Omega Timing is the official timekeeper for the Olympic Games, including US Olympic Trails. They don't do very many other events, which is why `SwimmeR` hasn't supported Omega-style results. Until now that is. Omega results can now be read into `R` with versions of `SwimmeR` >= `0.10.2`, presently available as developmental versions from Github. We'll read some Omega results in, and then do a quick set of tests about athlete reaction times.

```
devtools::install_github("gpilgrim2670/SwimmeR", build_vignettes =
TRUE)
```

The 2020 US Trials are being held in 2021, in two parts. Wave I was held June 4th to 7th, and Wave II is currently being held June 13th – 20th. Omega has published the entire Wave I results here, but to avoid any potential broken links down the road I'm also hosting them on github here.

Let's get set up and take a look.

```
library(SwimmeR)
library(dplyr)
library(stringr)
library(ggplot2)
library(flextable)

flextable_style <- function(x) {
  x %>%
    flextable() %>%
    bold(part = "header") %>% # bolds header
    bg(bg = "#D3D3D3", part = "header") %>%  # puts gray background
behind the header row
    autofit()
}
```

US Trials Wave I – Getting Omega Results

The process of reading in Omega results with `SwimmeR` is exactly the same as reading in Hy-Tek or S.A.M.M.S.. Here's the entire set of results from Wave I.

```
file <-
  "https://github.com/gpilgrim2670/Pilgrim_Data/raw/master/Omega/Omega_OT_Wave1_
FullResults_2021.pdf"

Wave_I <- file %>%
  read_results() %>%
  swim_parse(splits = TRUE)
```

Here's the top three finishers in the Women's 100 Fly Final. The usual information is present – `Place`, `Name`, `Team` `Finals_Time` (Omega results don't include prelims times…), various `Splits` columns. Also present is a `Reaction_Time` column, that will be the focus of a little demonstration later on.

```
Wave_I %>%
```

```
  filter(Event == "6 JUN 2021 - 7:37 PM Women's 100m Butterfly Final")
%>%
  head(3) %>%
  select(where( ~ !all(is.na(.)))) %>% # remove splits columns that
aren't relevant to this race (Split_150 etc.)
  select(-DQ,
         -Exhibition,
         "Reaction" = "Reaction_Time",
         "Finals" = "Finals_Time") %>%
  flextable_style()
```

Place	Lane	Name	Team	Reaction	Finals	Event	Split_50	Split_100
1	6	LU Sydney	PLS	0.64	1:00.38	6 JUN 2021 – 7:37 PM Women's 100m Butterfly Final	28.54	31.84
2	4	SMITHWICK Heidi	JDST	0.68	1:00.56	6 JUN 2021 – 7:37 PM Women's 100m Butterfly Final	28.08	32.48
3	5	VANNOTE Ellie	UNC	0.69	1:00.60	6 JUN 2021 – 7:37 PM Women's 100m Butterfly Final	28.33	32.27

US Trials Wave II

Wave II of the US trials is where the actual Olympic Team is being selected. It's still underway as of this writing, so there's not a single document containing all results available. Individual result documents for each event are being posted however, as the events are completed. Here's the Women's 100 Breaststroke final, featuring Lilly King.

```
file <-
  "https://github.com/gpilgrim2670/Pilgrim_Data/raw/master/Omega/Omega_OT_Wave2_W100Br_Finals_2021.pdf"

W100Br <- file %>%
  read_results() %>%
  swim_parse(splits = TRUE)

W100Br %>%
  select(-DQ,
         -Exhibition,
         "Reaction" = "Reaction_Time",
         "Finals" = "Finals_Time") %>%
  flextable_style()
```

