Gerrymandering: Exploring the Data

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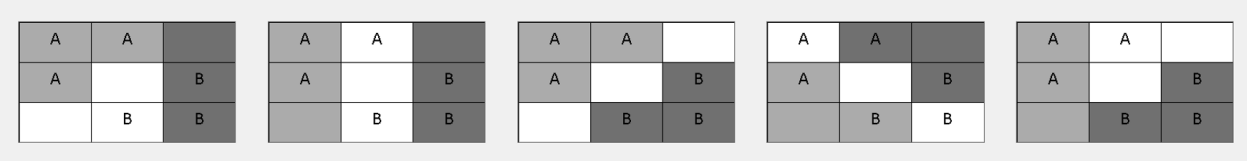
4/4/2021

We are interested in a more reasonable naming device to provide a better way to think about each map.

For the gerrymandered maps we refer to them as $Gerry_i$ for $i \in \{A, B\}$ where i identifies the player for whom the map is gerrymandered (Player A is advantaged in $Gerry_A$). That is, Map 1 will be $Gerry_B$ and Map 5 will be $Gerry_A$.

As the remaining maps are symmetric at the player level we reference $Sym_{d,z}$ for $d \in \{1, 3\}$ and $z \in \{1, 3\}$ where d denotes the number of competitive districts and z denotes the number of zones within each competitive district. That is, Map 2 will be $Sym_{1,1}$, Map 3 will be $Sym_{1,3}$, and Map 4 will be $Sym_{3,1}$.

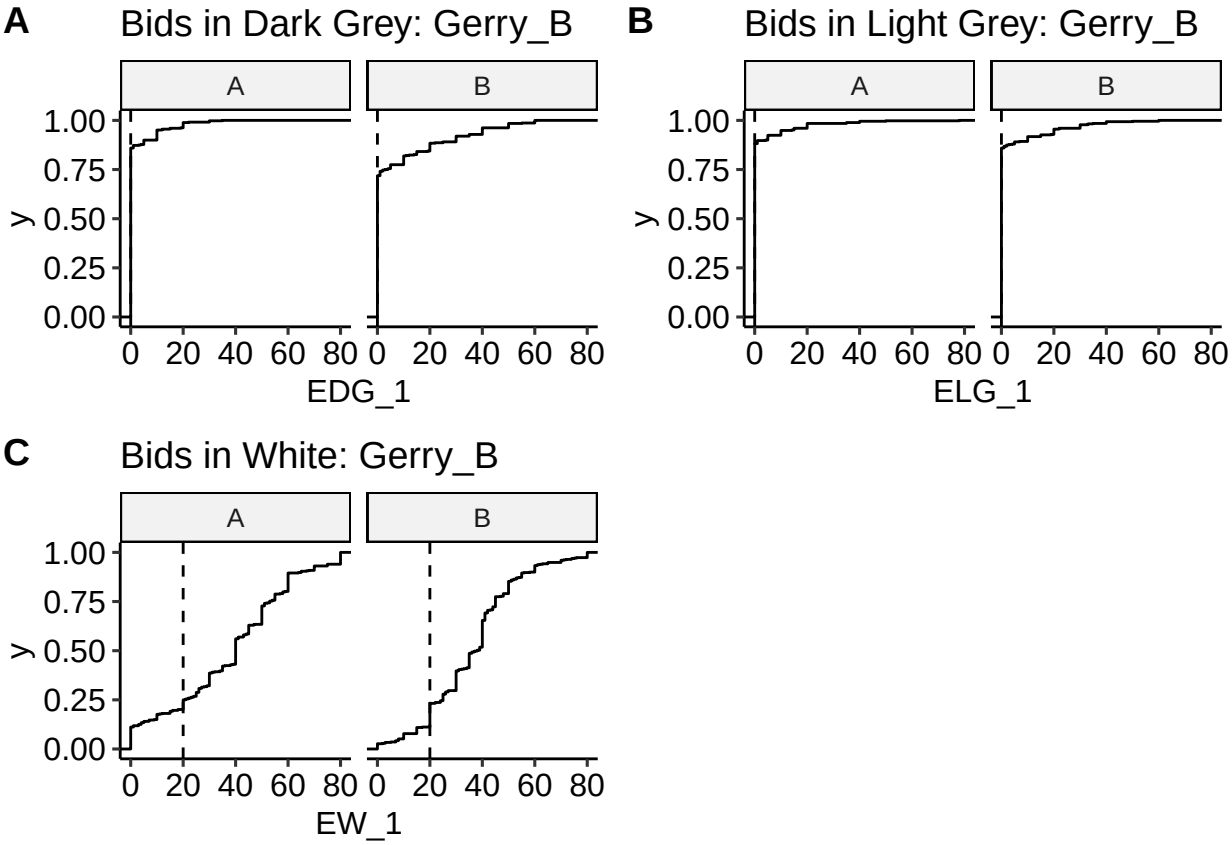
For reference:



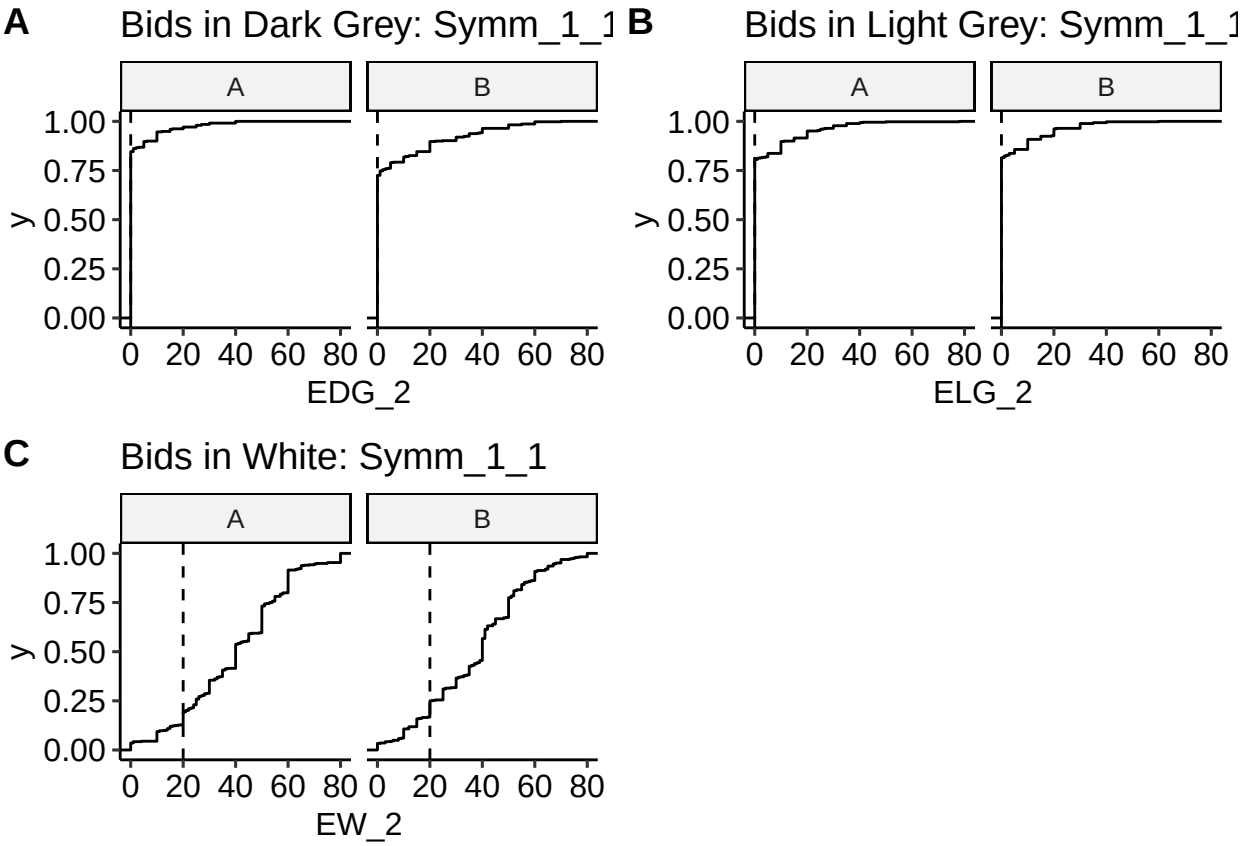
Reading from left to right we have Gerry_B, Symm_1_1, Symm_1_3, Symm_3_1, and Gerry_A.

Note that in Gerry_A, Gerry_B, Symm_1_1, and Symm_1_3 the white district is the only competitive district in the sense that only the competition within the white district determines whether a subject wins that Map. The exception is Symm_3_1 in which it is logical to bid in any district as no district is guaranteed a victor.

