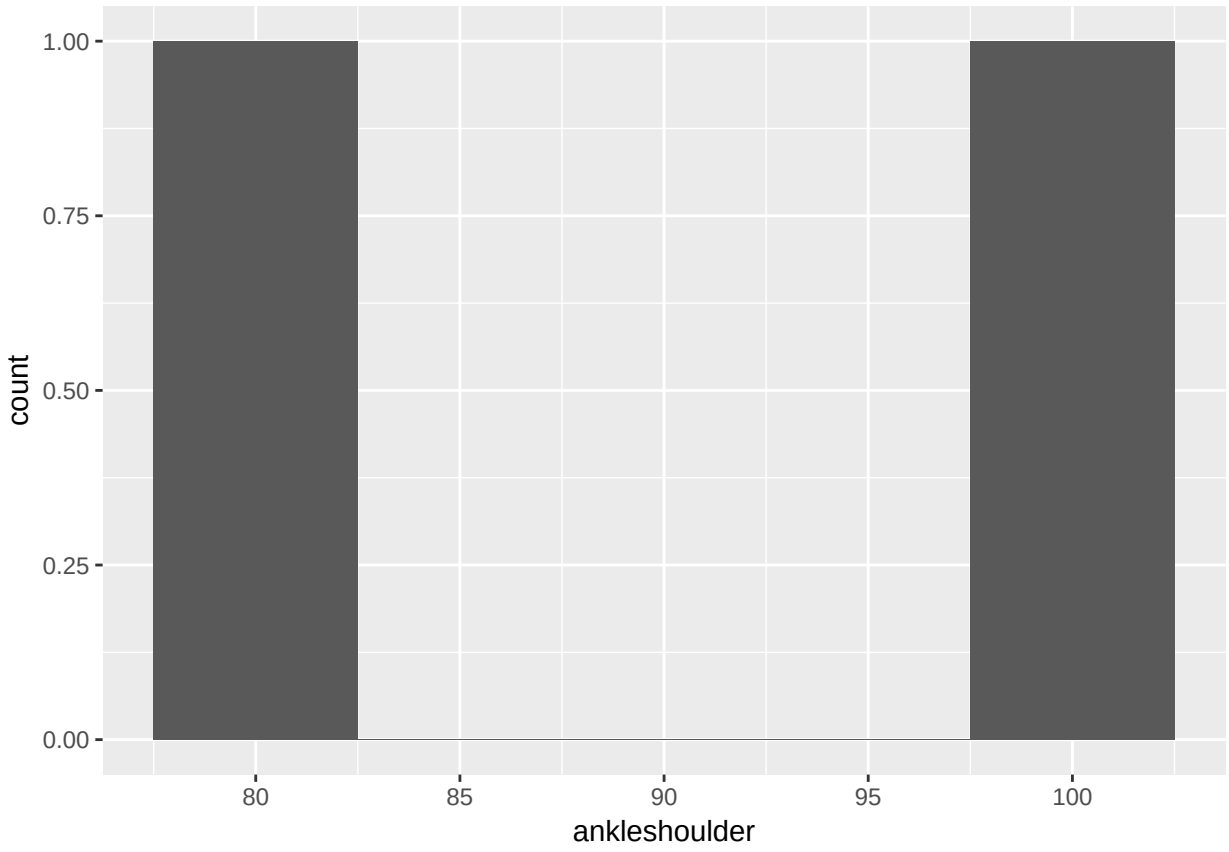

```
## No encoding supplied: defaulting to UTF-8.
```

```
dist.hist <- ggplot(data = distance, aes(x=ankleshoulder)) +
  geom_histogram(bins = 5)
```



Sum distance

```
with(distance, summary(ankleshoulder))
```

```
##    Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
##      80      85      90      90      95     100
```

```
# Calculate sum
dist.sum = with(distance, sum(ankleshoulder))
```

The total distance is 180 cm.