Place	Lane	Name	Team	Reaction	Finals	Event	Split_50	Split_100

Place	Lane	Name	Team	Reaction	Finals	Event	Split_50	Split_100
1	4	KING Lilly	ISC	0.65	1:04.79	PM Women's 100m Breaststroke Final	30.34	34.45
2	3	JACOBY Lydia	STSC	0.63	1:05.28	PM Women's 100m Breaststroke Final	30.94	34.34
3	5	LAZOR Annie	MVN	0.66	1:05.60	PM Women's 100m Breaststroke Final	30.82	34.78
4	6	GALAT Bethany	AGS	0.53	1:05.75	PM Women's 100m Breaststroke Final	30.69	35.06
5	0	DOBLER Kaitlyn	TDPS	0.65	1:06.29	PM Women's 100m Breaststroke Final	30.83	35.46
6	2	SUMRALL Micah	GAME	0.71	1:06.84	PM Women's 100m Breaststroke Final	31.83	35.01
7	7	HANNIS Molly	TNAQ	0.70	1:07.26	PM Women's 100m Breaststroke Final	31.29	35.97
8	1	ESCOBEDO Emily	COND	0.68	1:07.31	PM Women's 100m Breaststroke Final	31.91	35.40
9	8	TUCKER Miranda	UN-MI	0.68	1:07.44	PM Women's 100m Breaststroke Final	31.73	35.71

Australian Trials

Also underway are the Australian Trials. Similarly to the US Trials they can be read into `R` using `SwimmeR` versions >= `0.10.2`. For the very curious, these are Hy-Tek results, not Omega. We at Swimming + Data Science have scrapped entire Hy-Tek live results pages before and the same general principles can be applied the collect all Australian Trials results. Here's just the Men's 100 Fly Final.

```
file <-
  "http://liveresults.swimming.org.au/SAL/2021TRIALS/210612F015.htm"

M100Bk <- file %>%
  read_results() %>%
  swim_parse(splits = TRUE)
```

```
M100Bk %>%
  select(-DQ,
         -Exhibition,
         -Points,
         "Prelims" = "Prelims_Time",
         "Finals" = "Finals_Time") %>%
  flextable_style()
```

Place	Name	Age	Team	Prelims	Finals	Event	Split_50	Split_100
1	LARKIN, MITCH	27	STPET	53.04	53.40	Male 100 LC Metre Backstroke	25.86	27.54
2	COOPER, ISAAC	17	RACKL	53.79	53.49	Male 100 LC Metre Backstroke	25.94	27.55
3	HOLLARD, TRISTA	24	STHPT	54.56	54.00	Male 100 LC Metre Backstroke	26.73	27.27
4	WOODWARD, BRADL	22	MING	54.47	54.13	Male 100 LC Metre Backstroke	26.19	27.94
5	YANG, WILLIAM	22	LNSC	54.75	54.56	Male 100 LC Metre Backstroke	25.98	28.58
6	MAHONEY, TRAVIS	30	MARI	55.03	55.02	Male 100 LC Metre Backstroke	26.78	28.24
7	VAN KOOL, KAI	19	GUSC	54.68	55.13	Male 100 LC Metre Backstroke	26.38	28.75
8	HARTWELL, TY	20	CHAND	55.00	55.23	Male 100 LC Metre Backstroke	26.66	28.57
9	TYSOE, CAMERON	24	GIND	55.05	54.84	Male 100 LC Metre Backstroke	26.46	28.38
10	MILLS, PETER	24	MBAY	55.04	55.30	Male 100 LC Metre Backstroke	26.74	28.56
11	SWINBURN, STUAR	19	UNSW	55.80	55.65	Male 100 LC Metre Backstroke	27.00	28.65

Place	Name	Age	Team	Prelims	Finals	Event	Split_50	Split_100
12	BAYLISS, JAMES	17	NCOLL	56.06	55.91	Male 100 LC Metre Backstroke	26.68	29.23
13	BOOTH, SHAYE	20	MING	56.33	55.99	Male 100 LC Metre Backstroke	27.21	28.78
14	DAFF, CONOR	18	MBAY	56.25	56.08	Male 100 LC Metre Backstroke	26.93	29.15
15	FOOTE, NATHAN	20	STAND	56.19	56.33	Male 100 LC Metre Backstroke	27.59	28.74
16	CORNWELL, JYE	24	YERPK	56.03	56.43	Male 100 LC Metre Backstroke	27.17	29.26

US Trials Wave I Reaction Time Demo

Let's see if there's a difference between the reaction times of sprinters, mid distance swimmers and distance swimmers in the US Trials Wave I results. We'll define anyone who swims 50 or 100m distances as a sprinter, anyone who swims the 800 or 1500m distances as a distance swimmer, and everyone else as mid-distance.

For this analysis We'll need the `Lane`, `Name`, `Reaction_Time` and `Event` columns. The other columns won't be needed, so I'll remove them.

