# Time Pressure Exp4 Findings

### Load data and initial setup

```
setwd("~/Documents/Projects/harming_esn/Data/exp4/")
load("exp4_mdata3.Rdata")

library(tidyverse)
library(lme4)
library(simr)
library(kableExtra)

mean1 = function(x) {mean(x,na.rm=TRUE)}
median1 = function(x) {median(x, na.rm = TRUE)}
sd1 = function(x) {sd(x, na.rm = TRUE)}
se_mean = function(x) sd1(x)/sqrt(sum(is.na(x) == 0))

harmdata = mdata3 %>% as_tibble() %>%
  mutate(behavior = case_when(behavior_coop == 1 ~ "C",
                              behavior_defect == 1 ~ "D",
                              behavior_punish == 1 ~ "P"),
         time_pressure = ifelse(str_detect(gameID, "TP") == T, "Plus", "Minus"))

harmdata$timeUp = unlist(harmdata$timeUp.x)
```

### Question 1: Is harming slower in the TP- condition?

```
harmdata %>%
  filter(time_pressure == "Minus", round > 0, is.na(behavior) == FALSE) %>%
  group_by(behavior) %>%
  summarize(mean_dt = mean1(behaviorTime/1000),
```

| behavior | mean_dt | se_mean_dt | median_dt |
|---|---|---|---|
| C | 3.249304 | 0.0889681 | 2.5015 |
| D | 2.957714 | 0.0641134 | 2.2905 |
| P | 3.957338 | 0.3743462 | 2.4630 |

```
            se_mean_dt = se_mean(behaviorTime/1000),
            median_dt = median1(behaviorTime/1000)) %>%
  kbl() %>%
  kable_styling()
```

Just looking at means, the decision time for harming is definitely slower (3.96s average vs 3.25 for C for 2.96 for D). We can do a quick t-test to verify:

```
times_coop = harmdata %>% filter(time_pressure == "Minus", round > 0, is.na(behavior) == F

times_defect = harmdata %>% filter(time_pressure == "Minus", round > 0, is.na(behavior) ==

times_harm = harmdata %>% filter(time_pressure == "Minus", round > 0, is.na(behavior) == F

t.test(times_coop, times_harm)$p.val
```

```
[1] 0.0677618
```

```
t.test(times_defect, times_harm)$p.val
```

```
[1] 0.009441941
```

So the difference between cooperation times and punish times is marginally significant (not adjusting for game structure).

### Question 2: How many people decide within 3 seconds in the TP- condition? in 4 seconds?

```
harmdata %>%
  filter(time_pressure == "Minus", round > 0, is.na(behavior) == FALSE) %>%
  mutate(time_within_3 = ifelse(behaviorTime/1000 <= 3, "Yes", "No")) %>%
  group_by(time_within_3) %>%
  count() %>%
```

| time_within_3 | n | perc |
|---|---|---|
| No | 625 | 0.2977608 |
| Yes | 1474 | 0.7022392 |

| timeUp | n | perc |
|---|---|---|
| FALSE | 1561 | 0.7380615 |
| TRUE | 554 | 0.2619385 |

```
  ungroup() %>%
  mutate(perc = n/sum(n)) %>%
  kbl() %>%
  kable_styling()
```

```
harmdata %>%
  filter(time_pressure == "Plus", round > 0, is.na(behavior) == FALSE) %>%
  group_by(timeUp) %>%
  count() %>%
  ungroup() %>%
  mutate(perc = n/sum(n)) %>%
  kbl() %>%
  kable_styling()
```

The rate of decisions being made in 3s or less is a bit higher in the TP+ condition (70.2% in TP- vs 73.8% in TP+). **Does this suggest that only 3.6% of timeouts are avoided under TP (where the TP is making people speed up their decisions?)**

```
harmdata %>%
  filter(time_pressure == "Minus", round > 0, is.na(behavior) == FALSE) %>%
  mutate(time_within_4 = ifelse(behaviorTime/1000 <= 4, "Yes", "No")) %>%
  group_by(time_within_4) %>%
  count() %>%
  ungroup() %>%
  mutate(perc = n/sum(n))  %>%
  kbl() %>%
  kable_styling()
```

| time_within_4 | n | perc |
|---|---|---|
| No | 347 | 0.1653168 |
| Yes | 1752 | 0.8346832 |

| timeUp | behavior_lag | n | perc |
|---|---|---|---|
| FALSE | C | 574 | 0.4177584 |
| FALSE | D | 736 | 0.5356623 |
| FALSE | P | 64 | 0.0465793 |
| TRUE | C | 180 | 0.3964758 |
| TRUE | D | 228 | 0.5022026 |
| TRUE | P | 46 | 0.1013216 |

Extending the time limit to 4 seconds adds 8% of decisions to be included.