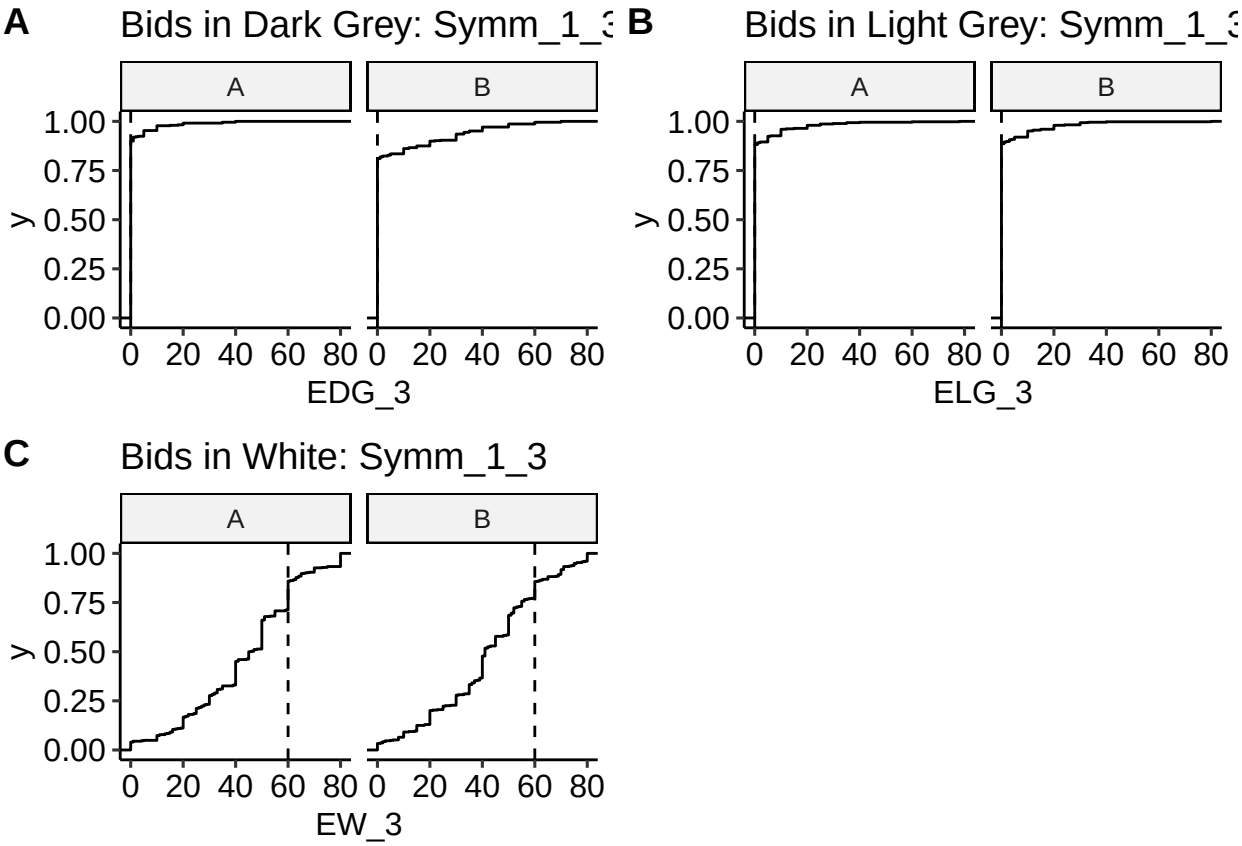
Gerry_B



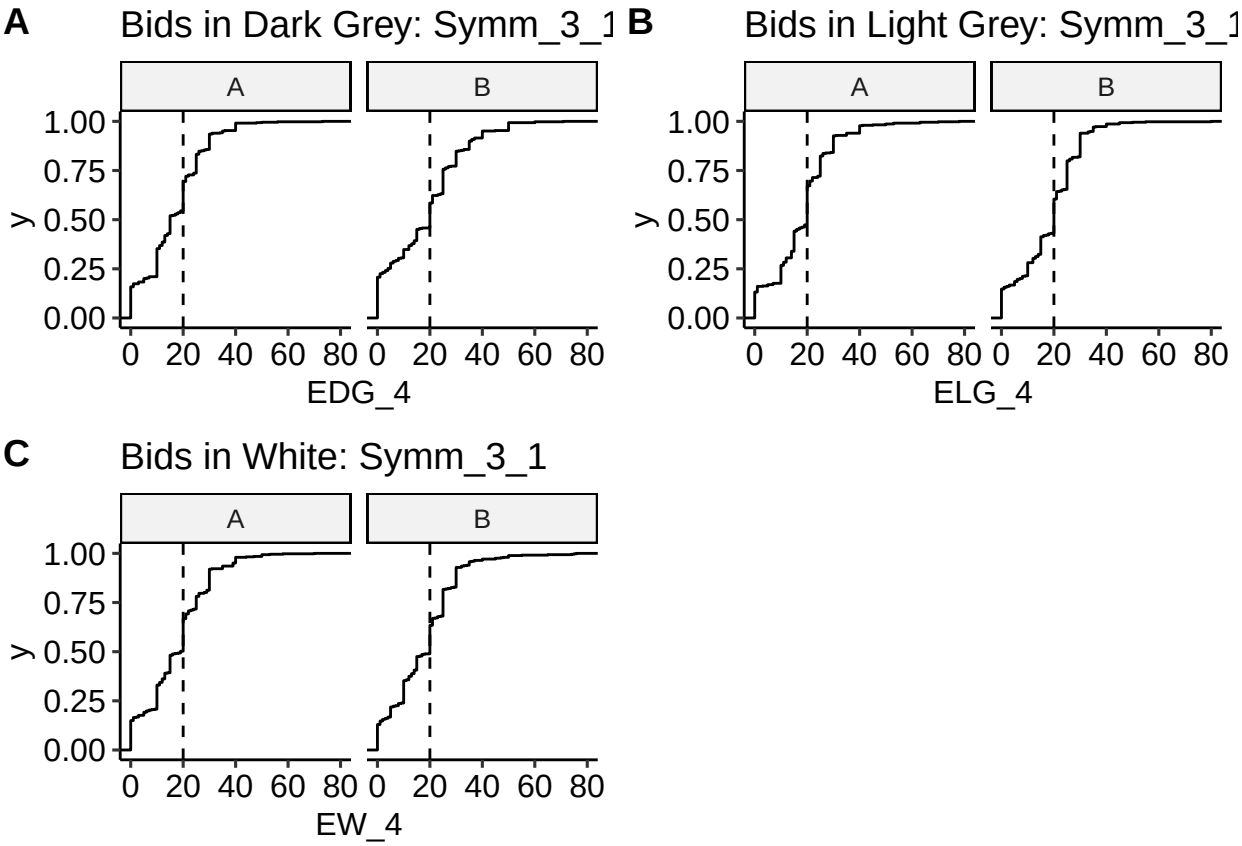
$Symmetric_{1,1}$



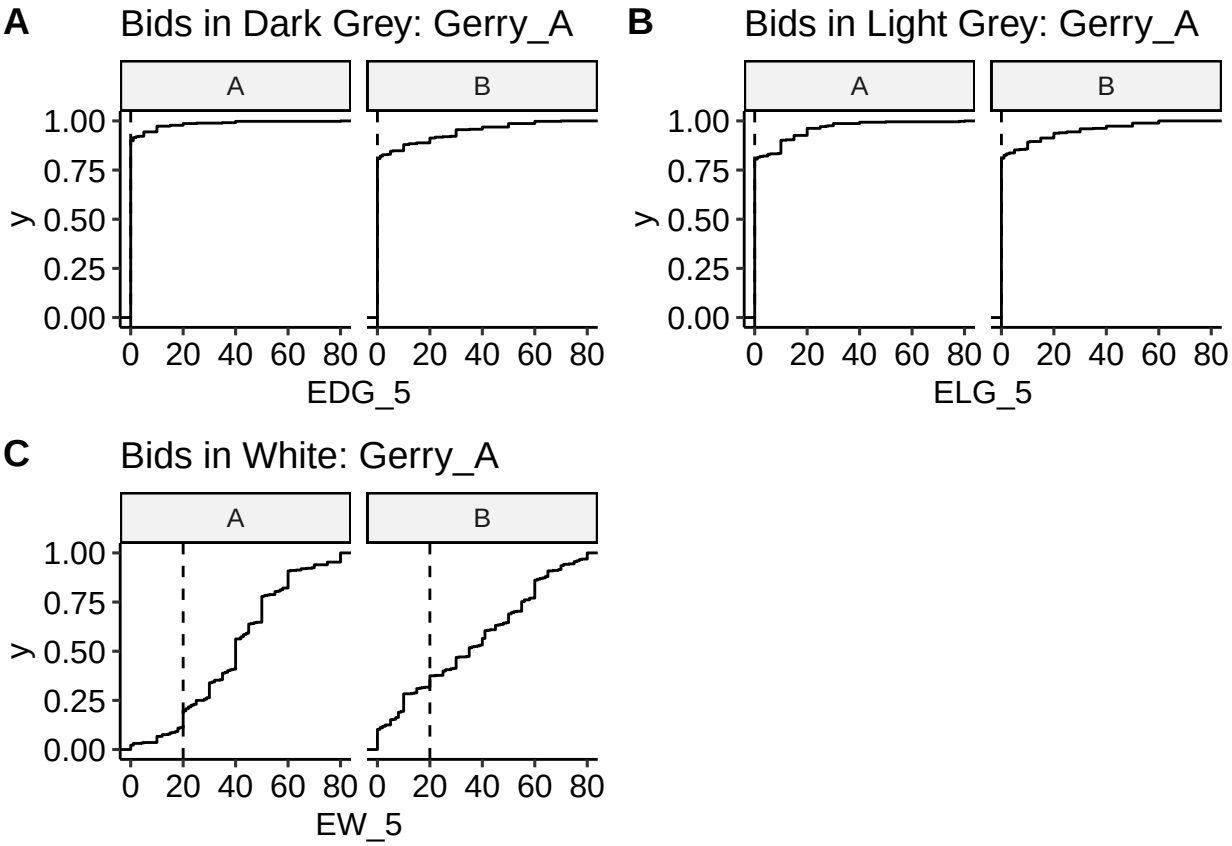
$Symmetric_{1,3}$



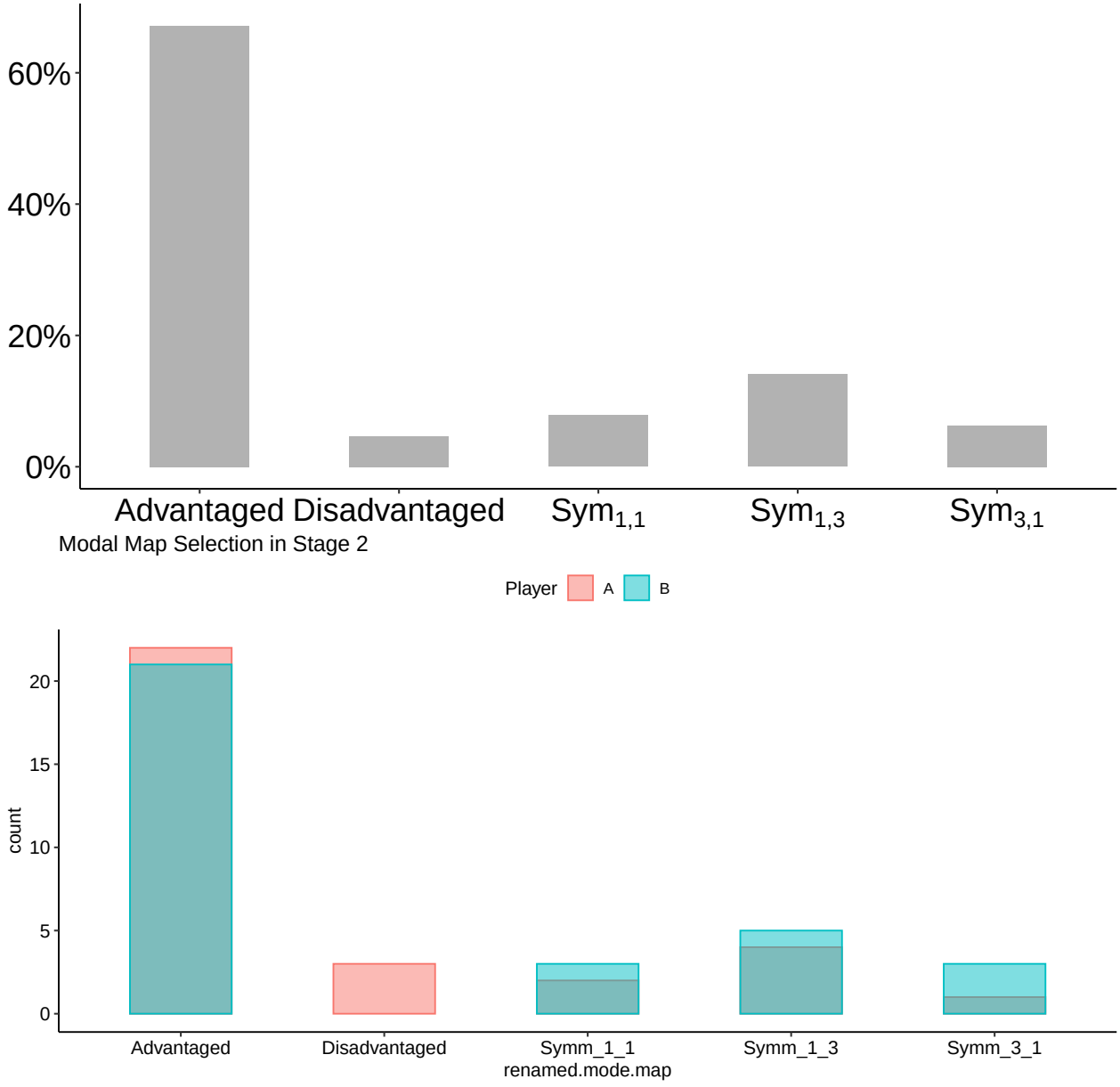
$Symmetric_{3,1}$



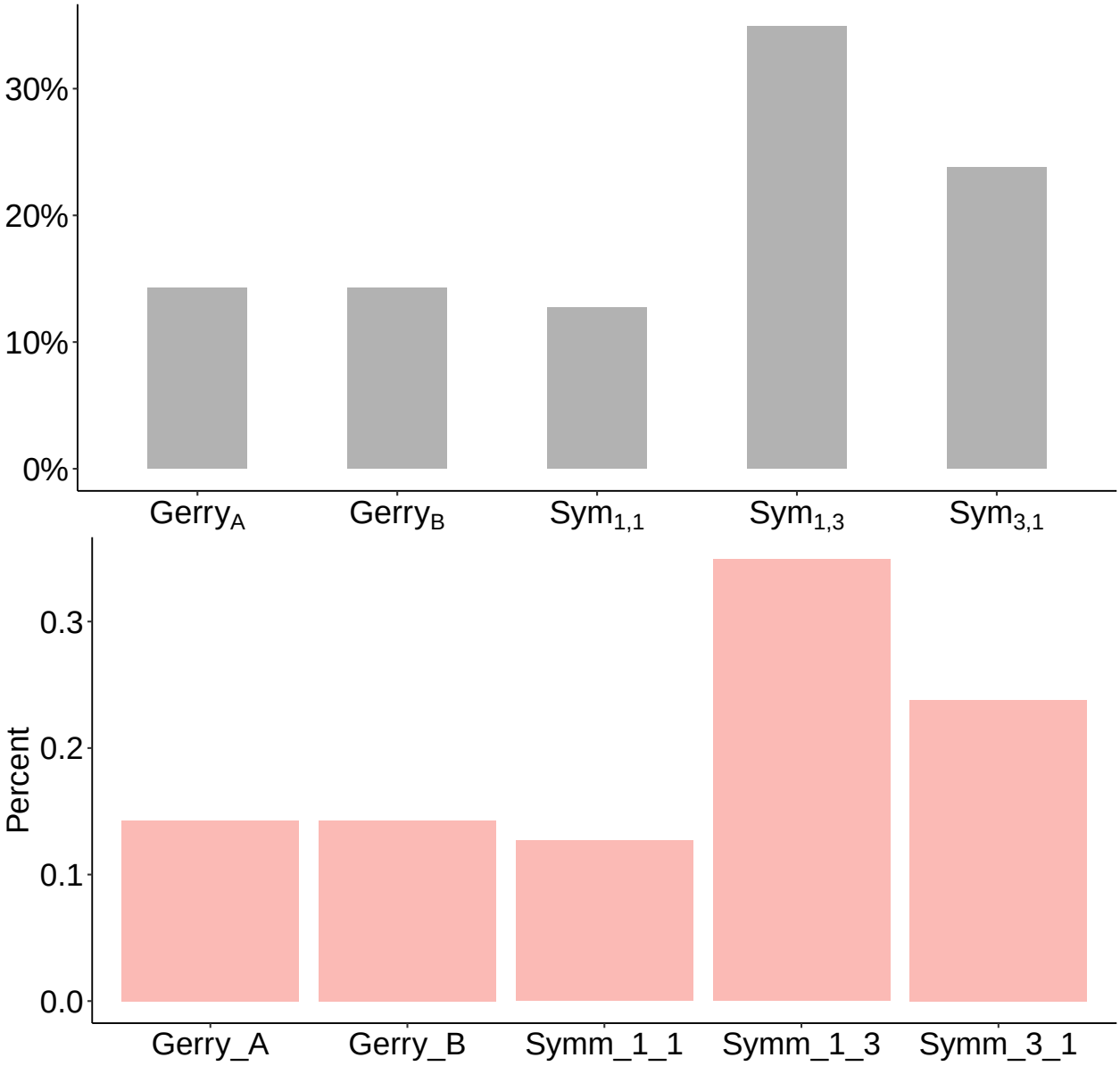
Gerry_A

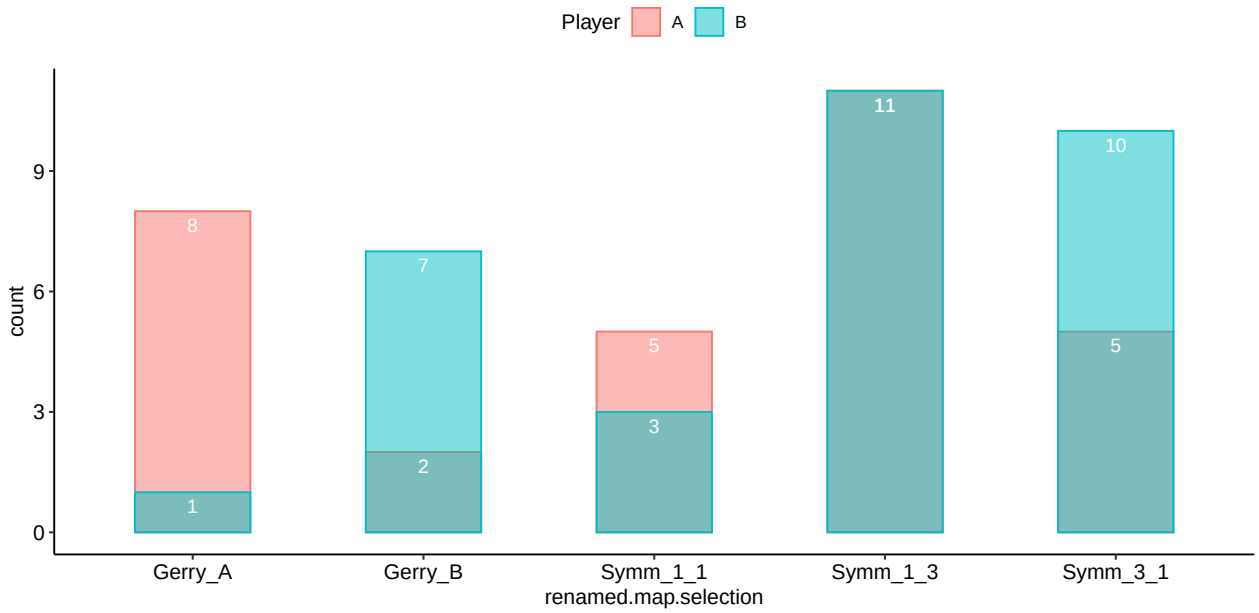

A
Bids in Dark Grey: Gerry_A
A
B
1.00
0.75
0.50
0.25
0.00
y
0 20 40 60 80
EDG_5
B
Bids in Light Grey: Gerry_A
ELG_5
C
Bids in White: Gerry_A
EW_5

Recall, Player A should pick Gerry_A and Player B should pick Gerry_B if they are choosing the map that gives them the best chance of winning.



The first figure depicts the map choices during the final stage for all participants. The second figure is of interest because we might have spillover from the previous stage whereby participants choose the map they have been choosing without really paying attention to the implications. . . or they could just be flipping the coin that they are the "incumbent" after randomization occurs.



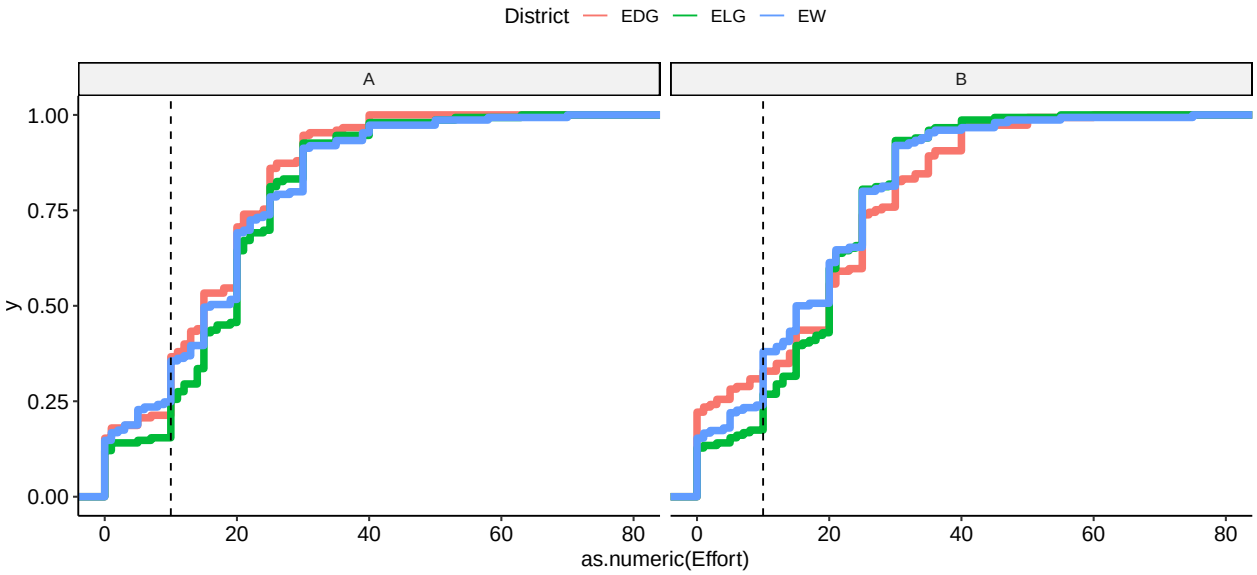

Player
A
B
count
0
3
6
9
8
1
7
2
5
3
11
10
5
Gerry_A
Gerry_B
Symm_1_1
Symm_1_3
Symm_3_1
renamed.map.selection

Now we are addressing:

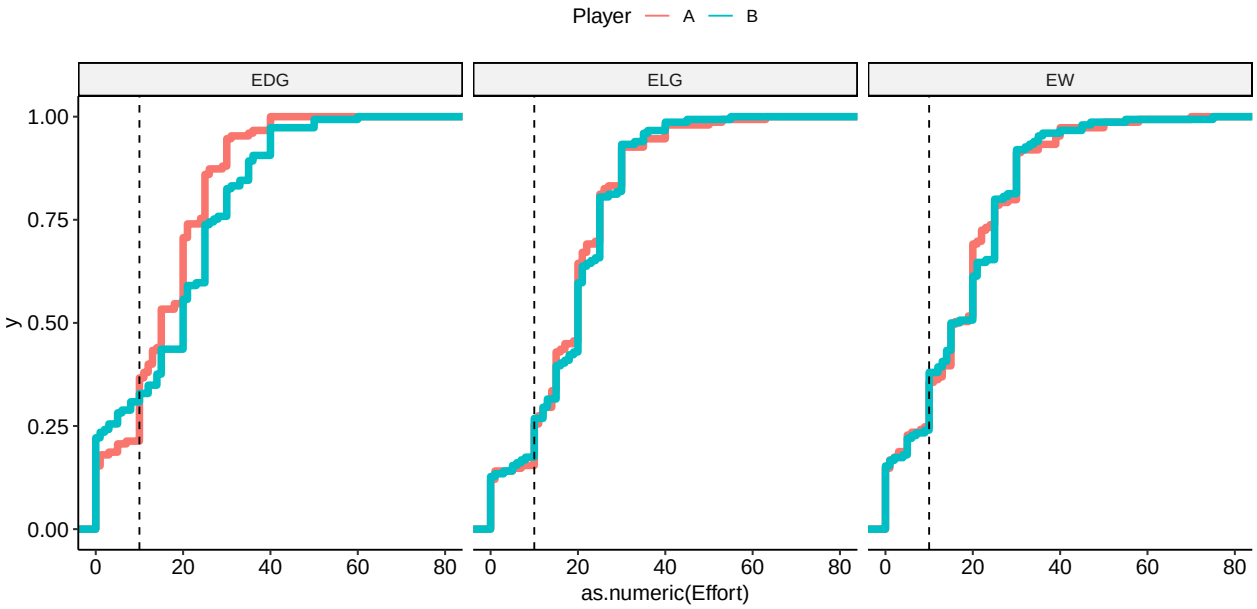
1) For the map where they should be bidding on every region, I would like to see player A's 3 CDFs overlaid on top of each other because there's no reason for them to differ but it's hard to tell in the version you sent.

2) I would also like to see player B's CDFs overlaid

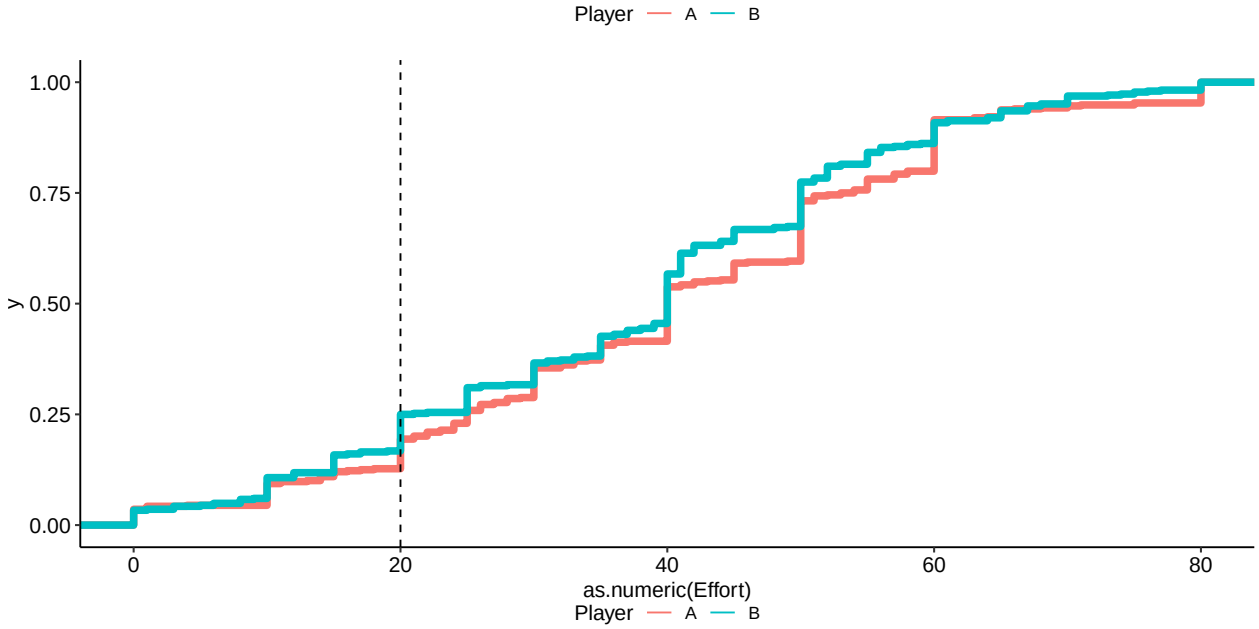
Symm_3_1

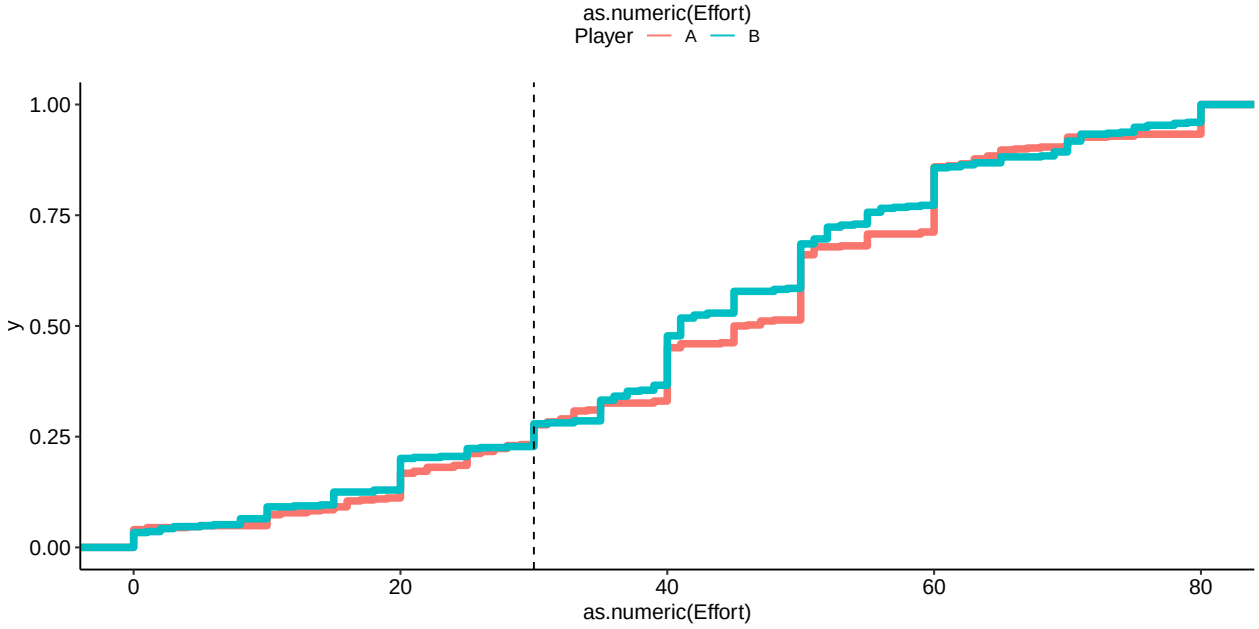


3), 4), & 5) Separately I would like to overlay player A and B's CDFs for districts 1-3 in the map where they bid on all districts since there's no reason for these to differ.