We can pull distances out the event names. Note however from the 100 Fly results above that the event names contain more information than we're perhaps used to seeing. Let's clean that up.

```
Wave_I_Clean <- Wave_I %>%
  select(Lane, Name, Team, Reaction_Time, Event) %>% # select only
columns of interest
  mutate(Event = str_remove(Event, ".*(?=(Men)|(Women))")) %>% # remove
everything in event names before Men or Women
  mutate(Reaction_Time = as.numeric(Reaction_Time)) # change type of
Reaction_Time column
```

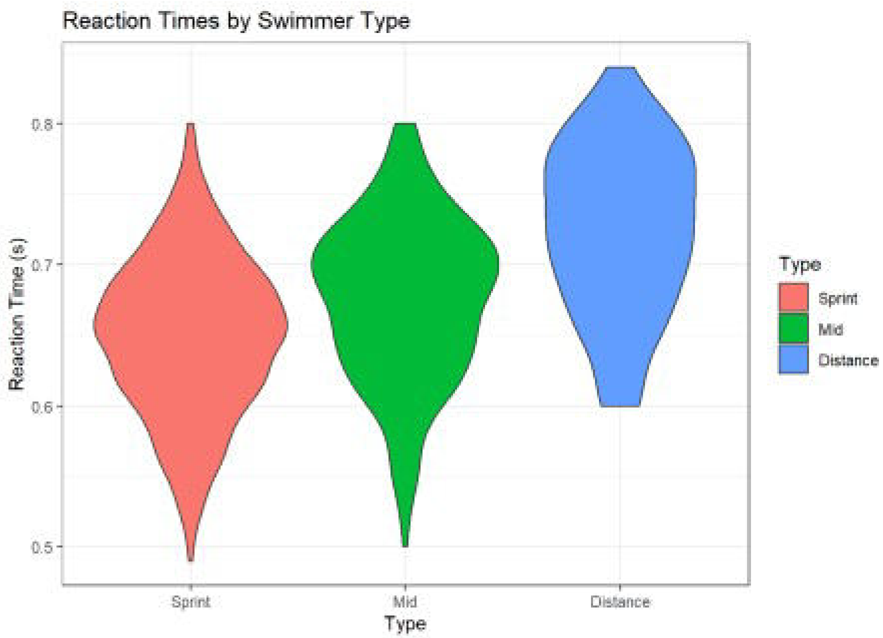
Now we can classify swimmers by type.

```
Wave_I_Clean <- Wave_I_Clean %>%
  group_by(Name) %>% # determining type by athlete
  mutate(Type = case_when(
    # encode athlete types based on events swam
    any(str_detect(Event, "(1500m)|(800m)"), na.rm = TRUE) == TRUE ~
"Distance",
```

```
    any(str_detect(Event, "(100m)|(50m)"), na.rm = TRUE) == TRUE ~
"Sprint",
    TRUE ~ "Mid"
  )) %>%
  mutate(Type = factor(Type, levels = c("Sprint", "Mid", "Distance")))
# type as ordered factor for ggplot later
```

Let's look at the distribution of reaction times by swimmer type.

```
Wave_I_Clean %>%
  ggplot(aes(x = Type, y = Reaction_Time, fill = Type)) +
  geom_violin() +
  theme_bw() +
  labs(y = "Reaction Time (s)",
       title = "Reaction Times by Swimmer Type")
```



There is a noticeable shift towards slower reaction times for distance swimmers compared to sprint and mid-distance, but is it significant? We can use an ANOVA test to determine if the values are significantly different to some standard (called a p value).

```
reaction_anova <- aov(Reaction_Time ~ Type, data = Wave_I_Clean) #
calculate anova
reaction_anova_summary <- summary(reaction_anova) # save summary anova
object
reaction_anova_summary # view anova results
##               Df Sum Sq Mean Sq F value Pr(>F)
## Type           2  0.479 0.23930   74.65 <2e-16 ***
## Residuals   1270  4.071 0.00321
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The p value is very low, at 2.2336931^{-31}. We can conclude that their are significant differences between the groups to at least a significance value (p value) of 0.001. That means the likelihood of these level of difference between the three groups appearing as the result of random variations in populations that are actually identical is less than 0.1%. The ANOVA test doesn't tell us which group(s) have the significant differences though. For that we can use a

Tukey HSD test.