Measuring time

```
psych260 %>%
  gs_read(ws = "time") ->
  time
```

```
## Accessing worksheet titled 'time'.
```

```
##
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```

```
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```
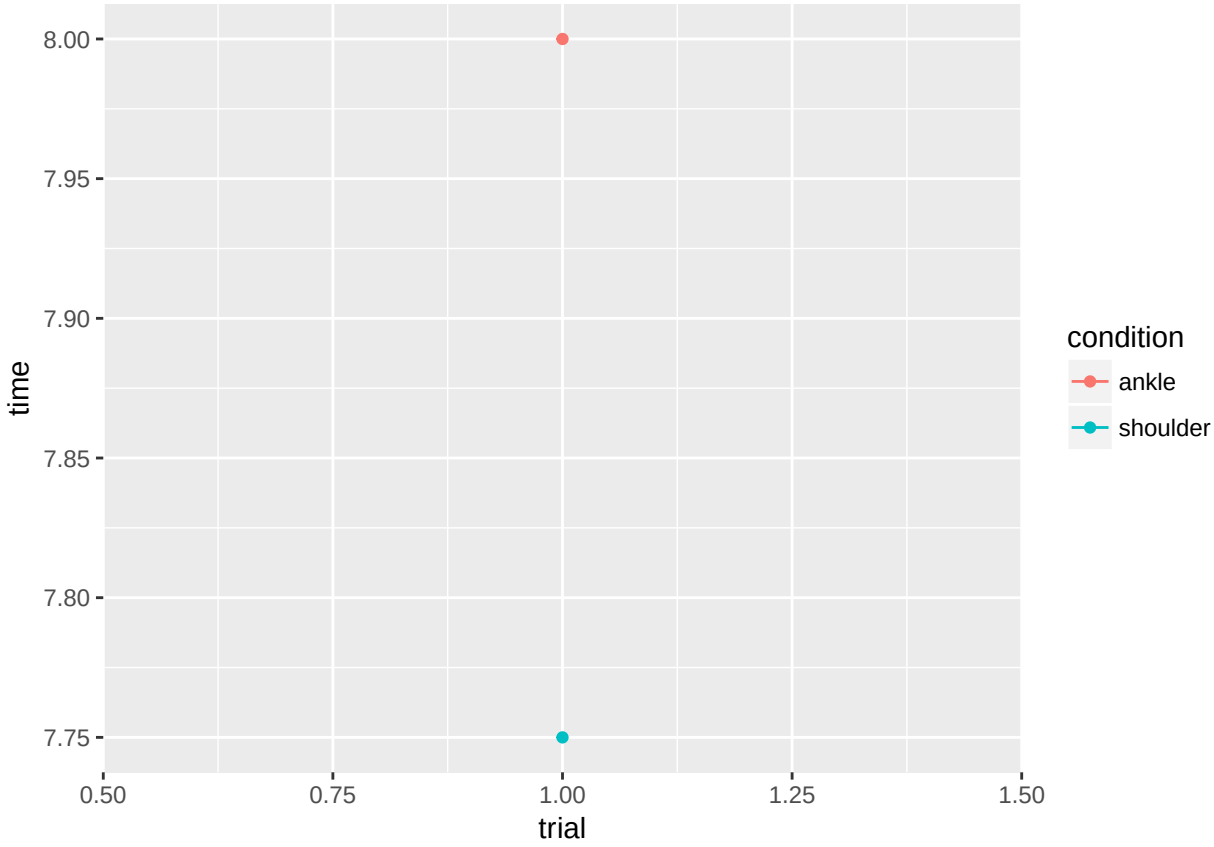

```