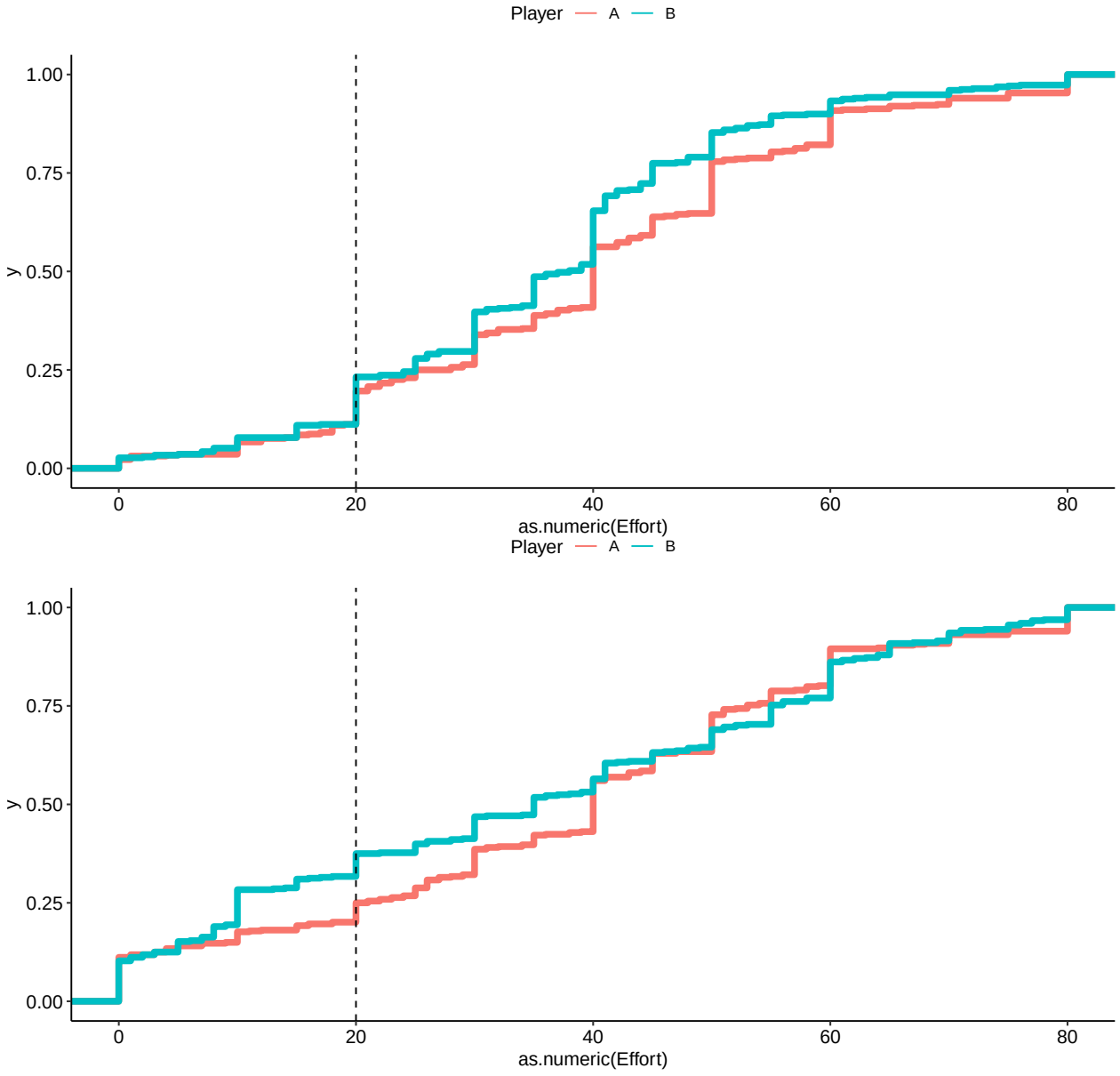
6) & 7) On each of the two maps where the players are symmetric and only bidding on one district I would like to see their CDF's overlaid.



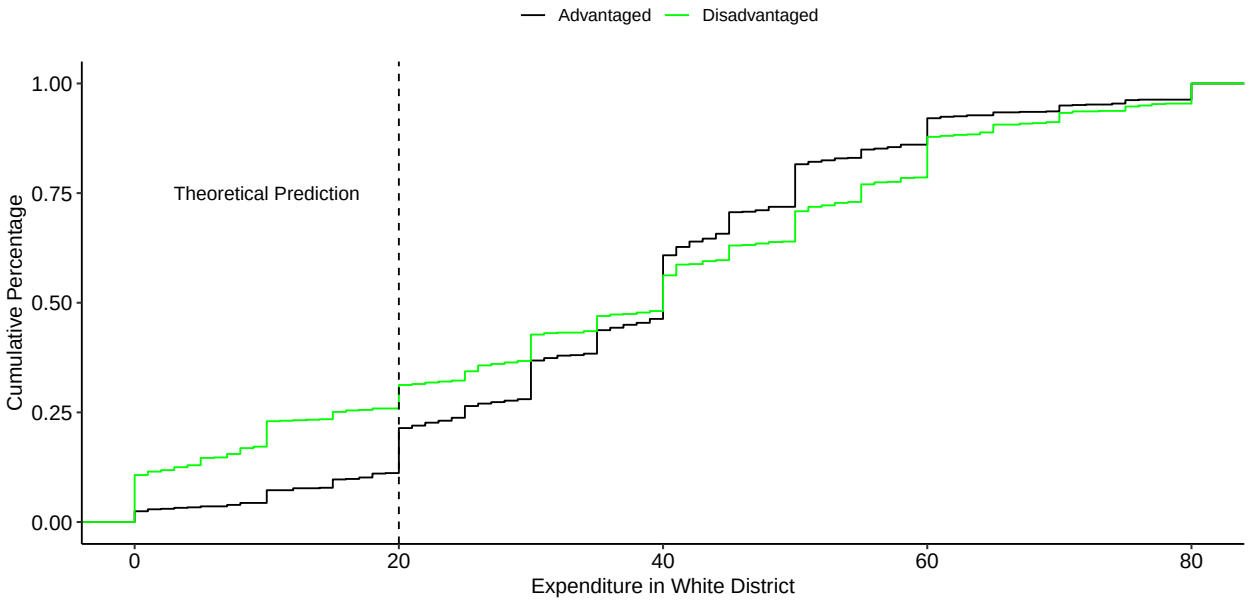


8) Overlay the CDFs of the advantage player in Gerry_B and the advantage player in Gerry_A.

9) Overlay the CDFs of the disadvantaged player in Gerry_B and the disadvantaged player in Gerry_A.



10) Assuming the two CDFs in 8) look the same and the two CDFs in 9) look the same, then make a combined advantaged CDF and a combined disadvantaged CDF and overlay those so we me can easily see how being advantaged matters.




```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(ADV.All)) and as.numeric(unlist(Dis.ADV.All))
## D = 0.15848, p-value = 3.369e-10
## alternative hypothesis: two-sided
```

I'd like to know the average bid of advantaged players and the average bid of disadvantaged players.

```
## # A tibble: 1 x 1
##   `mean(Effort)`
##            <dbl>
## 1           38.1
```

```
## # A tibble: 1 x 1
##   `mean(Effort)`
##            <dbl>
## 1           36.3
```

These average bids by advantaged and disadvantaged players seem odd given the difference in CDFs and the regression results below. How can we reconcile this discrepancy..?

Now let's throw together a large figure of all cdfs:

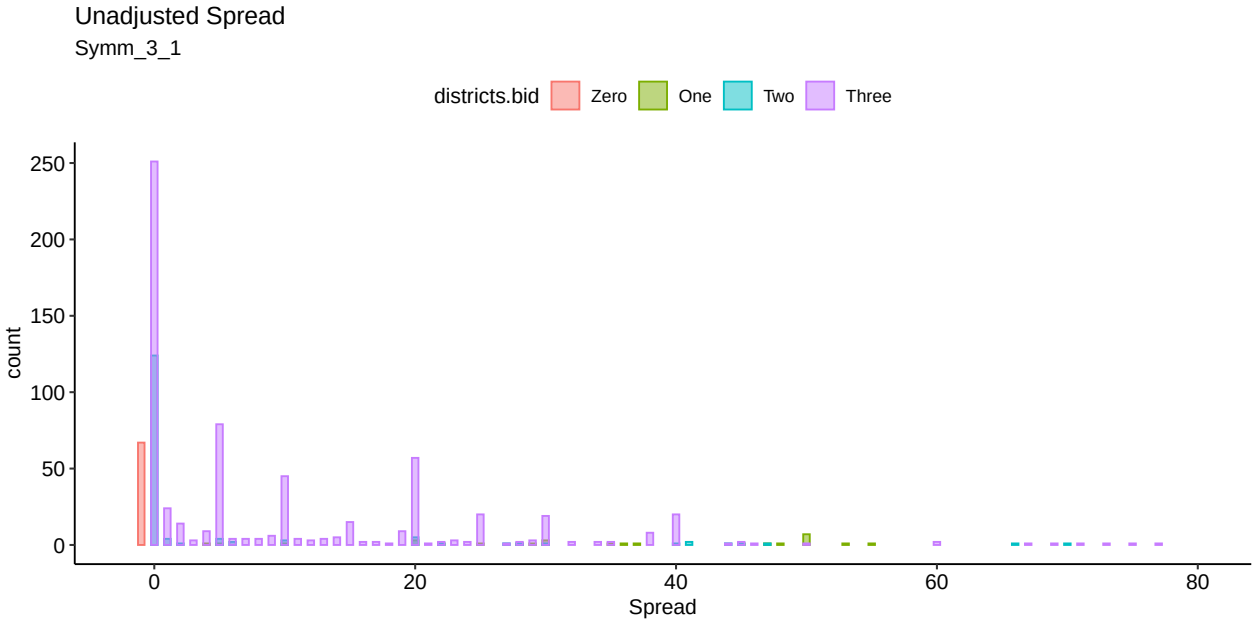
To be added as of 2021-04-07

[DONE]- One other small improvement to all the CDF figures would be to add a vertical line at the theoretical prediction for that map.

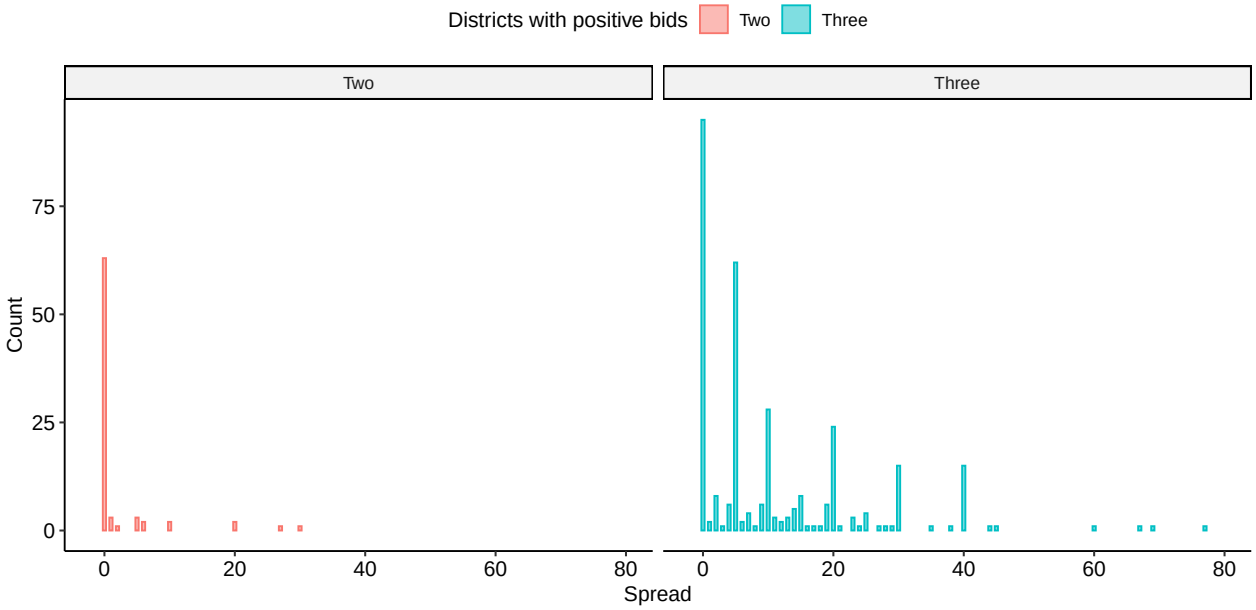
[DONE]- It looks like on Symm_3_1 there is a fair amount of zero bids placed on each map. My guess is that we have lots of instances where people bid on ONLY TWO MAPS. Could you find the proportions of cases (bid tripled by a person in a period) in Symm_3_1 where the person bid 0 on all three districts (that is in a period bid 0,0,0), bid 0 on one district (so 0,x,y or x,0,y, or x,y,0 for x,y>0), bid 0 on two districts, and bid 0 on none of the districts? My guess is that there are lots of cases where they bid 0 on one map.

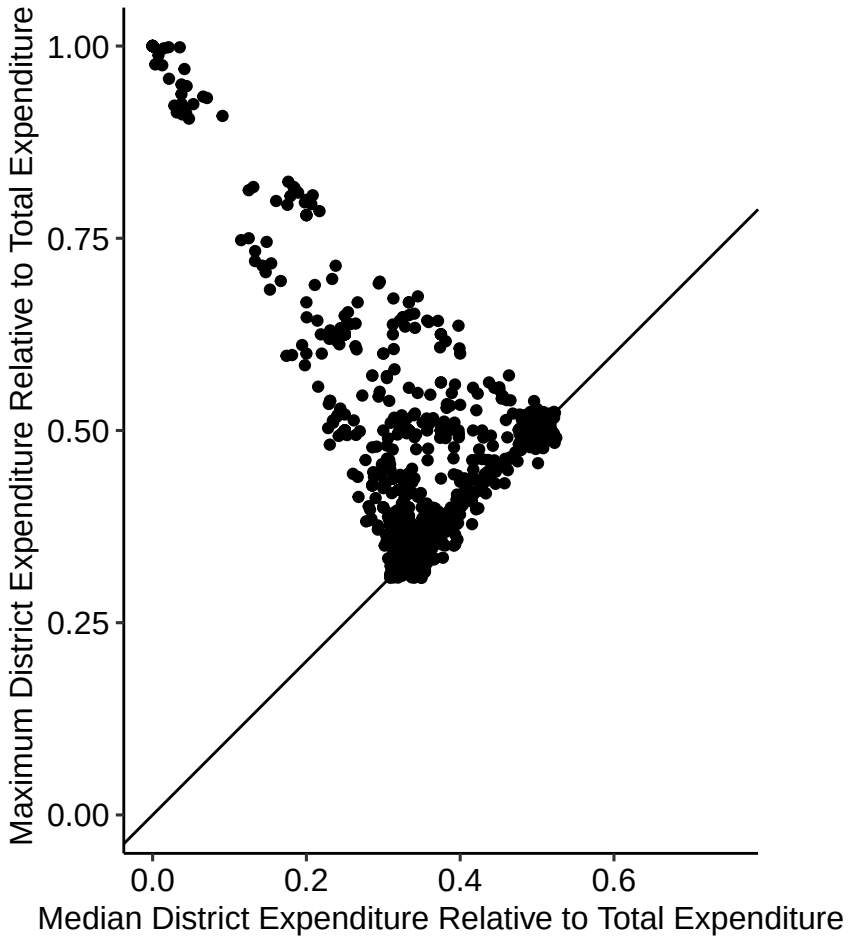
```
## # A tibble: 1 x 9
##   n.records n.all.zeros n.one.district n.two.districts n.three.distric~
##       <int>       <dbl>          <dbl>           <dbl>            <dbl>
## 1       896          67             29             155              645
## # ... with 4 more variables: pct.zeros <dbl>, pct.bid.one <dbl>,
## #   pct.bid.two <dbl>, pct.bid.three <dbl>
```

[DONE]- Look at "spread" of own bids across Symm_3_1 (max bid in any district of Symm_3_1 - min bid in any district in Symm_3_1); we'd like to see this overall (graph?) and just in the cases they bid a positive amount on everything then, for the case they only bid on 2, look at the max minus the median

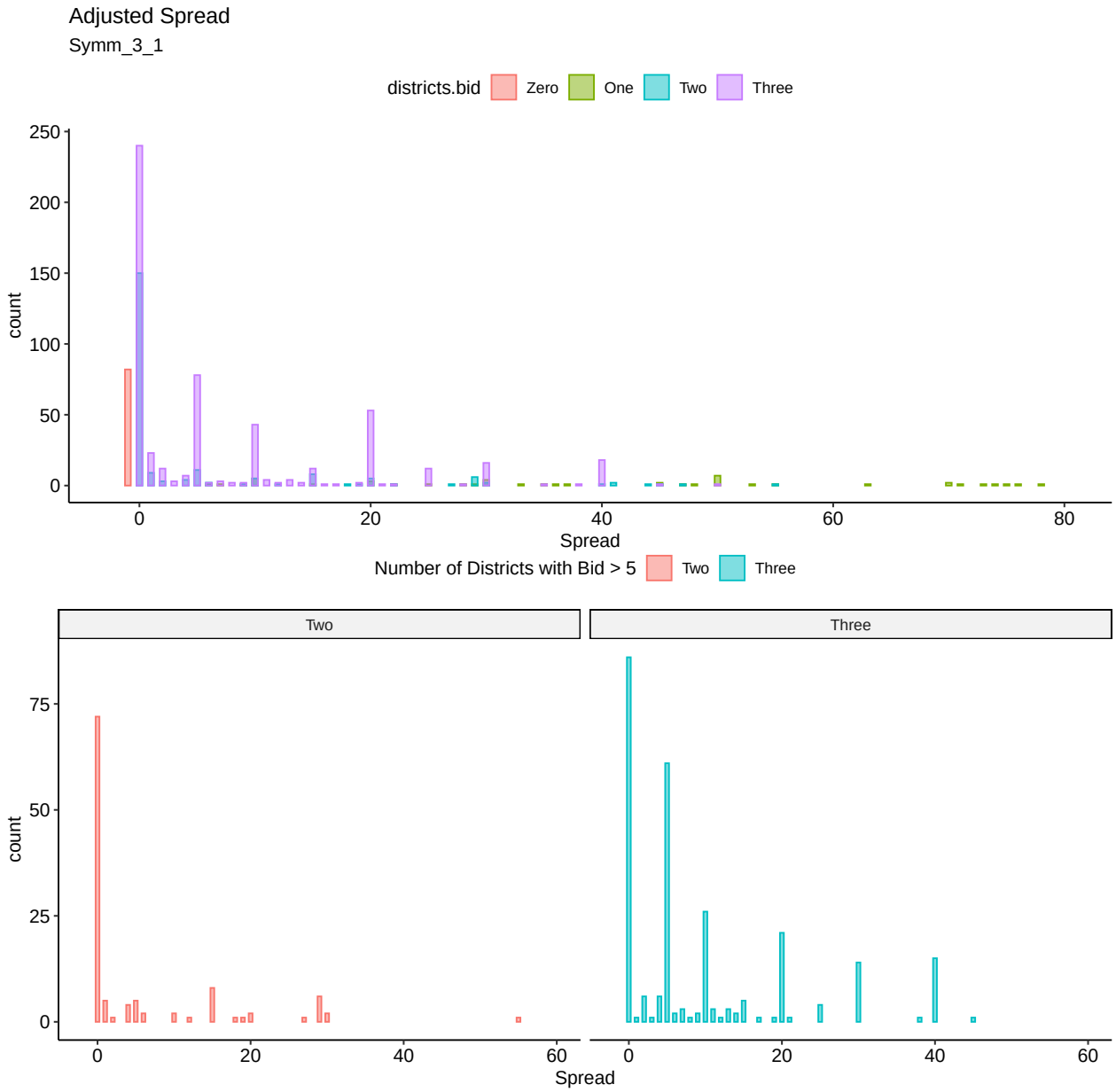


Separate graphs for bidding in two and separate for bidding in three (maybe under table with pct of Zero, One, Two, and Three bids in Symmetric_Map_3,1)






```
## # A tibble: 1 x 9
##   n.records n.all.zeros n.one.district n.two.districts n.three.distric~
##       <int>       <dbl>          <dbl>           <dbl>            <dbl>
## 1       896          82             47             218              549
## # ... with 4 more variables: pct.zeros <dbl>, pct.bid.one <dbl>,
## #   pct.bid.two <dbl>, pct.bid.three <dbl>
```



[DONE]- As a first pass, we should run a K-S tests to see if the various pairs of distributions you overlaid are the same.