```
reaction_Tukey <- TukeyHSD(reaction_anova) # calculate Tukey HSD
reaction_Tukey # view results
##   Tukey multiple comparisons of means
##     95% family-wise confidence level
##
## Fit: aov(formula = Reaction_Time ~ Type, data = Wave_I_Clean)
##
## $Type
##                       diff        lwr        upr p adj
## Mid-Sprint      0.02606628 0.01762142 0.03451114     0
## Distance-Sprint 0.07474784 0.05854508 0.09095060     0
## Distance-Mid    0.04868156 0.03158292 0.06578019     0
```

The adjusted p values are all approximately zero. we can see what they actually are by pulling them out of the `reaction_Tukey` model object.

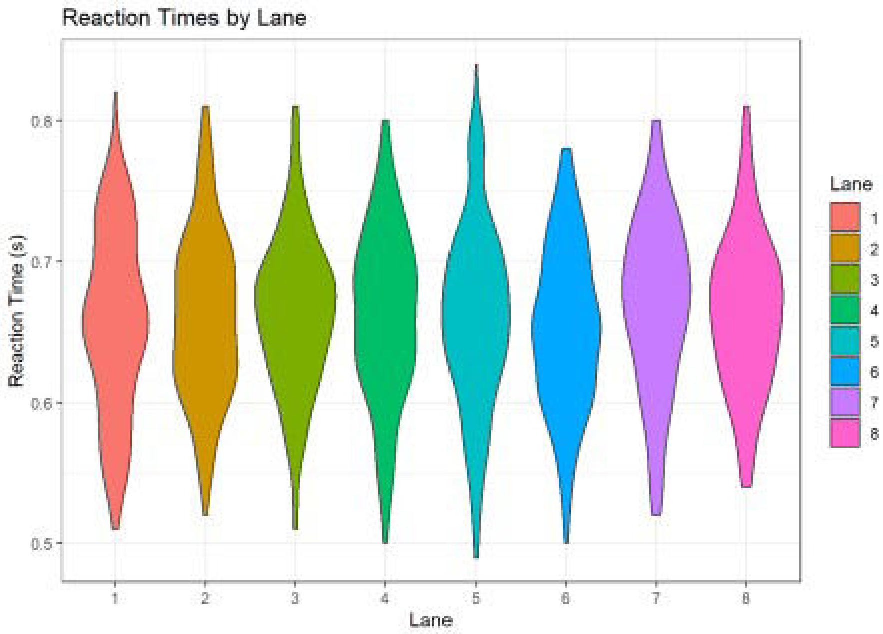
```
reaction_Tukey$Type[,"p adj"] # view actual adjusted p values
##      Mid-Sprint Distance-Sprint    Distance-Mid
##    1.634137e-12    0.000000e+00    1.058689e-10
```

All very low, so all the groups have differences significant at the p = 0.001 level. Sprinters really do have faster reaction times than mid-distance, who are in turn faster than distance swimmers.

Reaction Times By Lane

Just for giggles let's also look by lane. When I was swimming there was always this rumor going around that swimmers in the outside lane nearest the starting device would have an advantage, because the light/sound from the device would reach them before it reached athletes further from the device. It never made much sense, since faster swimmers were deliberately seeded into inner lanes and they usually won. Nowadays each block is equipped with a LED light bar and a sounding device so everything should be equal (if it ever wasn't).

```
Wave_I_Clean %>%
  filter(Lane != "0") %>%
  ggplot(aes(x = Lane, y = Reaction_Time, fill = Lane)) +
  geom_violin() +
  theme_bw() +
  labs(y = "Reaction Time (s)",
       title = "Reaction Times by Lane")
```



That looks about even to me. Let's see what the testing has to say.

```
reaction_anova <- aov(Reaction_Time ~ Lane, data = Wave_I_Clean) #
calculate anova
reaction_anova_summary <- summary(reaction_anova) # save summary anova
object
reaction_anova_summary # view anova results
##                Df Sum Sq  Mean Sq F value Pr(>F)
## Lane            8  0.025 0.003144   0.878  0.534
## Residuals    1264  4.525 0.003580
```

Here the p value is 0.5341483, which is larger than any p value we'd care to use. There is no significant difference in reaction time by lane.