## No encoding supplied: defaulting to UTF-8.
```

```
# Plot data
time.plot = ggplot(data = time, aes(x=trial, y=time, color=condition)) +
  geom_point() +
  geom_line()
```

```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```

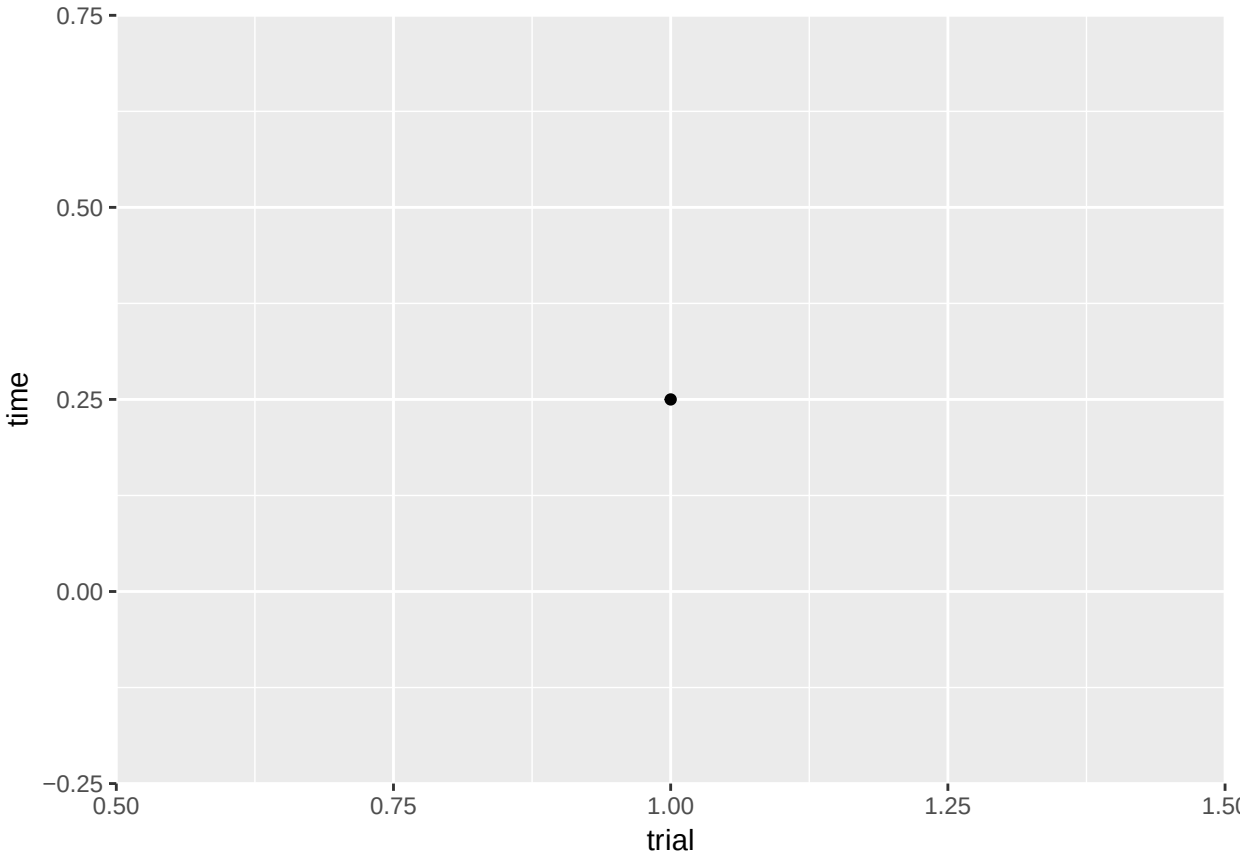


Calculate time difference