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EDG4A)) and as.numeric(unlist(EDG4B))
## D = 0.10938, p-value = 0.009408
## alternative hypothesis: two-sided
```

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(ELG4A)) and as.numeric(unlist(ELG4B))
## D = 0.069196, p-value = 0.2337
## alternative hypothesis: two-sided
```

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EW4A)) and as.numeric(unlist(EW4B))
## D = 0.035714, p-value = 0.9375
## alternative hypothesis: two-sided
```

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EW2A)) and as.numeric(unlist(EW2B))
## D = 0.087054, p-value = 0.06707
## alternative hypothesis: two-sided
```

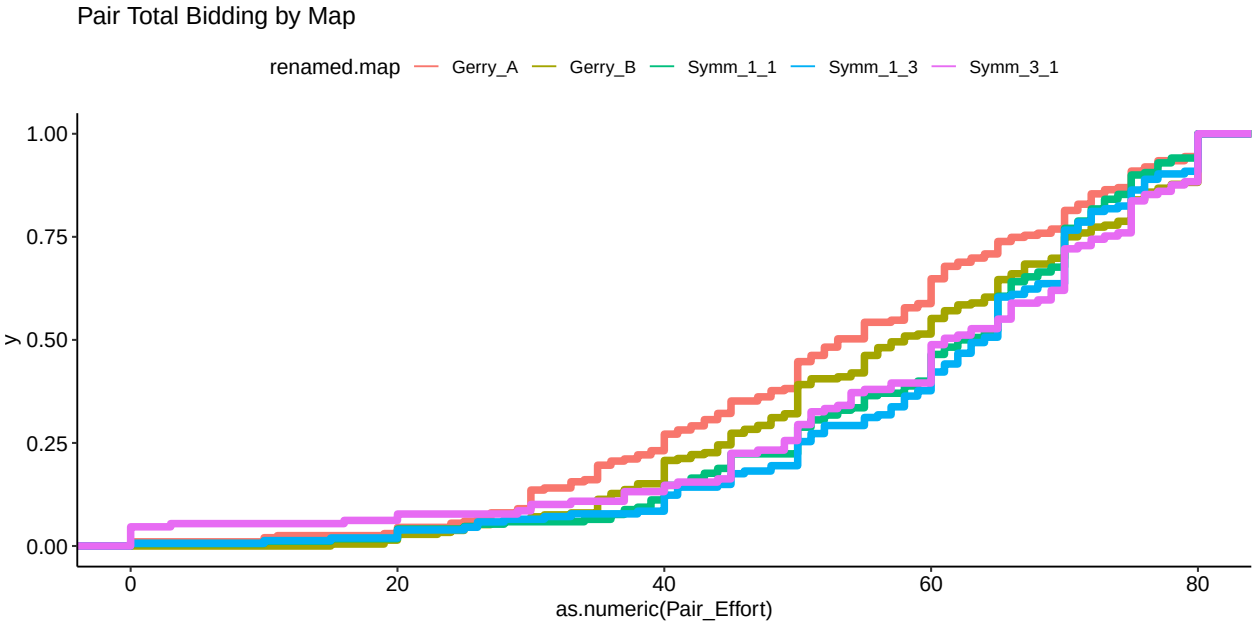
```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EW3A)) and as.numeric(unlist(EW3B))
## D = 0.078125, p-value = 0.1298
## alternative hypothesis: two-sided
```

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(ADV.A)) and as.numeric(unlist(ADV.B))
## D = 0.14286, p-value = 0.000214
## alternative hypothesis: two-sided
```

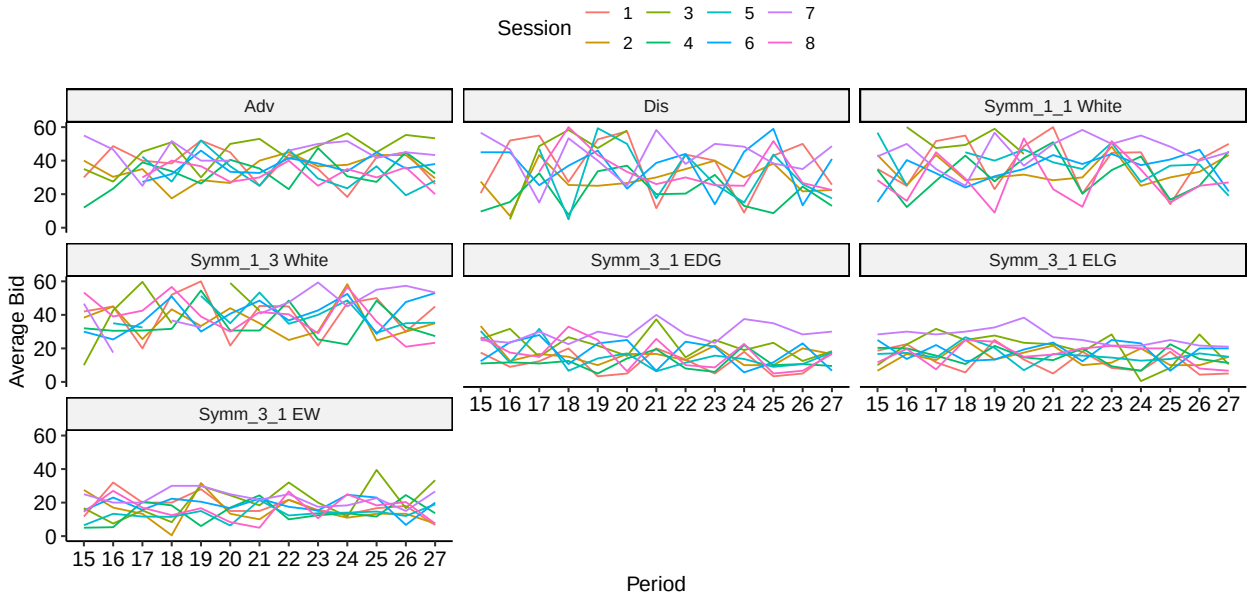
```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(Dis.ADV.A)) and as.numeric(unlist(Dis.ADV.B))
## D = 0.125, p-value = 0.001824
## alternative hypothesis: two-sided
```

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(ADV.All)) and as.numeric(unlist(Dis.ADV.All))
## D = 0.15848, p-value = 3.369e-10
## alternative hypothesis: two-sided
```

[DONE]- Also, since it seems that things are symmetric, it would be good to make a single graph that has the cdfs of total pair level investment by map (here a pair in a period is an observation). That way we can see if more is spent on some maps than others.

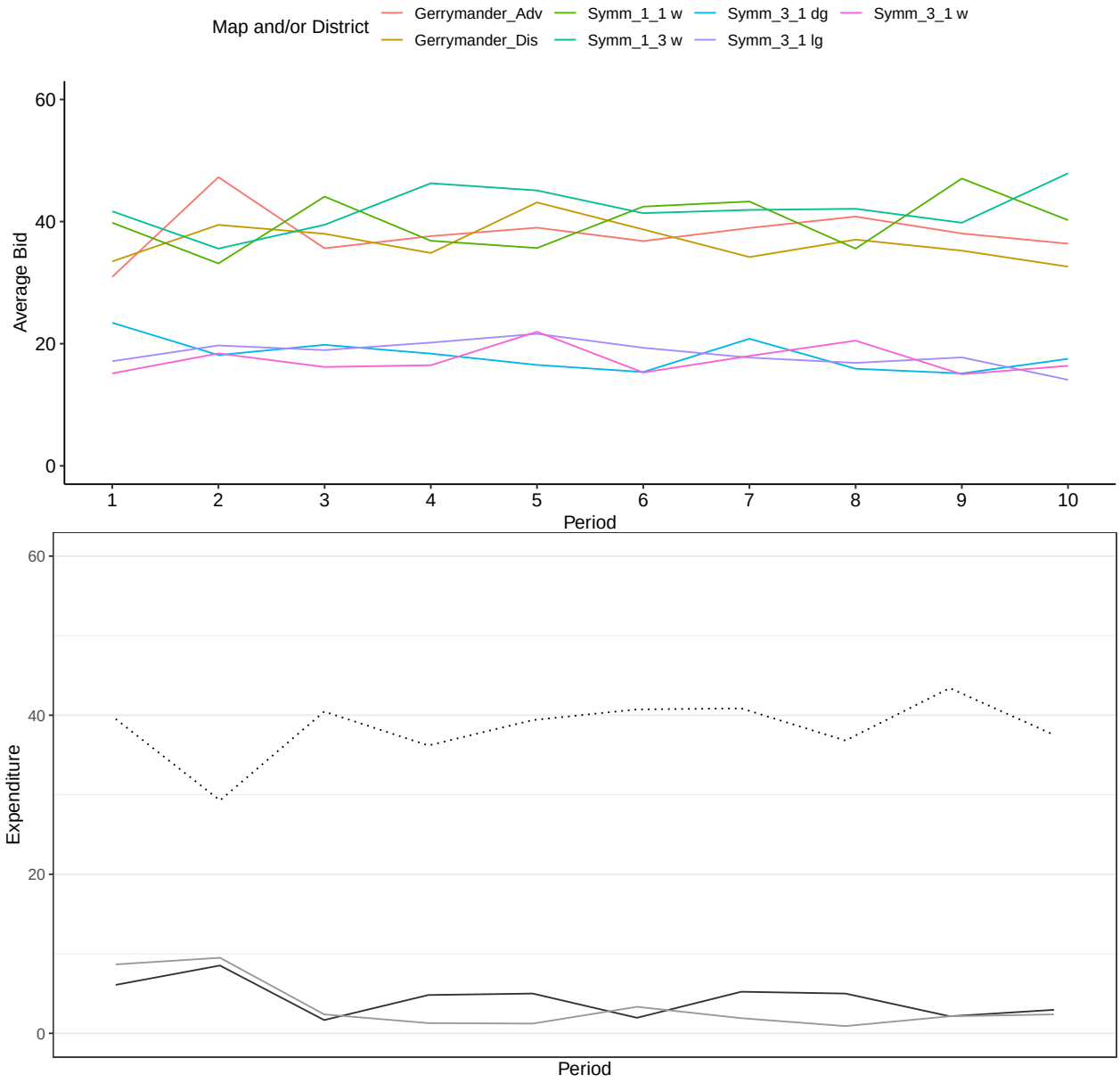


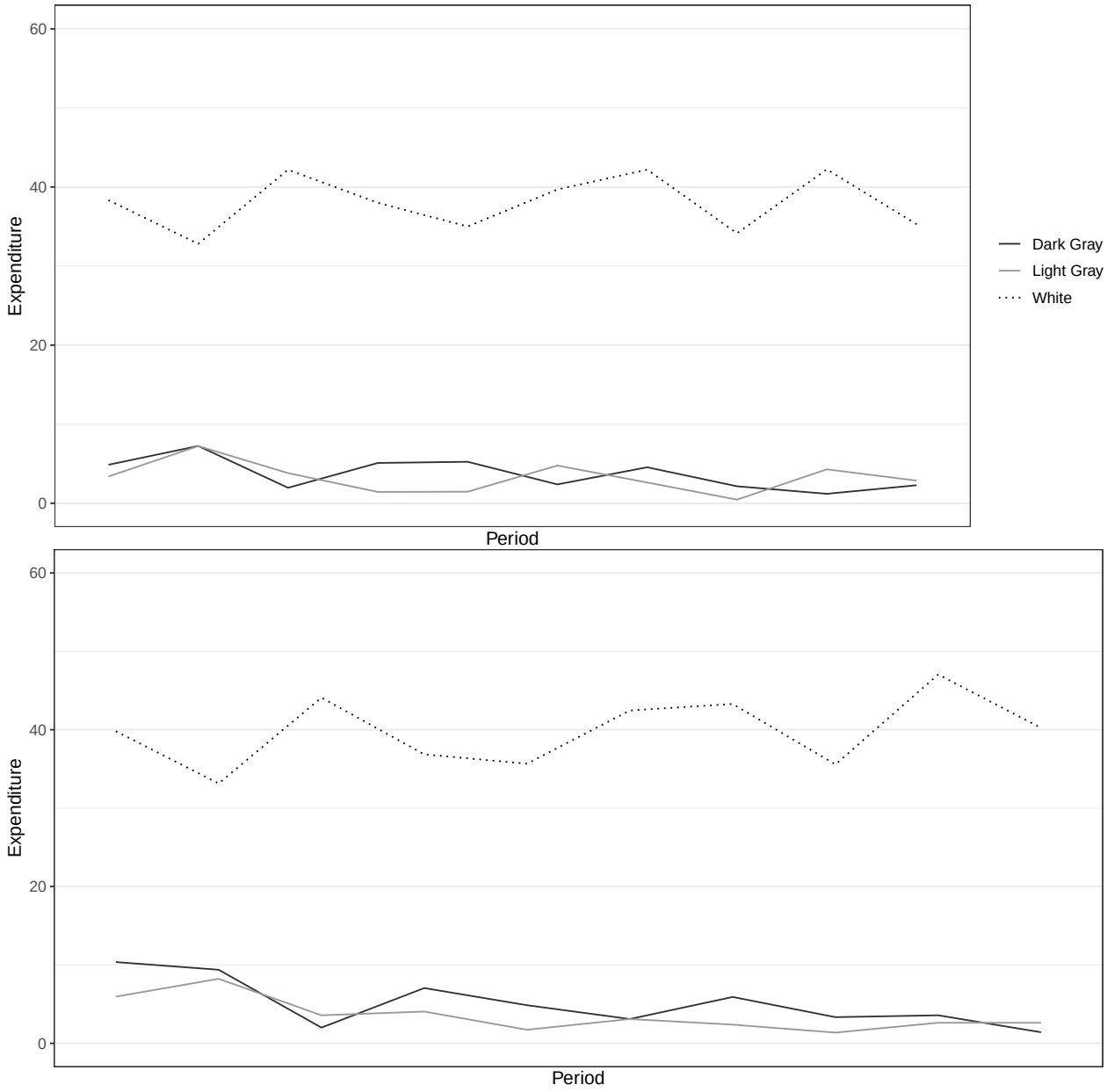
[DONE]- One thing that would be good to do is for each kind of choice (advantaged in map 1 or 5, disadvantaged in map 1 or 5, white in map 2, white in map 3, all regions in map 4) take the average across all subjects in a period. Then plot a time series of those averages. This should include phase 1 and 2 so we can see if map selection impacted bidding on maps.

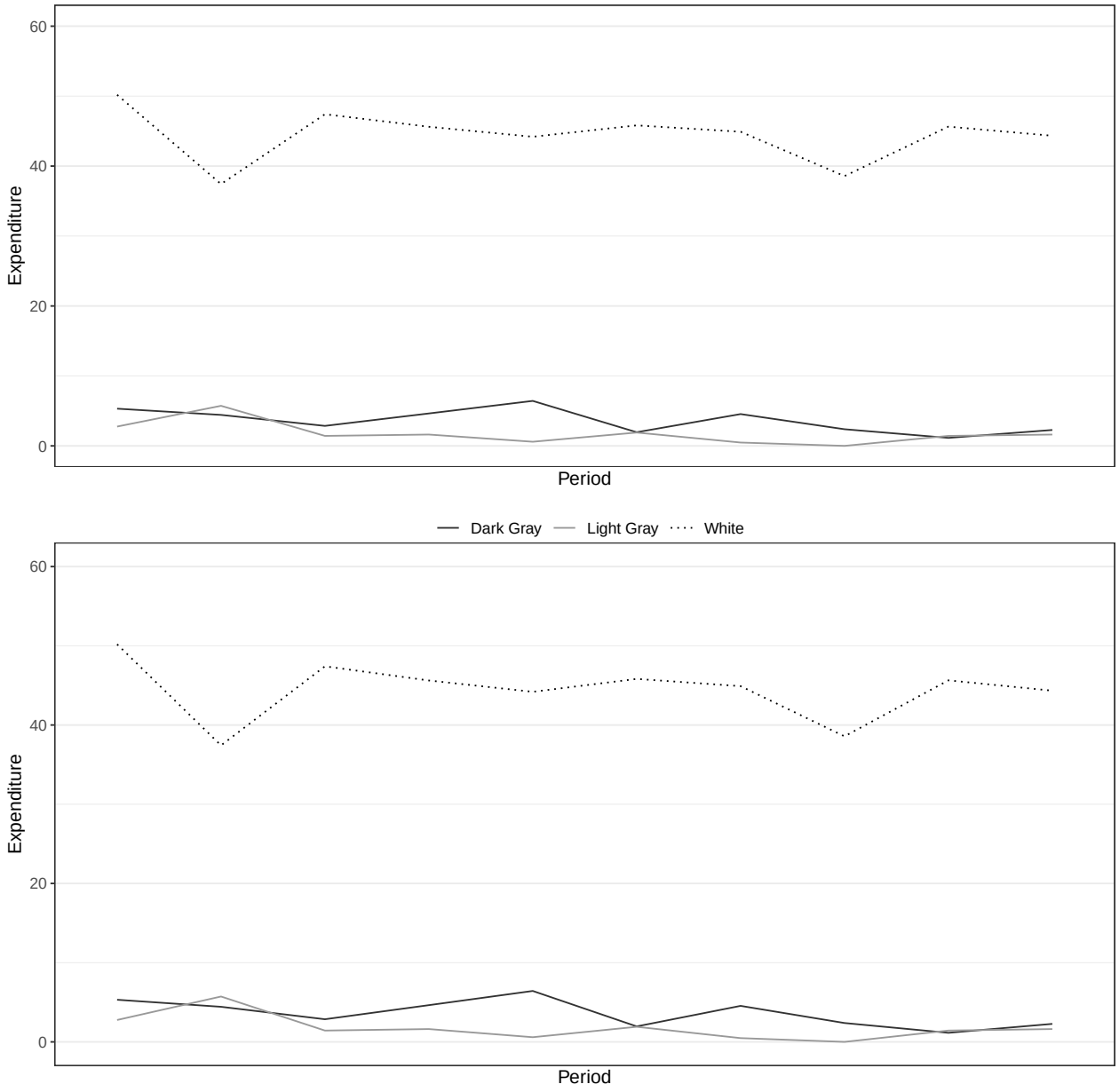


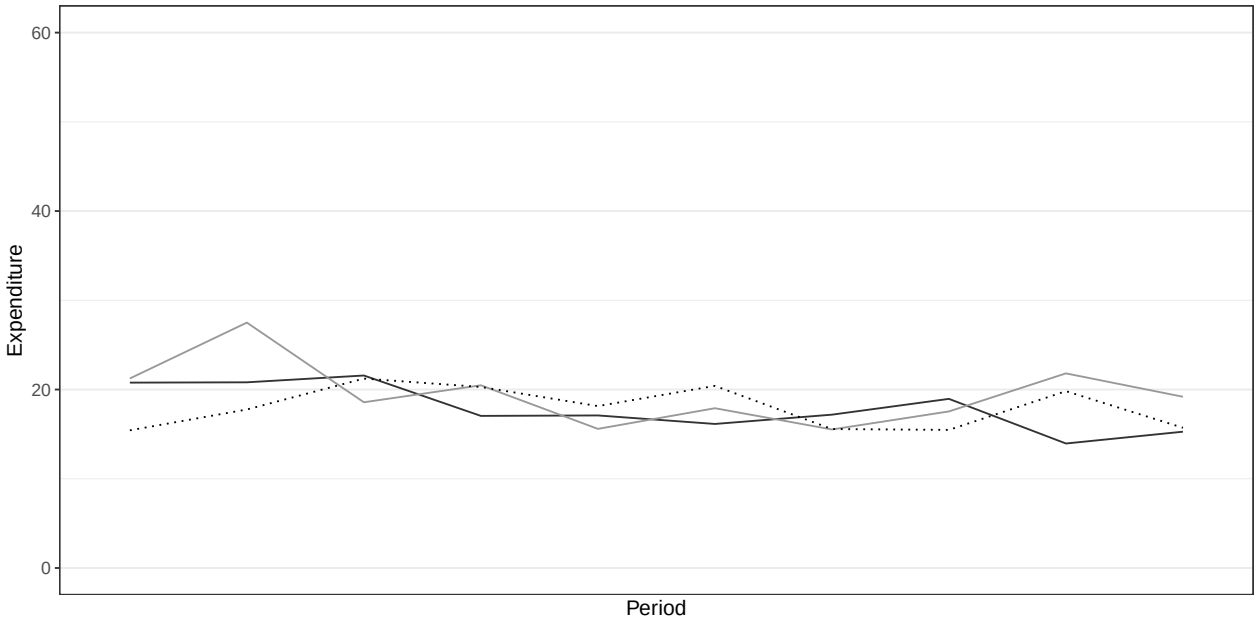

```
## # A tibble: 7 x 2
##   Choice          avg.bid.in.map
##   <chr>                    <dbl>
## 1 Adv                       37.9
## 2 Dis                       35.6
## 3 Symm_1_1 White            39.0
## 4 Symm_1_3 White            41.4
## 5 Symm_3_1 EDG              17.5
## 6 Symm_3_1 ELG              17.5
## 7 Symm_3_1 EW               17.4
```

What about a time series plot with the average across all sessions?