### Question 3: Distribution of timeout vs. previous behavior

```
data_lag = harmdata %>%
  select(superid, round, behavior, degree, behaviorTime) %>%
  mutate(round = round + 1)

names(data_lag)[-c(1,2)] = paste0(names(data_lag)[-c(1,2)],"_lag")
data_lag$round = data_lag$round + 1

harmdata2 = merge(x=harmdata,y=data_lag,all.x=T,all.y=F,by=c("superid","round"))

harmdata2 %>%
  filter(time_pressure == "Plus", round > 0, is.na(behavior_lag) == F) %>%
  group_by(timeUp, behavior_lag) %>%
  count() %>%
  ungroup() %>%
  group_by(timeUp) %>%
  mutate(perc = n/sum(n)) %>%
  kbl() %>%
  kable_styling()
```

10% of timeouts were last-round harmers, compared to only 4.6% in non-timeouts.

| round | coop_rate |
|---|---|
| 1 | 0.365 |
| 2 | 0.366 |
| 3 | 0.406 |
| 4 | 0.387 |
| 5 | 0.345 |
| 6 | 0.429 |
| 7 | 0.379 |
| 8 | 0.386 |
| 9 | 0.386 |
| 10 | 0.357 |
| 11 | 0.321 |
| 12 | 0.328 |
| 13 | 0.321 |
| 14 | 0.292 |
| 15 | 0.348 |

**Question 4: Does cooperation decay over time or does it start low? What about harming?**

```
harmdata %>%
  filter(round > 0, time_pressure == "Minus") %>%
  group_by(round) %>%
  summarize(coop_rate = mean1(behavior_coop)) %>%
  round(3) %>%
  kbl() %>%
  kable_styling()
```

In the TP- condition, cooperation starts lower and has a slight decrease after round 10:

```
harmdata %>%
  filter(round > 0, time_pressure == "Minus") %>%
  group_by(round) %>%
  summarize(coop_rate = mean1(behavior_coop)) %>%
  ungroup() %>%
  mutate(first_10_rds = ifelse(round <= 10, "Yes", "No")) %>%
  group_by(first_10_rds) %>%
  summarize(mean_coop_rate = round(mean(coop_rate),3)) %>%
  kbl() %>%
  kable_styling()
```

| first_10_rds | mean_coop_rate |
|---|---|
| No | 0.322 |
| Yes | 0.380 |

| round | coop_rate |
|---|---|
| 1 | 0.451 |
| 2 | 0.410 |
| 3 | 0.444 |
| 4 | 0.420 |
| 5 | 0.441 |
| 6 | 0.441 |
| 7 | 0.413 |
| 8 | 0.413 |
| 9 | 0.427 |
| 10 | 0.380 |
| 11 | 0.362 |
| 12 | 0.370 |
| 13 | 0.372 |
| 14 | 0.350 |
| 15 | 0.412 |

The mean rate of cooperation in rounds 1-10 is 38%, dropping to 32.2% in rounds 11-15.

```
harmdata %>%
  filter(round > 0, time_pressure == "Plus") %>%
  group_by(round) %>%
  summarize(coop_rate = mean1(behavior_coop)) %>%
  round(3) %>%
  kbl() %>%
  kable_styling()
```

```
harmdata %>%
  filter(round > 0, time_pressure == "Plus") %>%
  group_by(round) %>%
  summarize(coop_rate = mean1(behavior_coop)) %>%
  ungroup() %>%
  mutate(first_10_rds = ifelse(round <= 10, "Yes", "No")) %>%
  group_by(first_10_rds) %>%
  summarize(mean_coop_rate = round(mean(coop_rate), 3)) %>%
  kbl() %>%
```

| first_10_rds | mean_coop_rate |
|---|---|
| No | 0.373 |
| Yes | 0.424 |

```
  kable_styling()
```

We see the same decay in the TP+ games, however both rounds 1-10 and 11-15 have higher rates.

### Question 5: What sample size would we need to see a 6% reduction in harming rate?

(work in progress)

To answer this, we can use the **simr** package (Green and MacLeod 2015, https://besjournals.onlinelibrary.wiley.co 210X.12504).

```
m1 = glmer(behavior_punish ~ time_pressure + factor(round) + (1|superid), data = harmdata,

fixef(m1)["time_pressurePlus"] = -0.

powerSim(m1, nsim = 10)
```