```
time %>%
  filter(condition == "ankle") ->
  ankle.times

time %>%
  filter(condition == "shoulder") ->
  shoulder.times

time.diff <- data_frame(trial=unique(time$trial),
                        time=ankle.times$time - shoulder.times$time)

time.diff.plot = ggplot(data = time.diff, aes(x=trial, y=time)) +
```

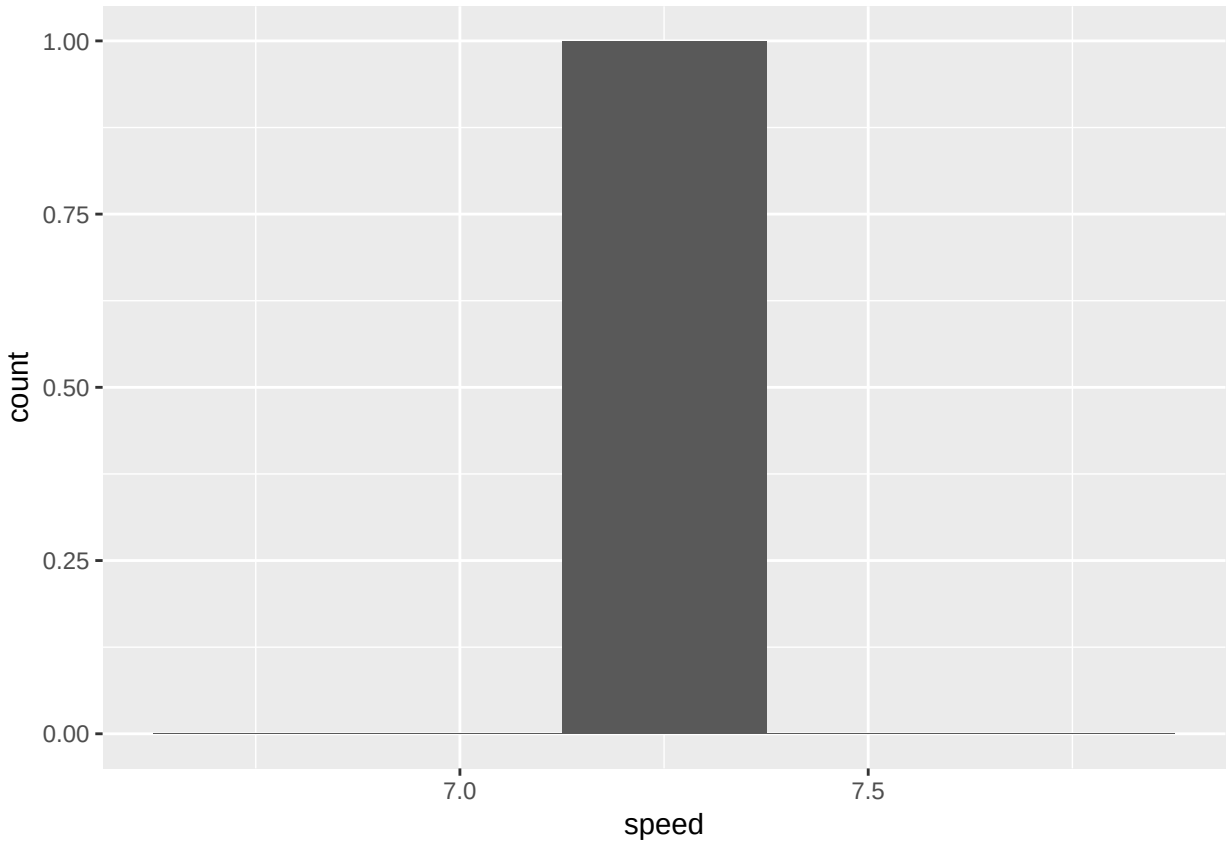
```
  geom_point() +
  geom_line()
```

```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



Calculating speed

```
time.diff$speed <- (dist.sum)*.01/time.diff$time

speed.hist <- ggplot(data = time.diff, aes(x=speed)) +
  geom_histogram(bins = 5)
```