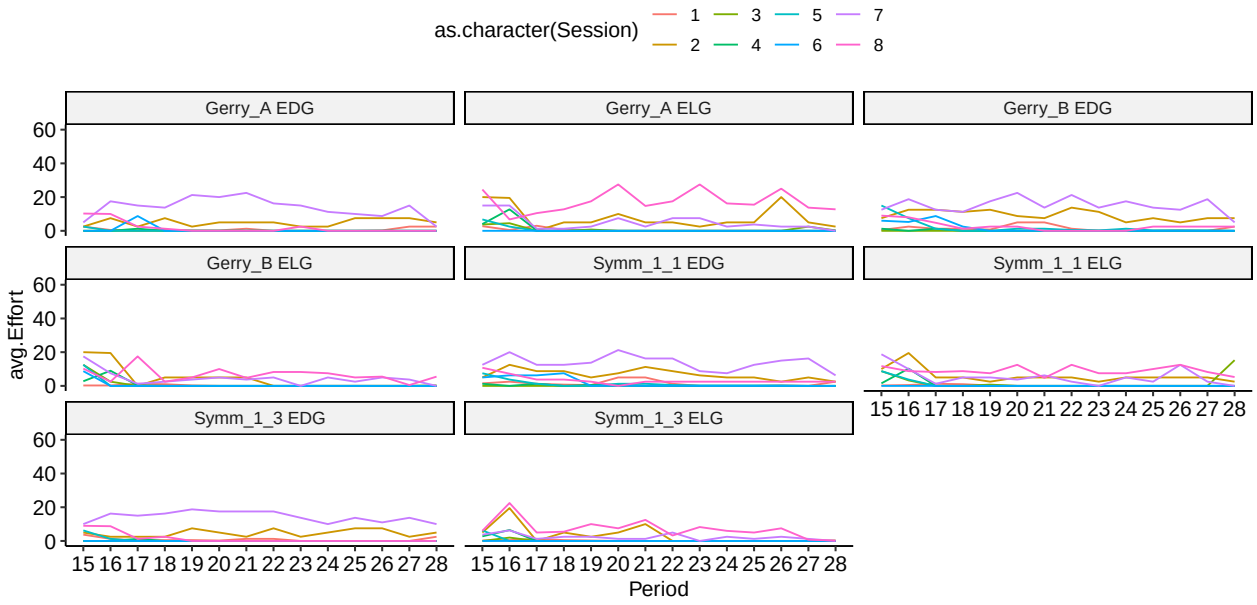


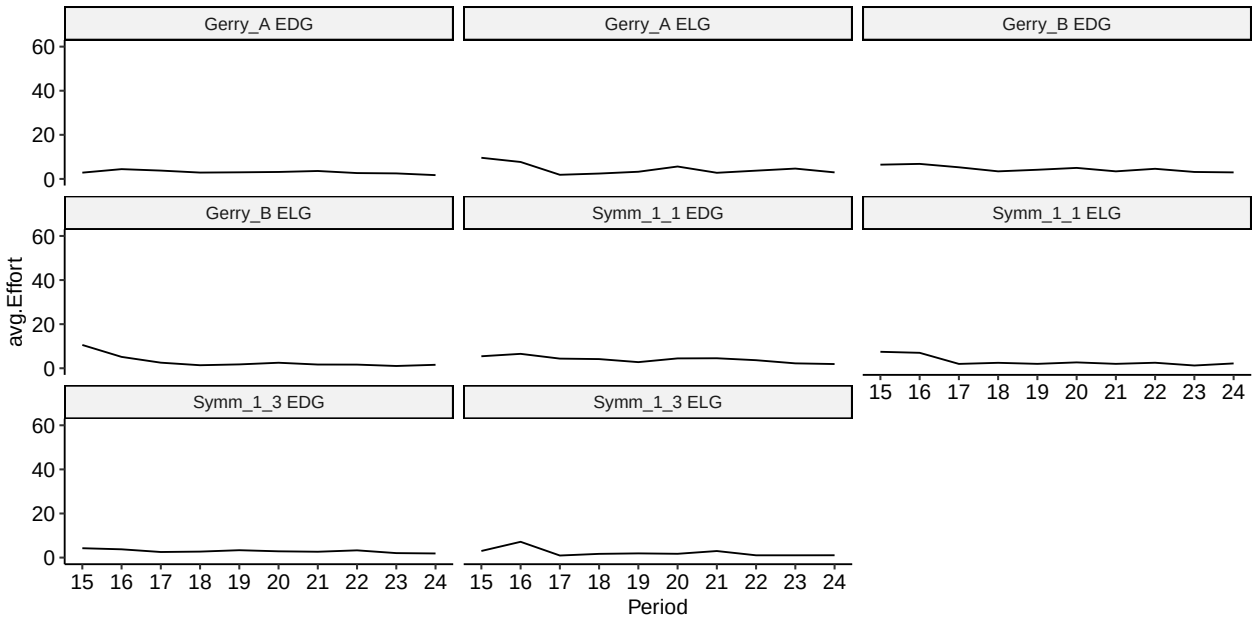

60
40
20
0
Expenditure
Period
Dark Gray
Light Gray
White
60
40
20
0
Expenditure
Period


60
40
20
0
Expenditure
Period
Dark Gray
Light Gray
White
60
40
20
0
Expenditure
Period



The following looks at the time series plots for only non-competitive districts to support our claim that a learning effect exists.





NOTE: We might wish to figure out if only a few bad eggs are driving these contributions to noncompetitive districts.

[DONE]- A small cosmetic point is to make sure you keep the x-axis fixed to make comparisons between graphs easier. It is not a big deal for this, just something to do in general. In the first part of the document you have some that include 80 and some that don't.

[DONE]- Average bid on each district on each map by role

```
##    Player Map District avg.Effort
## 1       A   1      EDG   1.680804
## 2       A   1      ELG   1.758929
## 3       A   1       EW  37.776786
## 4       A   1     pEDG   6.495536
## 5       A   1     pELG   2.662946
## 6       A   1      pEW  36.203125
## 7       A   2      EDG   1.968750
## 8       A   2      ELG   3.379464
## 9       A   2       EW  39.957589
## 10      A   2     pEDG   6.176339
## 11      A   2     pELG   2.901786
## 12      A   2      pEW  37.515625
## 13      A   3      EDG   1.008929
## 14      A   3      ELG   1.671875
## 15      A   3       EW  43.598214
## 16      A   3     pEDG   5.017857
## 17      A   3     pELG   1.669643
## 18      A   3      pEW  42.062500
## 19      A   4      EDG  16.325893
## 20      A   4      ELG  17.897321
## 21      A   4       EW  17.348214
## 22      A   4     pEDG  18.087054
## 23      A   4     pELG  17.917411
## 24      A   4      pEW  17.341518
## 25      A   5      EDG   1.258929
## 26      A   5      ELG   3.261161
```

```
## 27      A   5       EW  40.026786
## 28      A   5     pEDG   4.515625
## 29      A   5     pELG   3.901786
## 30      A   5      pEW  34.750000
## 31      B   1      EDG   6.495536
## 32      B   1      ELG   2.662946
## 33      B   1       EW  36.203125
## 34      B   1     pEDG   1.680804
## 35      B   1     pELG   1.758929
## 36      B   1      pEW  37.776786
## 37      B   2      EDG   6.176339
## 38      B   2      ELG   2.901786
## 39      B   2       EW  37.515625
## 40      B   2     pEDG   1.968750
## 41      B   2     pELG   3.379464
## 42      B   2      pEW  39.957589
## 43      B   3      EDG   5.017857
## 44      B   3      ELG   1.669643
## 45      B   3       EW  42.062500
## 46      B   3     pEDG   1.008929
## 47      B   3     pELG   1.671875
## 48      B   3      pEW  43.598214
## 49      B   4      EDG  18.087054
## 50      B   4      ELG  17.917411
## 51      B   4       EW  17.341518
## 52      B   4     pEDG  16.325893
## 53      B   4     pELG  17.897321
## 54      B   4      pEW  17.348214
## 55      B   5      EDG   4.515625
## 56      B   5      ELG   3.901786
## 57      B   5       EW  34.750000
## 58      B   5     pEDG   1.258929
## 59      B   5     pELG   3.261161
## 60      B   5      pEW  40.026786
```

[DONE]- Percent gerrymandering in stage 2

ISSUE: there seems to be a discrepency in how this is being calculated and it is coming from the use of "ties = 'random' " in the modal() command.

ISSUE RESOLVED

```
## [1] 3
```

```
## [1] 43
```

```
## [1] 0.671875
```

```
## # A tibble: 2 x 2
##   gerry count
##   <dbl> <int>
## 1     0    13
## 2     1    40
```

[DONE]- Percentage picking each map in stage 3

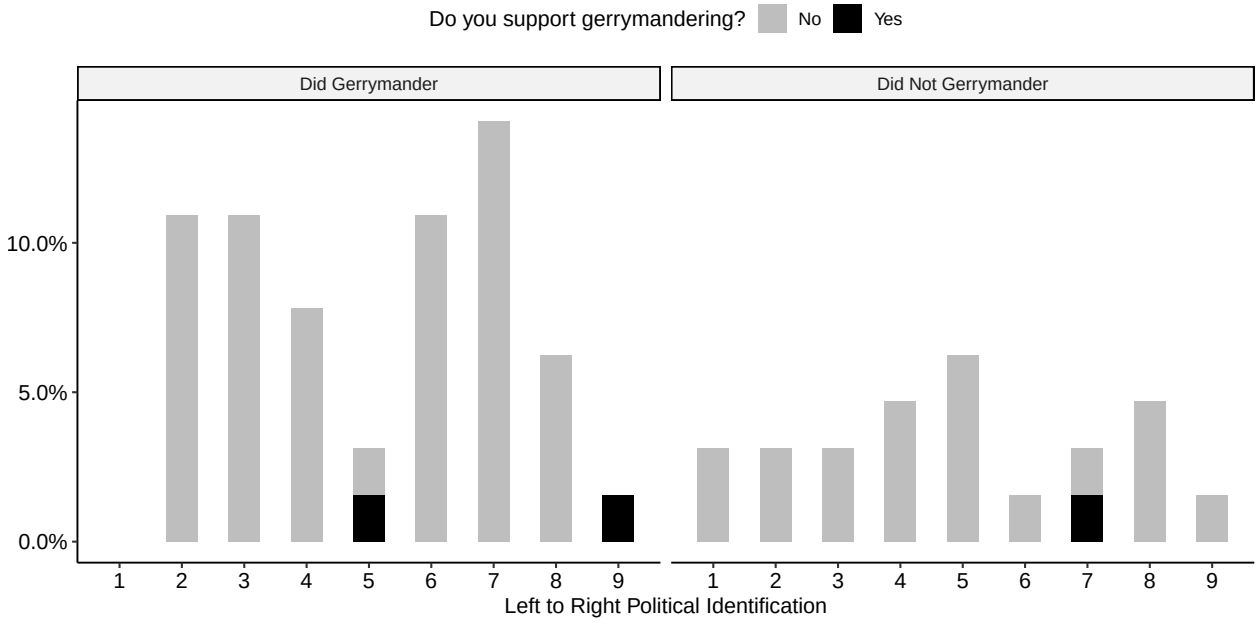
```
##   Map_Selection  n pct.of.pop
## 1           -99  1          2
```

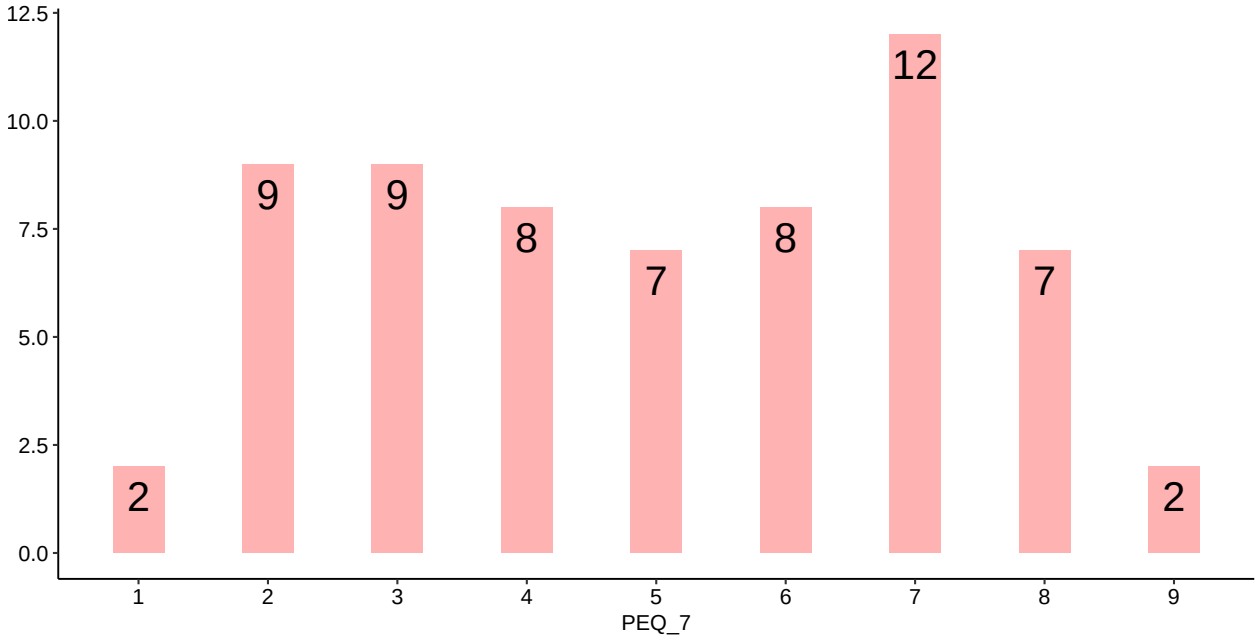
```
## 2              1  9          14
## 3              2  8          12
## 4              3 22          34
## 5              4 15          23
## 6              5  9          14
```

[DONE]- Rank sum test looking at whether or not their political views influence whether they gerrymander or not. . . ?

Before the rank sum test let's recall the PEQ relevant for the test.

PEQ_7: "On a scale of 1 to 9, how would you describe your political views with 1 being extremely liberal (i.e. to the left of the Democratic Party), 5 being centrist (i.e. falling between the Democratic Party and the Republican Party), and 9 being extremely conservative (i.e. to the right of the Republican party)." (multiple choice; 1 - 9)






```
## [1] 29
```

```
## [1] 28
```

```
## [1] 0.671875
```

Now, onto the rank sum test.

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  PEQ_7 by as.character(gerry)
## W = 448, p-value = 0.9655
## alternative hypothesis: true location shift is not equal to 0
```

So we fail to reject the null that the political preference is the same regardless of whether they actually gerrymandered.

What about based on whether they *support* gerrymandering? (a.k.a PEQ_8)

```
##
##  Wilcoxon rank sum test with continuity correction
##
## data:  PEQ_7 by support_gerry
## W = 44, p-value = 0.1319
## alternative hypothesis: true location shift is not equal to 0
```

Also fail to reject the null that political preference is the same regardless of whether they support gerrymandering.

[DONE]- political beliefs and saying gerrymandering (**done above**; no diff. between gerrymandering and politics)

[DONE]- how either of those answers depend on whether they actually gerrymander (**above** = no diff. b/w support gerry and politics; **below** = no diff in support of gerrymandering based on whether actually gerry)

```
##
##  Wilcoxon rank sum test with continuity correction
##
```

```
## data:  PEQ_8 by as.character(gerry)
## W = 451, p-value = 1
## alternative hypothesis: true location shift is not equal to 0
```

[DONE]- Z test of whether observations are same for number of people selecting whether they support gerrymandering or not (same # of people in both camps; probably going to be diff given the distribution between y and n)

This is a two sample t-test I believe. (^In Sig.)

[DONE]- Of the people who say they don't support it, what % actually did it

```
nrow(subset(gerry_and_politics, PEQ_8 == 2 & gerry == 1))/nrow(subset(gerry_and_politics, PEQ_8 == 2))
```

```
## [1] 0.6721311
```

[DONE]- for the same split, did they say they like gerrymandering or not proportionately (are the proportions the same) ????????? Only have 3 that say support gerrymandering... is this enough to make any determination?

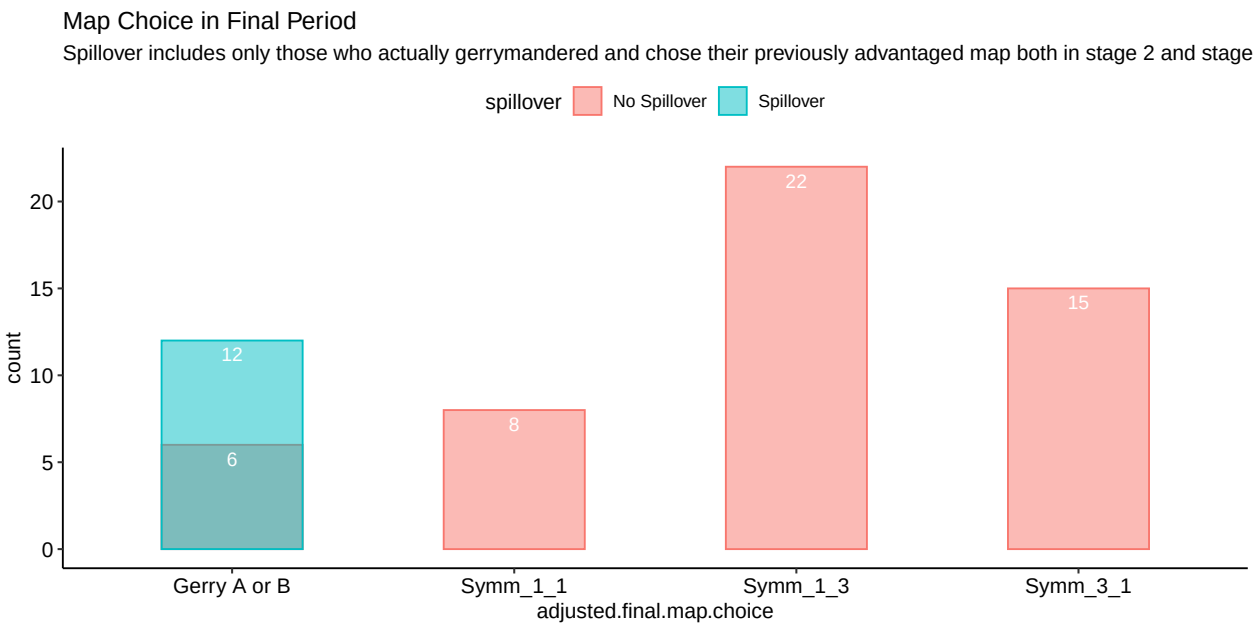
(Do you like it as a function of whether you actually did it)

```
## [1] 0.04651163
```

```
## [1] 0.04761905
```

This is for the bar graph

- when they don't know who they are which maps are they choosing
- distinguish b/w people choosing gerrymandered map based on if they are choosing it after having chosen it in previous periods
- 4 bars; gerrymander A and B on one column (two colored bars; one color is "gerrymandered for self" other color "gerrymandered for other")
- Some people like gerrymandered maps even not knowing who they are
- Some pick gerrymander for self (have been picking the map for themselves in previous round)



[DONE]- Regression from Deck's notes

$$Effort = \alpha + \beta_1 Player_B + \beta_2 Map_2 + \beta_3 Map_2 Player_B + \beta_4 Map_3 + \beta_5 Map_3 Player_B + \beta_6 Map_4 + \beta_7 Map_4 Player_B + \beta_8 Map_5 + \beta_9$$

```
##
## Call:
## lm(formula = Effort ~ Player_B + Gerry_B + Gerry_B * Player_B +
##     Symm_1_3 + Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B +
##     Gerry_A + Gerry_A * Player_B, data = regress_df)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -54.80 -14.38   1.75  15.62  36.52
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)        47.0500     1.2075  38.964  < 2e-16 ***
## Player_B            0.7000     1.7077   0.410   0.6819
## Gerry_B            -3.5656     1.7077  -2.088   0.0369 *
## Symm_1_3            1.2000     1.7077   0.703   0.4823
## Symm_3_1            7.3281     1.7077   4.291 1.83e-05 ***
## Gerry_A            -1.5281     1.7077  -0.895   0.3709
## Player_B:Gerry_B    2.1531     2.4151   0.892   0.3727
## Player_B:Symm_1_3   0.4344     2.4151   0.180   0.8573
## Player_B:Symm_3_1  -0.2781     2.4151  -0.115   0.9083
## Player_B:Gerry_A   -2.2187     2.4151  -0.919   0.3583
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 21.6 on 3190 degrees of freedom
## Multiple R-squared:  0.02821,    Adjusted R-squared:  0.02547
## F-statistic: 10.29 on 9 and 3190 DF,  p-value: 8.547e-16
```

Making better tables.

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:53
## \begin{table}[!htbp] \centering
##   \caption{Model 1 Regression Results}
##   \label{}
## \begin{tabular}{@{\extracolsep{5pt}}lc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{1}{c}{\textit{Dependent variable:}} \\
## \cline{2-2}
## \\[-1.8ex] & Effort \\
## \hline \\[-1.8ex]
##  Player\_B & 0.700 (1.708) \\
##   Gerry\_B & $-$3.566$^{**}$ (1.708) \\
##   Symm\_1\_3 & 1.200 (1.708) \\
##   Symm\_3\_1 & 7.328$^{***}$ (1.708) \\
##   Gerry\_A & $-$1.528 (1.708) \\
##   Player\_B:Gerry\_B & 2.153 (2.415) \\
##   Player\_B:Symm\_1\_3 & 0.434 (2.415) \\
##   Player\_B:Symm\_3\_1 & $-$0.278 (2.415) \\
##   Player\_B:Gerry\_A & $-$2.219 (2.415) \\
##   Constant & 47.050$^{***}$ (1.208) \\
##  \hline \\[-1.8ex]
```

```
## Observations & 3,200 \\
## R$^{2}$ & 0.028 \\
## Adjusted R$^{2}$ & 0.025 \\
## Residual Std. Error & 21.601 (df = 3190) \\
## F Statistic & 10.290$^{***}$ (df = 9; 3190) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{1}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

The below tells us the role does not really matter.

```
library(car)
```

```
## Loading required package: carData
```

```
##
## Attaching package: 'car'
```

```
## The following object is masked from 'package:dplyr':
##
##     recode
```

```
#linearHypothesis(map.player.interaction, c("Gerry_A + Player_B:Gerry_A = 0"))
linearHypothesis(map.player.interaction, c("Player_B + Player_B:Symm_1_3 = 0")) ## in sig at 5%
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Player_B:Symm_1_3 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3191 1488684
## 2   3190 1488478  1    205.89 0.4412 0.5066
```

```
linearHypothesis(map.player.interaction, c("Player_B + Player_B:Symm_3_1 = 0")) ## in sig at 5%
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Player_B:Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df     RSS Df Sum of Sq     F Pr(>F)
## 1   3191 1488506
## 2   3190 1488478  1    28.477 0.061 0.8049
```

```
linearHypothesis(map.player.interaction, c("Player_B + Player_B:Symm_1_3 = 0", "Player_B + Player_B:Symm
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Player_B:Symm_1_3 = 0
## Player_B  + Player_B:Symm_3_1 = 0
## Player_B = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3193 1488790
## 2   3190 1488478  3    312.77 0.2234 0.8802
```

```
linearHypothesis(map.player.interaction, c("Player_B + Gerry_B + Player_B:Gerry_B = Gerry_A"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Gerry_B - Gerry_A  + Player_B:Gerry_B = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3191 1488584
## 2   3190 1488478  1    106.44 0.2281  0.633
```

```
linearHypothesis(map.player.interaction, c("Player_B + Gerry_A + Player_B:Gerry_A = Gerry_B"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B - Gerry_B  + Gerry_A  + Player_B:Gerry_A = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3191 1488521
## 2   3190 1488478  1    43.056 0.0923 0.7613
```

```
linearHypothesis(map.player.interaction, c(
  "Player_B + Gerry_B + Player_B:Gerry_B = Gerry_A", "Player_B + Gerry_A + Player_B:Gerry_A = Gerry_B"
  )
```

```
## Linear hypothesis test
##
```

```
## Hypothesis:
## Player_B  + Gerry_B - Gerry_A  + Player_B:Gerry_B = 0
## Player_B - Gerry_B  + Gerry_A  + Player_B:Gerry_A = 0
## Player_B  + Player_B:Symm_1_3 = 0
## Player_B  + Player_B:Symm_3_1 = 0
## Player_B = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3195 1488940
## 2   3190 1488478  5    462.26 0.1981 0.9633
```

Justified ignoring player role in comparing treatments since the joint test (that player A and B play the same) is not rejected.

```
regress_df <- df %>% dplyr::select(Session, Period, Subject, Player, TE_1:TE_5) %>%
  filter(Period >= 15 & Period < 25) %>%
  gather(Map, Effort, TE_1:TE_5)


regress_df <- regress_df %>% mutate(subject.id = Session*8-(8-Subject),
                                    Player_B = ifelse(Player== "B", 1, 0),
         Gerry_B = ifelse(Map == "TE_1", 1, 0),
         Symm_1_1 = ifelse(Map == "TE_2", 1, 0),
         Symm_1_3 = ifelse(Map == "TE_3", 1, 0),
         Symm_3_1 = ifelse(Map == "TE_4", 1, 0),
         Gerry_A = ifelse(Map == "TE_5", 1, 0),
         Adv = ifelse((Map == "TE_1" & Player == "B")|(Map == "TE_5" & Player == "A"), 1,0),
         Disadv = ifelse((Map == "TE_1" & Player == "A")|(Map == "TE_5" & Player == "B"), 1,0),
         Stage_2_indicator = ifelse((Period > 24 & Period < 28), 1, 0))

map.adv.interaction <- lm(
  Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv*Period + Disadv*Period + Symm_1_3*Period +
  data = regress_df
  )

summary(map.adv.interaction)
```

```
##
## Call:
## lm(formula = Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period +
##     Adv * Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period, data = regress_df)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -57.94 -14.08   1.69  15.43  39.75
##
## Coefficients:
##                  Estimate Std. Error t value Pr(>|t|)
## (Intercept)     60.488636   5.835734  10.365   <2e-16 ***
```

```
## Adv             -1.298580   8.252975  -0.157   0.8750
## Disadv          -1.595455   8.252975  -0.193   0.8467
## Symm_1_3        -1.125568   8.252975  -0.136   0.8915
## Symm_3_1         8.598011   8.252975   1.042   0.2976
## Period          -0.671212   0.296074  -2.267   0.0235 *
## Adv:Period      -0.008807   0.418712  -0.021   0.9832
## Disadv:Period   -0.105682   0.418712  -0.252   0.8007
## Symm_1_3:Period  0.130398   0.418712   0.311   0.7555
## Symm_3_1:Period -0.072254   0.418712  -0.173   0.8630
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 21.51 on 3190 degrees of freedom
## Multiple R-squared:  0.03605,    Adjusted R-squared:  0.03333
## F-statistic: 13.26 on 9 and 3190 DF,  p-value: < 2.2e-16
```

```
stargazer(map.adv.interaction, title = "Model 3 Regression Results", single.row = T)
```

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:53
## \begin{table}[!htbp] \centering
##   \caption{Model 3 Regression Results}
##   \label{}
## \begin{tabular}{@{\extracolsep{5pt}}lc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{1}{c}{\textit{Dependent variable:}} \\
## \cline{2-2}
## \\[-1.8ex] & Effort \\
## \hline \\[-1.8ex]
##  Adv & $-$1.299 (8.253) \\
##   Disadv & $-$1.595 (8.253) \\
##   Symm\_1\_3 & $-$1.126 (8.253) \\
##   Symm\_3\_1 & 8.598 (8.253) \\
##   Period & $-$0.671$^{**}$ (0.296) \\
##   Adv:Period & $-$0.009 (0.419) \\
##   Disadv:Period & $-$0.106 (0.419) \\
##   Symm\_1\_3:Period & 0.130 (0.419) \\
##   Symm\_3\_1:Period & $-$0.072 (0.419) \\
##   Constant & 60.489$^{***}$ (5.836) \\
##  \hline \\[-1.8ex]
## Observations & 3,200 \\
## R$^{2}$ & 0.036 \\
## Adjusted R$^{2}$ & 0.033 \\
## Residual Std. Error & 21.514 (df = 3190) \\
## F Statistic & 13.257$^{***}$ (df = 9; 3190) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{1}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

```
linearHypothesis(map.adv.interaction, c("Symm_1_3 = 10"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3191 1477311
## 2   3190 1476470  1    841.12 1.8173 0.1777
```

```
linearHypothesis(map.adv.interaction, c("Symm_3_1 = 10")) # so map 4 is pushing expenditure up, but not
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3191 1476483
## 2   3190 1476470  1    13.357 0.0289 0.8651
```

```
linearHypothesis(map.adv.interaction, c("Symm_1_3 = Symm_3_1")) # map 4 has a larger effect than map 3
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 - Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3191 1477112
## 2   3190 1476470  1    642.49 1.3881 0.2388
```

```
linearHypothesis(map.adv.interaction, c("Adv = Disadv"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv - Disadv = 0
##
## Model 1: restricted model
```

```
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   3191 1476471
## 2   3190 1476470  1   0.59891 0.0013 0.9713
```

```
# testing on periods
linearHypothesis(map.adv.interaction, c("Adv:Period = 0", "Disadv:Period = 0", "Symm_1_3:Period = 0", "
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv:Period = 0
## Disadv:Period = 0
## Symm_1_3:Period = 0
## Symm_3_1:Period = 0
## Period = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df     RSS Df Sum of Sq      F    Pr(>F)
## 1   3195 1488940
## 2   3190 1476470  5     12470 5.3884 6.124e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

[Done?]- Regression of average bid as function of period with dummy variable for Map selection phase (periods 25,26,27)

(so we just want the impact on the map selection phase on the average map level bids)

```
##
## Call:
## lm(formula = Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator, data = regress_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.589 -14.234   1.256  15.766  41.438
##
## Coefficients:
##                             Estimate Std. Error t value Pr(>|t|)
## (Intercept)                  47.4000     0.8622  54.973  < 2e-16 ***
## Adv                          -1.4703     1.2194  -1.206  0.22798
## Disadv                       -3.6562     1.2194  -2.998  0.00273 **
## Symm_1_3                      1.4172     1.2194   1.162  0.24522
## Symm_3_1                      7.1891     1.2194   5.896 4.03e-09 ***
## Stage_2_indicator            -5.4052     1.7949  -3.011  0.00262 **
## Adv:Stage_2_indicator         2.2151     2.5384   0.873  0.38291
## Disadv:Stage_2_indicator      0.2240     2.5384   0.088  0.92970
```

```
## Symm_1_3:Stage_2_indicator   0.8224     2.5384   0.324  0.74597
## Symm_3_1:Stage_2_indicator  -2.4078     2.5384  -0.949  0.34290
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 21.81 on 4150 degrees of freedom
## Multiple R-squared:  0.03423,    Adjusted R-squared:  0.03213
## F-statistic: 16.34 on 9 and 4150 DF,  p-value: < 2.2e-16
```

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:53
## \begin{table}[!htbp] \centering
##   \caption{Model 2 Regression Results}
##   \label{}
## \begin{tabular}{@{\extracolsep{5pt}}lc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{1}{c}{\textit{Dependent variable:}} \\
## \cline{2-2}
## \\[-1.8ex] & Effort \\
## \hline \\[-1.8ex]
##  Adv & $-$1.470 (1.219) \\
##   Disadv & $-$3.656$^{***}$ (1.219) \\
##   Symm\_1\_3 & 1.417 (1.219) \\
##   Symm\_3\_1 & 7.189$^{***}$ (1.219) \\
##   Stage\_2\_indicator & $-$5.405$^{***}$ (1.795) \\
##   Adv:Stage\_2\_indicator & 2.215 (2.538) \\
##   Disadv:Stage\_2\_indicator & 0.224 (2.538) \\
##   Symm\_1\_3:Stage\_2\_indicator & 0.822 (2.538) \\
##   Symm\_3\_1:Stage\_2\_indicator & $-$2.408 (2.538) \\
##   Constant & 47.400$^{***}$ (0.862) \\
##  \hline \\[-1.8ex]
## Observations & 4,160 \\
## R$^{2}$ & 0.034 \\
## Adjusted R$^{2}$ & 0.032 \\
## Residual Std. Error & 21.813 (df = 4150) \\
## F Statistic & 16.343$^{***}$ (df = 9; 4150) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{1}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:53
## \begin{table}[!htbp] \centering
##   \caption{Effect of Map Configuration on Total Bid in Stage 1}
##   \label{}
## \begin{tabular}{@{\extracolsep{5pt}}lc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{1}{c}{\textit{Dependent variable:}} \\
## \cline{2-2}
```

```
## \\[-1.8ex] & Effort \\
## \hline \\[-1.8ex]
##  Adv & $-$1.470 (1.207) \\
##   Disadv & $-$3.656$^{***}$ (1.207) \\
##   Symm\_1\_3 & 1.417 (1.207) \\
##   Symm\_3\_1 & 7.189$^{***}$ (1.207) \\
##   Constant & 47.400$^{***}$ (0.853) \\
##  \hline \\[-1.8ex]
## Observations & 3,200 \\
## R$^{2}$ & 0.028 \\
## Adjusted R$^{2}$ & 0.027 \\
## Residual Std. Error & 21.588 (df = 3195) \\
## F Statistic & 22.934$^{***}$ (df = 4; 3195) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{1}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

```
linearHypothesis(stage_2_impact, c("Symm_1_3 = 10"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F    Pr(>F)
## 1   4151 1998224
## 2   4150 1974651  1     23573 49.541 2.263e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
linearHypothesis(stage_2_impact, c("Symm_3_1 = 10"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F  Pr(>F)
## 1   4151 1977179
## 2   4150 1974651  1    2528.4 5.3139 0.02121 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
linearHypothesis(stage_2_impact, c("Symm_1_3 = Symm_3_1"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 - Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F    Pr(>F)
## 1   4151 1985312
## 2   4150 1974651  1     10661 22.405 2.282e-06 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
linearHypothesis(stage_2_impact, c("Adv:Stage_2_indicator = 0", "Disadv:Stage_2_indicator = 0",
                                   "Symm_1_3:Stage_2_indicator = 0", "Symm_3_1:Stage_2_indicator = 0"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv:Stage_2_indicator = 0
## Disadv:Stage_2_indicator = 0
## Symm_1_3:Stage_2_indicator = 0
## Symm_3_1:Stage_2_indicator = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   4154 1976318
## 2   4150 1974651  4    1666.7 0.8757 0.4775
```

```
linearHypothesis(map_impact, c("Adv" = "Disadv"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Disadv = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df     RSS Df Sum of Sq      F   Pr(>F)
## 1   3196 1493218
## 2   3195 1488940  1    4277.8 9.1794 0.002467 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Redo the regressions and tests with the data from only 20 through 24 (second half of stage 1) to account for potential learning. this is because the period coefficient shows a downward trend over time.

Below are the regressions and tests using only the last 5 periods from the first stage:

```
##
## Call:
## lm(formula = Effort ~ Player_B + Gerry_B + Gerry_B * Player_B +
##     Symm_1_3 + Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B +
##     Gerry_A + Gerry_A * Player_B, data = regress_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -53.088 -14.325   3.125  14.344  38.669
##
## Coefficients:
##                   Estimate Std. Error t value Pr(>|t|)
## (Intercept)         45.656      1.659  27.529  < 2e-16 ***
## Player_B             1.219      2.345   0.520  0.60339
## Gerry_B             -4.325      2.345  -1.844  0.06537 .
## Symm_1_3             0.575      2.345   0.245  0.80637
## Symm_3_1             7.431      2.345   3.168  0.00156 **
## Gerry_A             -1.331      2.345  -0.568  0.57039
## Player_B:Gerry_B     2.562      3.317   0.773  0.43990
## Player_B:Symm_1_3    1.194      3.317   0.360  0.71897
## Player_B:Symm_3_1   -1.531      3.317  -0.462  0.64440
## Player_B:Gerry_A    -3.194      3.317  -0.963  0.33576
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.98 on 1590 degrees of freedom
## Multiple R-squared:  0.03074,    Adjusted R-squared:  0.02525
## F-statistic: 5.603 on 9 and 1590 DF,  p-value: 1.2e-07
```

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:53
## \begin{table}[!htbp] \centering
##   \caption{Model 1 Regression Results}
##   \label{Tab:regression_1}
## \begin{tabular}{@{\extracolsep{5pt}}lcc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{2}{c}{\textit{Dependent variable:}} \\
## \cline{2-3}
## \\[-1.8ex] & \multicolumn{2}{c}{Effort} \\
##  & w/out learning & w/ learning \\
## \\[-1.8ex] & (1) & (2)\\
## \hline \\[-1.8ex]
##  Player\_B & 0.700 (1.708) & 1.219 (2.345) \\
##   Gerry\_B & $-$3.566$^{**}$ (1.708) & $-$4.325$^{*}$ (2.345) \\
##   Symm\_1\_3 & 1.200 (1.708) & 0.575 (2.345) \\
##   Symm\_3\_1 & 7.328$^{***}$ (1.708) & 7.431$^{***}$ (2.345) \\
##   Gerry\_A & $-$1.528 (1.708) & $-$1.331 (2.345) \\
##   Player\_B:Gerry\_B & 2.153 (2.415) & 2.563 (3.317) \\
```

```
##   Player\_B:Symm\_1\_3 & 0.434 (2.415) & 1.194 (3.317) \\
##   Player\_B:Symm\_3\_1 & $-$0.278 (2.415) & $-$1.531 (3.317) \\
##   Player\_B:Gerry\_A & $-$2.219 (2.415) & $-$3.194 (3.317) \\
##   Constant & 47.050$^{***}$ (1.208) & 45.656$^{***}$ (1.658) \\
##  \hline \\[-1.8ex]
## Observations & 3,200 & 1,600 \\
## R$^{2}$ & 0.028 & 0.031 \\
## Adjusted R$^{2}$ & 0.025 & 0.025 \\
## Residual Std. Error & 21.601 (df = 3190) & 20.978 (df = 1590) \\
## F Statistic & 10.290$^{***}$ (df = 9; 3190) & 5.603$^{***}$ (df = 9; 1590) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{2}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

and the tests for this regression:

```
library(car)
#linearHypothesis(map.player.interaction, c("Map_5 + Player_B:Map_5 = 0"))
linearHypothesis(map.player.interaction.adj, c("Player_B + Player_B:Symm_1_3 = 0")) ## in sig at 5%
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Player_B:Symm_1_3 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df    RSS Df Sum of Sq     F Pr(>F)
## 1   1591 700192
## 2   1590 699726  1    465.61 1.058 0.3038
```

```
linearHypothesis(map.player.interaction.adj, c("Player_B + Player_B:Symm_3_1 = 0")) ## in sig at 5%
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Player_B:Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1591 699734
## 2   1590 699726  1    7.8125 0.0178  0.894
```

```
linearHypothesis(map.player.interaction.adj, c("Player_B + Player_B:Symm_1_3 = 0", "Player_B + Player_B
```

```
## Linear hypothesis test
##
## Hypothesis:
```

```
## Player_B  + Player_B:Symm_1_3 = 0
## Player_B  + Player_B:Symm_3_1 = 0
## Player_B = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1593 700319
## 2   1590 699726  3    592.25 0.4486 0.7183
```

```
linearHypothesis(map.player.interaction.adj, c("Player_B + Gerry_B + Player_B:Gerry_B = Gerry_A"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Gerry_B - Gerry_A  + Player_B:Gerry_B = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1591 699776
## 2   1590 699726  1    49.613 0.1127 0.7371
```

```
linearHypothesis(map.player.interaction.adj, c("Player_B + Gerry_A + Player_B:Gerry_A = Gerry_B"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B - Gerry_B  + Gerry_A  + Player_B:Gerry_A = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1591 699809
## 2   1590 699726  1    83.028 0.1887 0.6641
```

```
linearHypothesis(map.player.interaction.adj, c(
  "Player_B + Gerry_B + Player_B:Gerry_B = Gerry_A", "Player_B + Gerry_A + Player_B:Gerry_A = Gerry_B"
  )
```

```
## Linear hypothesis test
##
## Hypothesis:
## Player_B  + Gerry_B - Gerry_A  + Player_B:Gerry_B = 0
## Player_B - Gerry_B  + Gerry_A  + Player_B:Gerry_A = 0
## Player_B  + Player_B:Symm_1_3 = 0
## Player_B  + Player_B:Symm_3_1 = 0
```

```
## Player_B = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Player_B + Gerry_B + Gerry_B * Player_B + Symm_1_3 +
##     Symm_1_3 * Player_B + Symm_3_1 + Symm_3_1 * Player_B + Gerry_A +
##     Gerry_A * Player_B
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1595 700451
## 2   1590 699726  5    724.89 0.3294 0.8954
```

The above tests allow us to ignore player role given the null hypothesis that players A and B do not differ in their behavior.

That is, we can run:

```
regress_df <- df %>% dplyr::select(Session, Period, Subject, Player, TE_1:TE_5) %>%
  filter(Period >= 20 & Period <= 24) %>%
  gather(Map, Effort, TE_1:TE_5)


regress_df <- regress_df %>% mutate(subject.id = Session*8-(8-Subject),
                                    Player_B = ifelse(Player== "B", 1, 0),
         Gerry_B = ifelse(Map == "TE_1", 1, 0),
         Symm_1_1 = ifelse(Map == "TE_2", 1, 0),
         Symm_1_3 = ifelse(Map == "TE_3", 1, 0),
         Symm_3_1 = ifelse(Map == "TE_4", 1, 0),
         Gerry_A = ifelse(Map == "TE_5", 1, 0),
         Adv = ifelse((Map == "TE_1" & Player == "B")|(Map == "TE_5" & Player == "A"), 1,0),
         Disadv = ifelse((Map == "TE_1" & Player == "A")|(Map == "TE_5" & Player == "B"), 1,0),
         Stage_2_indicator = ifelse((Period > 24 & Period < 28), 1, 0))

map.adv.interaction.adj <- lm(
  Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv*Period + Disadv*Period + Symm_1_3*Period +
  data = regress_df
  )

summary(map.adv.interaction.adj)
```

```
##
## Call:
## lm(formula = Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period +
##     Adv * Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period, data = regress_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.856 -14.291   2.741  14.120  40.447
##
## Coefficients:
##                Estimate Std. Error t value Pr(>|t|)
## (Intercept)     67.9906    18.2584   3.724 0.000203 ***
## Adv             -9.5219    25.8212  -0.369 0.712354
## Disadv          -0.9875    25.8212  -0.038 0.969498
## Symm_1_3       -10.5156    25.8212  -0.407 0.683881
## Symm_3_1         6.1156    25.8212   0.237 0.812808
```

```
## Period           -0.9875     0.8282  -1.192 0.233313
## Adv:Period        0.3625     1.1713   0.309 0.756988
## Disadv:Period    -0.1562     1.1713  -0.133 0.893893
## Symm_1_3:Period   0.5312     1.1713   0.454 0.650203
## Symm_3_1:Period   0.0250     1.1713   0.021 0.982974
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 20.95 on 1590 degrees of freedom
## Multiple R-squared:  0.03311,    Adjusted R-squared:  0.02764
## F-statistic:  6.05 on 9 and 1590 DF,  p-value: 2.195e-08
```