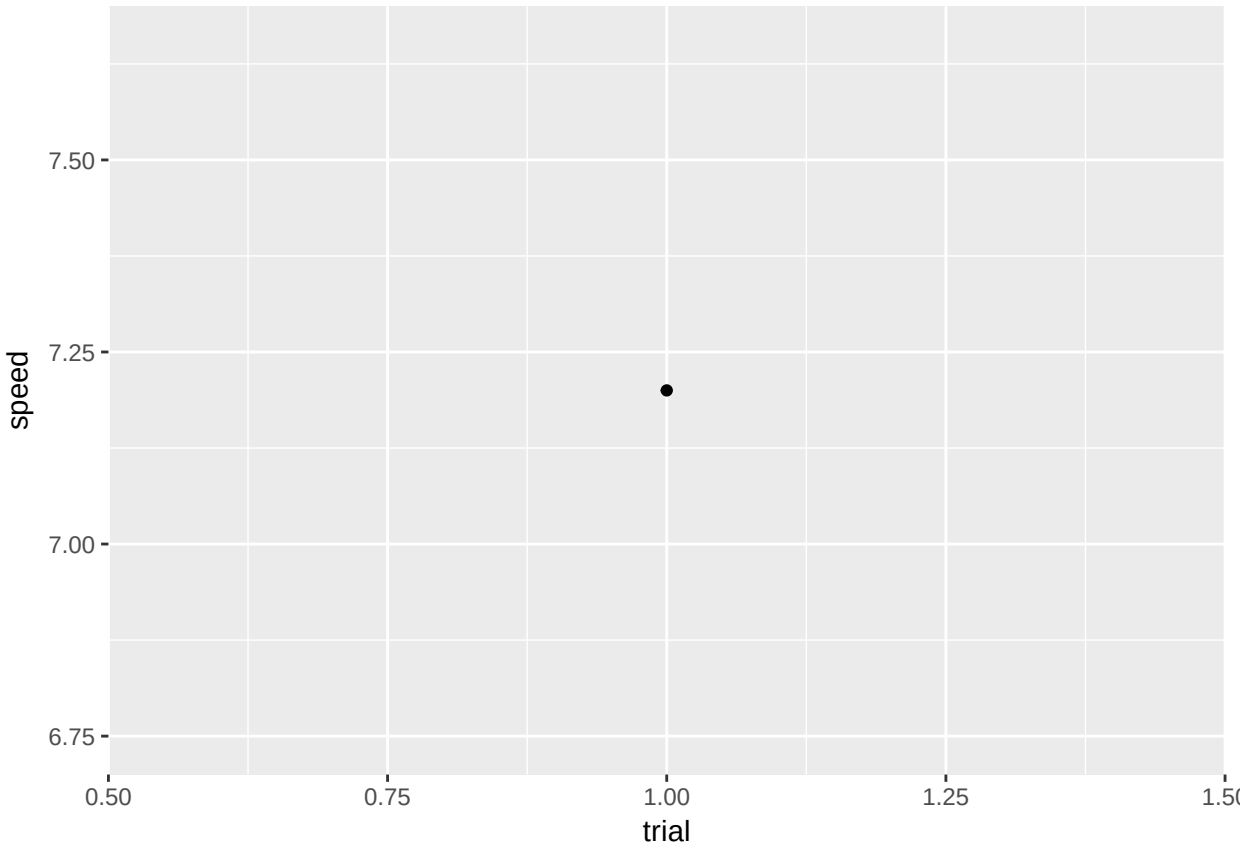


Plot time series of speeds

```
speed.plot <- ggplot(data = time.diff, aes(x=trial, y=speed)) +
  geom_point() +
  geom_line()
```

```
speed.plot
```

```
## geom_path: Each group consists of only one observation. Do you need to
## adjust the group aesthetic?
```



Summarizing findings

- We tested the mean speed of neural propagation in a sample of n=2 college-age adults.
- The mean speed of neural propagation over 1 trials was 0.072 m/s with a range of [0.072, 0.072] m/s.
- These findings are/are not generally in accord with values we would expect from the literature.

Limitations

How to replicate/extend

Resources

This document was prepared in RStudio 1.0.36 on 2017-04-24 06:40:25.

```
sessionInfo()
```

```
## R version 3.3.2 (2016-10-31)
## Platform: x86_64-apple-darwin13.4.0 (64-bit)
## Running under: OS X El Capitan 10.11.6
##
## locale:
## [1] en_US.UTF-8/en_US.UTF-8/en_US.UTF-8/C/en_US.UTF-8/en_US.UTF-8
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
```

```
## other attached packages:
## [1] ggplot2_2.2.1      dplyr_0.5.0        googlesheets_0.2.1
##
## loaded via a namespace (and not attached):
##  [1] Rcpp_0.12.10     xml2_1.1.1       knitr_1.15.1     magrittr_1.5
##  [5] hms_0.3          munsell_0.4.3    colorspace_1.3-2 R6_2.2.0
##  [9] httr_1.2.1       stringr_1.2.0    plyr_1.8.4       tools_3.3.2
## [13] grid_3.3.2       gtable_0.2.0     DBI_0.6-1        htmltools_0.3.5
## [17] openssl_0.9.6    lazyeval_0.2.0   yaml_2.1.14      rprojroot_1.2
## [21] digest_0.6.12    assertthat_0.2.0 tibble_1.3.0     readr_1.1.0
## [25] purrr_0.2.2      curl_2.5         rsconnect_0.7    evaluate_0.10
## [29] rmarkdown_1.4    labeling_0.3     stringi_1.1.5    cellranger_1.1.0
## [33] scales_0.4.1     backports_1.0.5  jsonlite_1.4
```