```
stargazer(map.adv.interaction, map.adv.interaction.adj, title = "Model 3 Regression Results", column.lab
```

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:53
## \begin{table}[!htbp] \centering
##   \caption{Model 3 Regression Results}
##   \label{Tab:regression_3}
## \begin{tabular}{@{\extracolsep{5pt}}lcc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{2}{c}{\textit{Dependent variable:}} \\
## \cline{2-3}
## \\[-1.8ex] & \multicolumn{2}{c}{Effort} \\
##  & w/out learning & w/ learning \\
## \\[-1.8ex] & (1) & (2)\\
## \hline \\[-1.8ex]
##  Adv & $-$1.299 (8.253) & $-$9.522 (25.821) \\
##   Disadv & $-$1.595 (8.253) & $-$0.988 (25.821) \\
##   Symm\_1\_3 & $-$1.126 (8.253) & $-$10.516 (25.821) \\
##   Symm\_3\_1 & 8.598 (8.253) & 6.116 (25.821) \\
##   Period & $-$0.671$^{**}$ (0.296) & $-$0.988 (0.828) \\
##   Adv:Period & $-$0.009 (0.419) & 0.363 (1.171) \\
##   Disadv:Period & $-$0.106 (0.419) & $-$0.156 (1.171) \\
##   Symm\_1\_3:Period & 0.130 (0.419) & 0.531 (1.171) \\
##   Symm\_3\_1:Period & $-$0.072 (0.419) & 0.025 (1.171) \\
##   Constant & 60.489$^{***}$ (5.836) & 67.991$^{***}$ (18.258) \\
##  \hline \\[-1.8ex]
## Observations & 3,200 & 1,600 \\
## R$^{2}$ & 0.036 & 0.033 \\
## Adjusted R$^{2}$ & 0.033 & 0.028 \\
## Residual Std. Error & 21.514 (df = 3190) & 20.952 (df = 1590) \\
## F Statistic & 13.257$^{***}$ (df = 9; 3190) & 6.050$^{***}$ (df = 9; 1590) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{2}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

with tests:

```
linearHypothesis(map.adv.interaction.adj, c("Symm_1_3 = 10"))
```

```
## Linear hypothesis test
```

```
##
## Hypothesis:
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1591 698291
## 2   1590 698014  1    277.13 0.6313  0.427
```

```
linearHypothesis(map.adv.interaction.adj, c("Symm_3_1 = 10")) # so map 4 is pushing expenditure up, but
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1591 698024
## 2   1590 698014  1    9.9347 0.0226 0.8804
```

```
linearHypothesis(map.adv.interaction.adj, c("Symm_1_3 = Symm_3_1")) # map 4 has a larger effect than ma
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 - Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1591 698196
## 2   1590 698014  1    182.12 0.4149 0.5196
```

```
linearHypothesis(map.adv.interaction.adj, c("Adv = Disadv"))
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv - Disadv = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
```

```
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1591 698062
## 2   1590 698014  1    47.958 0.1092 0.7411
```

```
# testing on periods
linearHypothesis(map.adv.interaction.adj, c("Adv:Period = 0", "Disadv:Period = 0", "Symm_1_3:Period = 0
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv:Period = 0
## Disadv:Period = 0
## Symm_1_3:Period = 0
## Symm_3_1:Period = 0
## Period = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Period + Adv *
##     Period + Disadv * Period + Symm_1_3 * Period + Symm_3_1 *
##     Period
##
##   Res.Df    RSS Df Sum of Sq      F Pr(>F)
## 1   1595 700451
## 2   1590 698014  5    2437.4 1.1104 0.3527
```

Now, let's look specifically at the effect of map selection.

First, look only at Stage 1 data

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:54
## \begin{table}[!htbp] \centering
##   \caption{Map Impact on Stage 1 Bidding (FE and Clustereed SE)}
##   \label{Tab:stage_1_with_and_without_learning_FE_CSE}
## \begin{tabular}{@{\extracolsep{5pt}}lcc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{2}{c}{\textit{Dependent variable:}} \\
## \cline{2-3}
## \\[-1.8ex] & \multicolumn{2}{c}{Effort} \\
##  & w/out learning & w/ learning \\
## \\[-1.8ex] & (1) & (2)\\
## \hline \\[-1.8ex]
##  Adv & $-$1.470$^{*}$ (0.832) & $-$1.547 (1.030) \\
##   Disadv & $-$3.656$^{***}$ (0.832) & $-$4.425$^{***}$ (1.030) \\
##   Symm\_1\_3 & 1.417$^{*}$ (0.832) & 1.172 (1.030) \\
##   Symm\_3\_1 & 7.189$^{***}$ (0.832) & 6.666$^{***}$ (1.030) \\
##   Constant & 40.704$^{***}$ (2.169) & 30.147$^{***}$ (2.686) \\
##  \hline \\[-1.8ex]
## Observations & 3,200 & 1,600 \\
## R$^{2}$ & 0.547 & 0.640 \\
## Adjusted R$^{2}$ & 0.538 & 0.624 \\
## Residual Std. Error & 14.879 (df = 3132) & 13.031 (df = 1532) \\
## F Statistic & 56.523$^{***}$ (df = 67; 3132) & 40.586$^{***}$ (df = 67; 1532) \\
```

```
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{2}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

```
## R^2= 0.54734
##
##                 Estimate   Std. Error       t value    Pr(>|t|)
## (Intercept)   40.704062 8.812972e-01  4.618653e+01 0.000000000
## Adv           -1.470312 1.225149e+00 -1.200109e+00 0.230096953
## Disadv        -3.656250 1.730422e+00 -2.112924e+00 0.034607280
## Symm_1_3       1.417188 6.564988e-01  2.158706e+00 0.030873020
## Symm_3_1       7.189062 2.272159e+00  3.163979e+00 0.001556282
## subject.id2    0.700000 1.379973e-12  5.072565e+11 0.000000000
## subject.id3    5.600000 1.391128e-12  4.025510e+12 0.000000000
## subject.id4  -13.360000 1.388889e-12 -9.619199e+12 0.000000000
## subject.id5   23.080000 1.390415e-12  1.659936e+13 0.000000000
## subject.id6   10.800000 1.397857e-12  7.726111e+12 0.000000000
## subject.id7  -20.520000 1.409054e-12 -1.456297e+13 0.000000000
## subject.id8   -5.180000 1.385625e-12 -3.738385e+12 0.000000000
## subject.id9    0.400000 1.349830e-12  2.963336e+11 0.000000000
## subject.id10 -11.000000 1.423507e-12 -7.727393e+12 0.000000000
## subject.id11  13.040000 1.382908e-12  9.429405e+12 0.000000000
## subject.id12  36.000000 1.337007e-12  2.692581e+13 0.000000000
## subject.id13  21.200000 1.198791e-12  1.768449e+13 0.000000000
## subject.id14 -29.320000 1.404813e-12 -2.087111e+13 0.000000000
## subject.id15   4.600000 1.393975e-12  3.299915e+12 0.000000000
## subject.id16  13.240000 1.382601e-12  9.576151e+12 0.000000000
## subject.id17  18.000000 1.329849e-12  1.353537e+13 0.000000000
## subject.id18  38.600000 1.328030e-12  2.906562e+13 0.000000000
## subject.id19   6.280000 1.388075e-12  4.524251e+12 0.000000000
## subject.id20   7.760000 1.354073e-12  5.730859e+12 0.000000000
## subject.id21   6.520000 1.277004e-12  5.105700e+12 0.000000000
## subject.id22  19.520000 1.385063e-12  1.409322e+13 0.000000000
## subject.id23  21.660000 1.305483e-12  1.659156e+13 0.000000000
## subject.id24  12.000000 1.385041e-12  8.664000e+12 0.000000000
## subject.id25 -16.300000 1.365038e-12 -1.194106e+13 0.000000000
## subject.id26 -12.200000 1.384684e-12 -8.810672e+12 0.000000000
## subject.id27  11.560000 1.392087e-12  8.304078e+12 0.000000000
## subject.id28 -18.800000 1.386565e-12 -1.355869e+13 0.000000000
## subject.id29  -3.580000 1.346662e-12 -2.658425e+12 0.000000000
## subject.id30  -4.860000 1.390079e-12 -3.496203e+12 0.000000000
## subject.id31 -11.420000 1.357189e-12 -8.414449e+12 0.000000000
## subject.id32 -11.420000 1.382615e-12 -8.259711e+12 0.000000000
## subject.id33   0.120000 1.399712e-12  8.573194e+10 0.000000000
## subject.id34  12.620000 1.381048e-12  9.137991e+12 0.000000000
## subject.id35 -12.380000 1.382461e-12 -8.955047e+12 0.000000000
## subject.id36  20.200000 1.385281e-12  1.458188e+13 0.000000000
## subject.id37  -5.780000 1.381326e-12 -4.184384e+12 0.000000000
## subject.id38 -13.600000 1.383626e-12 -9.829246e+12 0.000000000
## subject.id39  26.680000 1.393702e-12  1.914325e+13 0.000000000
## subject.id40  -1.280000 1.384011e-12 -9.248478e+11 0.000000000
## subject.id41 -21.800000 1.386935e-12 -1.571812e+13 0.000000000
```

```
## subject.id42  -7.220000 1.392664e-12 -5.184307e+12 0.000000000
## subject.id43  17.220000 1.382204e-12  1.245837e+13 0.000000000
## subject.id44  10.600000 1.387486e-12  7.639718e+12 0.000000000
## subject.id45   6.880000 1.387898e-12  4.957136e+12 0.000000000
## subject.id46   3.820000 1.382711e-12  2.762688e+12 0.000000000
## subject.id47 -19.620000 1.385974e-12 -1.415611e+13 0.000000000
## subject.id48   7.460000 1.383187e-12  5.393341e+12 0.000000000
## subject.id49  16.800000 1.383037e-12  1.214718e+13 0.000000000
## subject.id50  20.480000 1.383757e-12  1.480029e+13 0.000000000
## subject.id51  25.200000 1.384193e-12  1.820555e+13 0.000000000
## subject.id52  25.980000 1.383599e-12  1.877712e+13 0.000000000
## subject.id53  30.700000 1.384224e-12  2.217849e+13 0.000000000
## subject.id54  25.800000 1.383103e-12  1.865371e+13 0.000000000
## subject.id55  33.000000 1.384691e-12  2.383204e+13 0.000000000
## subject.id56  16.380000 1.383224e-12  1.184190e+13 0.000000000
## subject.id57   6.260000 1.381546e-12  4.531155e+12 0.000000000
## subject.id58  -2.640000 1.385661e-12 -1.905227e+12 0.000000000
## subject.id59  15.860000 1.383058e-12  1.146734e+13 0.000000000
## subject.id60   9.200000 1.383401e-12  6.650279e+12 0.000000000
## subject.id61   8.340000 1.382148e-12  6.034087e+12 0.000000000
## subject.id62  13.120000 1.384234e-12  9.478164e+12 0.000000000
## subject.id63   9.460000 1.378950e-12  6.860294e+12 0.000000000
## subject.id64  38.080000 1.384919e-12  2.749620e+13 0.000000000
## R^2= 0.63963
##
##                Estimate   Std. Error       t value    Pr(>|t|)
## (Intercept)   30.146875 7.860060e-01  3.835451e+01 0.000000000
## Adv           -1.546875 1.592366e+00 -9.714316e-01 0.331333407
## Disadv        -4.425000 1.517078e+00 -2.916791e+00 0.003536525
## Symm_1_3       1.171875 7.880557e-01  1.487046e+00 0.137002671
## Symm_3_1       6.665625 2.261614e+00  2.947286e+00 0.003205762
## subject.id2   13.880000 7.903864e-13  1.756103e+13 0.000000000
## subject.id3   10.680000 7.261507e-13  1.470769e+13 0.000000000
## subject.id4   -0.200000 7.451268e-13 -2.684107e+11 0.000000000
## subject.id5   19.240000 7.323242e-13  2.627252e+13 0.000000000
## subject.id6   27.080000 7.370422e-13  3.674145e+13 0.000000000
## subject.id7  -11.920000 7.574973e-13 -1.573603e+13 0.000000000
## subject.id8    2.280000 7.380326e-13  3.089295e+12 0.000000000
## subject.id9   11.480000 7.278704e-13  1.577204e+13 0.000000000
## subject.id10 -11.320000 7.210113e-13 -1.570017e+13 0.000000000
## subject.id11  24.160000 7.276132e-13  3.320445e+13 0.000000000
## subject.id12  47.080000 7.253420e-13  6.490731e+13 0.000000000
## subject.id13  32.680000 7.756868e-13  4.213041e+13 0.000000000
## subject.id14 -16.080000 7.466292e-13 -2.153679e+13 0.000000000
## subject.id15  13.880000 7.267063e-13  1.909988e+13 0.000000000
## subject.id16  17.360000 7.388296e-13  2.349662e+13 0.000000000
## subject.id17  29.480000 7.343021e-13  4.014697e+13 0.000000000
## subject.id18  49.480000 7.383758e-13  6.701195e+13 0.000000000
## subject.id19  22.840000 7.340808e-13  3.111374e+13 0.000000000
## subject.id20  25.560000 7.457219e-13  3.427551e+13 0.000000000
## subject.id21  17.800000 7.178344e-13  2.479681e+13 0.000000000
## subject.id22  39.280000 7.320471e-13  5.365775e+13 0.000000000
## subject.id23  35.000000 7.910210e-13  4.424662e+13 0.000000000
```

```
## subject.id24  23.240000 7.636192e-13  3.043402e+13 0.000000000
## subject.id25   3.480000 7.380408e-13  4.715186e+12 0.000000000
## subject.id26  -6.360000 7.445616e-13 -8.541940e+12 0.000000000
## subject.id27  21.120000 7.116283e-13  2.967842e+13 0.000000000
## subject.id28  -6.800000 7.426458e-13 -9.156451e+12 0.000000000
## subject.id29  10.600000 7.596951e-13  1.395297e+13 0.000000000
## subject.id30  11.800000 7.373265e-13  1.600377e+13 0.000000000
## subject.id31  -2.560000 7.419033e-13 -3.450584e+12 0.000000000
## subject.id32  -8.680000 7.418082e-13 -1.170114e+13 0.000000000
## subject.id33  -1.080000 7.500457e-13 -1.439912e+12 0.000000000
## subject.id34  20.320000 7.339189e-13  2.768698e+13 0.000000000
## subject.id35  -2.880000 7.305048e-13 -3.942479e+12 0.000000000
## subject.id36  22.160000 7.286562e-13  3.041215e+13 0.000000000
## subject.id37  -3.280000 7.262556e-13 -4.516316e+12 0.000000000
## subject.id38   0.280000 7.466765e-13  3.749951e+11 0.000000000
## subject.id39  30.680000 7.399223e-13  4.146382e+13 0.000000000
## subject.id40  -0.560000 7.355095e-13 -7.613770e+11 0.000000000
## subject.id41 -12.120000 7.396150e-13 -1.638690e+13 0.000000000
## subject.id42   2.160000 7.281692e-13  2.966344e+12 0.000000000
## subject.id43  26.680000 7.367406e-13  3.621356e+13 0.000000000
## subject.id44  23.080000 7.427129e-13  3.107527e+13 0.000000000
## subject.id45  25.640000 7.253164e-13  3.535009e+13 0.000000000
## subject.id46  10.080000 7.316863e-13  1.377640e+13 0.000000000
## subject.id47  -1.360000 7.357670e-13 -1.848411e+12 0.000000000
## subject.id48  12.080000 7.359169e-13  1.641490e+13 0.000000000
## subject.id49  35.080000 7.307885e-13  4.800294e+13 0.000000000
## subject.id50  32.800000 7.316784e-13  4.482844e+13 0.000000000
## subject.id51  35.480000 7.310006e-13  4.853621e+13 0.000000000
## subject.id52  33.440000 7.308937e-13  4.575221e+13 0.000000000
## subject.id53  41.280000 7.381657e-13  5.592240e+13 0.000000000
## subject.id54  32.880000 7.381121e-13  4.454608e+13 0.000000000
## subject.id55  42.880000 7.380099e-13  5.810220e+13 0.000000000
## subject.id56  25.840000 7.381913e-13  3.500448e+13 0.000000000
## subject.id57  17.000000 7.414136e-13  2.292917e+13 0.000000000
## subject.id58  -3.240000 7.296506e-13 -4.440482e+12 0.000000000
## subject.id59  14.280000 7.277537e-13  1.962202e+13 0.000000000
## subject.id60  21.680000 7.282315e-13  2.977075e+13 0.000000000
## subject.id61  18.160000 7.361470e-13  2.466899e+13 0.000000000
## subject.id62  29.560000 7.379106e-13  4.005905e+13 0.000000000
## subject.id63   7.800000 7.372406e-13  1.057999e+13 0.000000000
## subject.id64  49.240000 7.377497e-13  6.674350e+13 0.000000000
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv - Disadv = 0
##
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 0.9636     0.3263
```

```
## Linear hypothesis test
```

```
##
## Hypothesis:
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 170.92  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 1.5305      0.216
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 - Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 10.642   0.001105 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Linear hypothesis test
##
## Hypothesis:
## Adv - Disadv = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df    RSS Df Sum of Sq     F  Pr(>F)
## 1   1596 701777
## 2   1595 700451  1    1325.4 3.018 0.08254 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
## Linear hypothesis test
##
## Hypothesis:
```

```
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1   1596 712921
## 2   1595 700451  1     12470 28.395 1.131e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df    RSS Df Sum of Sq      F  Pr(>F)
## 1   1596 702230
## 2   1595 700451  1    1778.9 4.0507 0.04432 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 - Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1   1596 705280
## 2   1595 700451  1      4829 10.996 0.0009335 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

Now, look at stage 2 impact as a dummy variable

```
##
## Call:
## lm(formula = Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator, data = regress_df)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -52.931 -14.719   2.563  15.281  41.437
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 46.2656     1.2057  38.374  < 2e-16 ***
## Adv                         -1.5469     1.7051  -0.907  0.36438
## Disadv                      -4.4250     1.7051  -2.595  0.00951 **
```

```
## Symm_1_3                     1.1719     1.7051   0.687  0.49196
## Symm_3_1                     6.6656     1.7051   3.909  9.5e-05 ***
## Stage_2_indicator           -4.2708     1.9688  -2.169  0.03016 *
## Adv:Stage_2_indicator        2.2917     2.7844   0.823  0.41056
## Disadv:Stage_2_indicator     0.9927     2.7844   0.357  0.72147
## Symm_1_3:Stage_2_indicator   1.0677     2.7844   0.383  0.70141
## Symm_3_1:Stage_2_indicator  -1.8844     2.7844  -0.677  0.49861
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 21.57 on 2550 degrees of freedom
## Multiple R-squared:  0.03027,    Adjusted R-squared:  0.02685
## F-statistic: 8.844 on 9 and 2550 DF,  p-value: 3.224e-13
```

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:54
## \begin{table}[!htbp] \centering
##   \caption{Model 2 Regression Results}
##   \label{Tab:regression_2}
## \begin{tabular}{@{\extracolsep{5pt}}lcc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{2}{c}{\textit{Dependent variable:}} \\
## \cline{2-3}
## \\[-1.8ex] & \multicolumn{2}{c}{Effort} \\
##  & w/out learning & w/ learning \\
## \\[-1.8ex] & (1) & (2)\\
## \hline \\[-1.8ex]
##  Adv & $-$1.470 (1.219) & $-$1.547 (1.705) \\
##   Disadv & $-$3.656$^{***}$ (1.219) & $-$4.425$^{***}$ (1.705) \\
##   Symm\_1\_3 & 1.417 (1.219) & 1.172 (1.705) \\
##   Symm\_3\_1 & 7.189$^{***}$ (1.219) & 6.666$^{***}$ (1.705) \\
##   Stage\_2\_indicator & $-$5.405$^{***}$ (1.795) & $-$4.271$^{**}$ (1.969) \\
##   Adv:Stage\_2\_indicator & 2.215 (2.538) & 2.292 (2.784) \\
##   Disadv:Stage\_2\_indicator & 0.224 (2.538) & 0.993 (2.784) \\
##   Symm\_1\_3:Stage\_2\_indicator & 0.822 (2.538) & 1.068 (2.784) \\
##   Symm\_3\_1:Stage\_2\_indicator & $-$2.408 (2.538) & $-$1.884 (2.784) \\
##   Constant & 47.400$^{***}$ (0.862) & 46.266$^{***}$ (1.206) \\
##  \hline \\[-1.8ex]
## Observations & 4,160 & 2,560 \\
## R$^{2}$ & 0.034 & 0.030 \\
## Adjusted R$^{2}$ & 0.032 & 0.027 \\
## Residual Std. Error & 21.813 (df = 4150) & 21.568 (df = 2550) \\
## F Statistic & 16.343$^{***}$ (df = 9; 4150) & 8.844$^{***}$ (df = 9; 2550) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{2}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

with joint test:

```
linearHypothesis(stage_2_impact.adj, c("Symm_1_3 = 10")) # can reject this
```

```
## Linear hypothesis test
```

```
##
## Hypothesis:
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F    Pr(>F)
## 1   2551 1198632
## 2   2550 1186162  1     12470 26.807 2.423e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
linearHypothesis(stage_2_impact.adj, c("Symm_3_1 = 10")) # can't reject this (marginally we can)
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F  Pr(>F)
## 1   2551 1187941
## 2   2550 1186162  1    1778.9 3.8242 0.05063 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
linearHypothesis(stage_2_impact.adj, c("Symm_3_1 = Symm_1_3")) # can safely reject they are the same
```

```
## Linear hypothesis test
##
## Hypothesis:
## - Symm_1_3  + Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F   Pr(>F)
## 1   2551 1190991
## 2   2550 1186162  1      4829 10.381 0.001289 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
linearHypothesis(stage_2_impact.adj, c("Adv:Stage_2_indicator = 0", "Disadv:Stage_2_indicator = 0",
                                       "Symm_1_3:Stage_2_indicator = 0", "Symm_3_1:Stage_2_indicator = 0"))
```

```
## Linear hypothesis test
##
```

```
## Hypothesis:
## Adv:Stage_2_indicator = 0
## Disadv:Stage_2_indicator = 0
## Symm_1_3:Stage_2_indicator = 0
## Symm_3_1:Stage_2_indicator = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Adv * Stage_2_indicator + Disadv * Stage_2_indicator + Symm_1_3 *
##     Stage_2_indicator + Symm_3_1 * Stage_2_indicator
##
##   Res.Df     RSS Df Sum of Sq      F Pr(>F)
## 1   2554 1187327
## 2   2550 1186162  4    1165.2 0.6262 0.6438
```

Now, we need to verify the other tests still hold with this sub-sample. We might also be interested in comparing a few tables.

To start:

```
summarize(map_four_bidding, n.records = n(),
          n.all.zeros = sum(all.zeros.bids),
          n.one.district  = sum(one.bids),
          n.two.districts = sum(two.bids),
          n.three.districts = sum(all.three.bids),
          pct.zeros = n.all.zeros/n.records,
          pct.bid.one = n.one.district/n.records,
          pct.bid.two = n.two.districts/n.records,
          pct.bid.three = n.three.districts/n.records,
          )
```

```
## # A tibble: 1 x 9
##   n.records n.all.zeros n.one.district n.two.districts n.three.distric~
##       <int>       <dbl>          <dbl>           <dbl>            <dbl>
## 1       896          67             29             155              645
## # ... with 4 more variables: pct.zeros <dbl>, pct.bid.one <dbl>,
## #   pct.bid.two <dbl>, pct.bid.three <dbl>
```

```
# compared to

summarize(subset(map_four_bidding, Period > 19), n.records = n(),
          n.all.zeros = sum(all.zeros.bids),
          n.one.district  = sum(one.bids),
          n.two.districts = sum(two.bids),
          n.three.districts = sum(all.three.bids),
          pct.zeros = n.all.zeros/n.records,
          pct.bid.one = n.one.district/n.records,
          pct.bid.two = n.two.districts/n.records,
          pct.bid.three = n.three.districts/n.records,
          )
```

```
## # A tibble: 1 x 9
##   n.records n.all.zeros n.one.district n.two.districts n.three.distric~
##       <int>       <dbl>          <dbl>           <dbl>            <dbl>
## 1       576          54             20              88              414
## # ... with 4 more variables: pct.zeros <dbl>, pct.bid.one <dbl>,
## #   pct.bid.two <dbl>, pct.bid.three <dbl>
```

```
# the above have very little difference
```

Now, the K-S tests:

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EDG4A)) and as.numeric(unlist(EDG4B))
## D = 0.13889, p-value = 0.007732
## alternative hypothesis: two-sided
```

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(ELG4A)) and as.numeric(unlist(ELG4B))
```

```
## D = 0.10764, p-value = 0.0711
## alternative hypothesis: two-sided

##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EW4A)) and as.numeric(unlist(EW4B))
## D = 0.0625, p-value = 0.6272
## alternative hypothesis: two-sided

##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EW2A)) and as.numeric(unlist(EW2B))
## D = 0.11111, p-value = 0.05713
## alternative hypothesis: two-sided

##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(EW3A)) and as.numeric(unlist(EW3B))
## D = 0.059028, p-value = 0.6973
## alternative hypothesis: two-sided

##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(ADV.A)) and as.numeric(unlist(ADV.B))
## D = 0.13889, p-value = 0.007732
## alternative hypothesis: two-sided

##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(Dis.ADV.A)) and as.numeric(unlist(Dis.ADV.B))
## D = 0.13194, p-value = 0.01329
## alternative hypothesis: two-sided

##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  as.numeric(unlist(ADV.All)) and as.numeric(unlist(Dis.ADV.All))
## D = 0.18576, p-value = 4.663e-09
## alternative hypothesis: two-sided
```

Additions on August 2, 2021

Table with each of 5 maps' 3 districts and percent of bids == 0, average bid if != 0, and the average bid unconditional.

1

```
## EDG_5 ELG_5  EW_5 EDG_4 ELG_4  EW_4 EDG_3 ELG_3  EW_3 EDG_2 ELG_2  EW_2 EDG_1
## 22.05 20.50 39.88 20.63 21.14 19.99 23.81 16.73 44.37 20.56 15.00 41.26 21.40
## ELG_1  EW_1
## 17.62 40.21

## EDG_5 ELG_5  EW_5 EDG_4 ELG_4  EW_4 EDG_3 ELG_3  EW_3 EDG_2 ELG_2  EW_2 EDG_1
```

```
##  2.62  3.20 37.52 16.89 18.36 17.68  2.68  1.36 43.40  3.79  2.25 40.23  3.68
## ELG_1  EW_1
##  1.60 37.95
```

```
## # A tibble: 15 x 6
## # Groups:   District, Map [12]
##    District Map   Fairness pct.bid.zero avg.positive.bid avg.bid
##    <chr>    <chr> <chr>           <dbl>            <dbl>   <dbl>
##  1 EDG      2     fair               76             19.9    4.80
##  2 EDG      3     fair               84             21.1    3.43
##  3 EDG      4     fair               16             21.2   17.9
##  4 EDG      gerry Adv                79             20.8    4.41
##  5 EDG      gerry Dis.adv            82             19.8    3.62
##  6 ELG      2     fair               80             16.0    3.26
##  7 ELG      3     fair               87             15.0    1.99
##  8 ELG      4     fair               12             21.6   18.9
##  9 ELG      gerry Adv                82             18.2    3.29
## 10 ELG      gerry Dis.adv            83             17.7    3.05
## 11 EW       2     fair                3             40.4   39.3
## 12 EW       3     fair                3             44.5   43.4
## 13 EW       4     fair               13             20.4   17.7
## 14 EW       gerry Adv                 2             39.1   38.2
## 15 EW       gerry Dis.adv            10             41.0   37.1
```

```
## # A tibble: 15 x 6
## # Groups:   District, Map [12]
##    District Map   Fairness pct.bid.zero avg.positive.bid avg.bid
##    <chr>    <chr> <chr>           <dbl>            <dbl>   <dbl>
##  1 EDG      2     fair               82             20.6    3.79
##  2 EDG      3     fair               89             23.8    2.68
##  3 EDG      4     fair               18             20.6   16.9
##  4 EDG      gerry Adv                84             21.4    3.48
##  5 EDG      gerry Dis.adv            87             22      2.82
##  6 ELG      2     fair               85             15      2.25
##  7 ELG      3     fair               92             16.7    1.36
##  8 ELG      4     fair               13             21.1   18.4
##  9 ELG      gerry Adv                88             19.2    2.34
## 10 ELG      gerry Dis.adv            88             19.7    2.46
## 11 EW       2     fair                3             41.3   40.2
## 12 EW       3     fair                2             44.4   43.4
## 13 EW       4     fair               12             20.0   17.7
## 14 EW       gerry Adv                 1             39.4   38.9
## 15 EW       gerry Dis.adv            10             40.8   36.6
```

```
## # A tibble: 30 x 2
##    District pct.bid.zero
##    <chr>           <dbl>
##  1 EDG_1            0.77
##  2 EDG_2            0.76
##  3 EDG_3            0.84
##  4 EDG_4            0.16
##  5 EDG_5            0.84
##  6 ELG_1            0.85
##  7 ELG_2            0.8
##  8 ELG_3            0.87
```

```
##  9 ELG_4            0.12
## 10 ELG_5            0.8
## # ... with 20 more rows
```

```
## [1] 0.7566222
```

3

Regression like Model 3, but only with data from the last 5 periods of Stage 1 (6 - 10). The only explanatory should be Adv, Disadv, Symm_1_3, Symm_3_1, and a constant. Standard errors should be clustered at the session level and we should include subject fixed effects.

Test that Disadv = Adv and that Symm_1_3 = Symm_3_1.

```
## Oneway (individual) effect Within Model
##
## Call:
## plm(formula = Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1, data = regress_df,
##     effect = "individual", index = "subject.id")
##
## Balanced Panel: n = 64, T = 25, N = 1600
##
## Residuals:
##     Min.  1st Qu.   Median  3rd Qu.     Max.
## -52.8787  -6.6302   0.3075   7.4803  47.4131
##
## Coefficients:
##          Estimate Std. Error t-value  Pr(>|t|)
## Adv       -1.5469     1.0302 -1.5015    0.1334
## Disadv    -4.4250     1.0302 -4.2952 1.855e-05 ***
## Symm_1_3   1.1719     1.0302  1.1375    0.2555
## Symm_3_1   6.6656     1.0302  6.4702 1.314e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Total Sum of Squares:    281620
## Residual Sum of Squares: 260150
## R-Squared:      0.076223
## Adj. R-Squared: 0.035823
## F-statistic: 31.6023 on 4 and 1532 DF, p-value: < 2.22e-16
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv  + Disadv = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1   1533
## 2   1532  1 11.201  0.0008176 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
```

```
## Hypothesis:
## Symm_1_3  + Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df Df  Chisq Pr(>Chisq)
## 1   1533
## 2   1532  1 19.292  1.122e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:55
## \begin{table}[!htbp] \centering
##   \caption{Model 4 Regression Results}
##   \label{Tab:regression_4}
## \begin{tabular}{@{\extracolsep{5pt}}lc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{1}{c}{\textit{Dependent variable:}} \\
## \cline{2-2}
## \\[-1.8ex] & Effort \\
## \hline \\[-1.8ex]
##  Adv & $-$1.547 (1.030) \\
##   Disadv & $-$4.425$^{***}$ (1.030) \\
##   Symm\_1\_3 & 1.172 (1.030) \\
##   Symm\_3\_1 & 6.666$^{***}$ (1.030) \\
##  \hline \\[-1.8ex]
## Observations & 1,600 \\
## R$^{2}$ & 0.076 \\
## Adjusted R$^{2}$ & 0.036 \\
## F Statistic & 31.602$^{***}$ (df = 4; 1532) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{1}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

Additions on August 4, 2021

1 and 2

The average [total] bid by an advantaged player on a gerrymandered map in the last 5 periods of stage 1.

The average bid by a disadvantaged player on a gerrymandered map in the last 5 periods of stage 1.

```
## # A tibble: 2 x 2
##   advantage avg.bid.by.gerry
##   <chr>                <dbl>
## 1 n                     41.8
## 2 y                     44.7
```

3

The percentage of times the advantaged player actually won on gerrymandered maps periods 1-10 and periods 6-10.

For Appendix:

Difference between Stage 1 and Stage 2

```
##
## Call:
## lm(formula = Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Stage_2_indicator * Adv + Stage_2_indicator * Disadv + Stage_2_indicator *
##     Symm_1_3 + Stage_2_indicator * Symm_3_1 + subject.id, data = stage_1to2_regression_data)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -54.470  -8.360   0.414   8.621  70.312
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                 38.5428     1.9212  20.062  < 2e-16 ***
## Adv                         -1.4703     0.8309  -1.770 0.076881 .
## Disadv                      -3.6562     0.8309  -4.400 1.11e-05 ***
## Symm_1_3                     1.4172     0.8309   1.706 0.088160 .
## Symm_3_1                     7.1891     0.8309   8.652  < 2e-16 ***
## Stage_2_indicator           -5.4052     1.2231  -4.419 1.02e-05 ***
## subject.id2                  5.3538     2.6073   2.053 0.040094 *
## subject.id3                  7.7385     2.6073   2.968 0.003015 **
## subject.id4                 -9.1077     2.6073  -3.493 0.000482 ***
## subject.id5                 20.4923     2.6073   7.860 4.89e-15 ***
## subject.id6                 15.5692     2.6073   5.971 2.55e-09 ***
## subject.id7                -18.8923     2.6073  -7.246 5.11e-13 ***
## subject.id8                 -1.9846     2.6073  -0.761 0.446590
## subject.id9                 -4.4923     2.6073  -1.723 0.084965 .
## subject.id10               -11.9385     2.6073  -4.579 4.81e-06 ***
## subject.id11                15.6154     2.6073   5.989 2.29e-09 ***
## subject.id12                38.7385     2.6073  14.858  < 2e-16 ***
## subject.id13                24.5846     2.6073   9.429  < 2e-16 ***
## subject.id14               -27.3846     2.6073 -10.503  < 2e-16 ***
## subject.id15                 6.8923     2.6073   2.643 0.008237 **
## subject.id16                17.8462     2.6073   6.845 8.80e-12 ***
## subject.id17                21.5077     2.6073   8.249  < 2e-16 ***
## subject.id18                41.9692     2.6073  16.097  < 2e-16 ***
## subject.id19                 5.9538     2.6073   2.284 0.022449 *
## subject.id20                12.6154     2.6073   4.839 1.36e-06 ***
## subject.id21                10.3538     2.6073   3.971 7.28e-05 ***
## subject.id22                27.2923     2.6073  10.468  < 2e-16 ***
## subject.id23                25.8462     2.6073   9.913  < 2e-16 ***
## subject.id24                14.9231     2.6073   5.724 1.12e-08 ***
## subject.id25               -11.8000     2.6073  -4.526 6.19e-06 ***
## subject.id26                -7.1846     2.6073  -2.756 0.005884 **
## subject.id27                14.8154     2.6073   5.682 1.42e-08 ***
## subject.id28               -15.4462     2.6073  -5.924 3.40e-09 ***
## subject.id29                -1.6154     2.6073  -0.620 0.535576
## subject.id30                -1.3846     2.6073  -0.531 0.595406
```

```
## subject.id31                -8.1231     2.6073  -3.116 0.001849 **
## subject.id32               -12.1692     2.6073  -4.667 3.15e-06 ***
## subject.id33                 0.5077     2.6073   0.195 0.845620
## subject.id34                11.7846     2.6073   4.520 6.36e-06 ***
## subject.id35                -9.3385     2.6073  -3.582 0.000345 ***
## subject.id36                19.3231     2.6073   7.411 1.51e-13 ***
## subject.id37                -5.8769     2.6073  -2.254 0.024246 *
## subject.id38                -8.0000     2.6073  -3.068 0.002167 **
## subject.id39                26.4154     2.6073  10.131  < 2e-16 ***
## subject.id40                -1.9077     2.6073  -0.732 0.464405
## subject.id41               -22.0308     2.6073  -8.450  < 2e-16 ***
## subject.id42                -6.6462     2.6073  -2.549 0.010837 *
## subject.id43                19.3077     2.6073   7.405 1.58e-13 ***
## subject.id44                12.8923     2.6073   4.945 7.93e-07 ***
## subject.id45                12.5692     2.6073   4.821 1.48e-06 ***
## subject.id46                 9.7077     2.6073   3.723 0.000199 ***
## subject.id47               -16.4462     2.6073  -6.308 3.13e-10 ***
## subject.id48                10.4000     2.6073   3.989 6.76e-05 ***
## subject.id49                19.3538     2.6073   7.423 1.39e-13 ***
## subject.id50                25.1077     2.6073   9.630  < 2e-16 ***
## subject.id51                27.0462     2.6073  10.373  < 2e-16 ***
## subject.id52                28.4000     2.6073  10.893  < 2e-16 ***
## subject.id53                33.0462     2.6073  12.675  < 2e-16 ***
## subject.id54                28.7385     2.6073  11.022  < 2e-16 ***
## subject.id55                35.4769     2.6073  13.607  < 2e-16 ***
## subject.id56                17.2308     2.6073   6.609 4.38e-11 ***
## subject.id57                 1.2462     2.6073   0.478 0.632709
## subject.id58                -2.2769     2.6073  -0.873 0.382552
## subject.id59                15.5538     2.6073   5.966 2.64e-09 ***
## subject.id60                13.1231     2.6073   5.033 5.03e-07 ***
## subject.id61                10.7692     2.6073   4.130 3.69e-05 ***
## subject.id62                13.5231     2.6073   5.187 2.24e-07 ***
## subject.id63                 9.7077     2.6073   3.723 0.000199 ***
## subject.id64                41.5692     2.6073  15.944  < 2e-16 ***
## Adv:Stage_2_indicator        2.2151     1.7297   1.281 0.200389
## Disadv:Stage_2_indicator     0.2240     1.7297   0.129 0.896984
## Symm_1_3:Stage_2_indicator   0.8224     1.7297   0.475 0.634482
## Symm_3_1:Stage_2_indicator  -2.4078     1.7297  -1.392 0.163979
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.86 on 4087 degrees of freedom
## Multiple R-squared:  0.5584, Adjusted R-squared:  0.5506
## F-statistic: 71.77 on 72 and 4087 DF,  p-value: < 2.2e-16
```

```
##
## Call:
## lm(formula = Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1 + Stage_2_indicator +
##     Stage_2_indicator * Adv + Stage_2_indicator * Disadv + Stage_2_indicator *
##     Symm_1_3 + Stage_2_indicator * Symm_3_1 + subject.id, data = stage_1to2_regression_data_with_lea
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -49.840  -7.046   0.206   7.363  48.710
```

```
##
## Coefficients:
##                            Estimate Std. Error t value Pr(>|t|)
## (Intercept)                3.017e+01  2.209e+00  13.657  < 2e-16 ***
## Adv                       -1.547e+00  1.049e+00  -1.475 0.140296
## Disadv                    -4.425e+00  1.049e+00  -4.220 2.53e-05 ***
## Symm_1_3                   1.172e+00  1.049e+00   1.118 0.263870
## Symm_3_1                   6.666e+00  1.049e+00   6.357 2.45e-10 ***
## Stage_2_indicator         -4.271e+00  1.211e+00  -3.527 0.000428 ***
## subject.id2                1.650e+01  2.966e+00   5.563 2.93e-08 ***
## subject.id3                1.225e+01  2.966e+00   4.130 3.74e-05 ***
## subject.id4                1.775e+00  2.966e+00   0.598 0.549586
## subject.id5                1.648e+01  2.966e+00   5.555 3.08e-08 ***
## subject.id6                2.873e+01  2.966e+00   9.685  < 2e-16 ***
## subject.id7               -1.250e+01  2.966e+00  -4.215 2.59e-05 ***
## subject.id8                4.675e+00  2.966e+00   1.576 0.115100
## subject.id9               -6.250e-01  2.966e+00  -0.211 0.833118
## subject.id10              -1.272e+01  2.966e+00  -4.290 1.85e-05 ***
## subject.id11               2.418e+01  2.966e+00   8.151 5.66e-16 ***
## subject.id12               4.738e+01  2.966e+00  15.973  < 2e-16 ***
## subject.id13               3.388e+01  2.966e+00  11.421  < 2e-16 ***
## subject.id14              -1.790e+01  2.966e+00  -6.035 1.82e-09 ***
## subject.id15               1.413e+01  2.966e+00   4.762 2.02e-06 ***
## subject.id16               2.330e+01  2.966e+00   7.856 5.86e-15 ***
## subject.id17               3.088e+01  2.966e+00  10.410  < 2e-16 ***
## subject.id18               5.088e+01  2.966e+00  17.153  < 2e-16 ***
## subject.id19               1.610e+01  2.966e+00   5.428 6.24e-08 ***
## subject.id20               2.678e+01  2.966e+00   9.028  < 2e-16 ***
## subject.id21               1.980e+01  2.966e+00   6.676 3.02e-11 ***
## subject.id22               4.450e+01  2.966e+00  15.004  < 2e-16 ***
## subject.id23               3.680e+01  2.966e+00  12.408  < 2e-16 ***
## subject.id24               2.378e+01  2.966e+00   8.016 1.66e-15 ***
## subject.id25               3.375e+00  2.966e+00   1.138 0.255263
## subject.id26              -4.000e-01  2.966e+00  -0.135 0.892730
## subject.id27               2.283e+01  2.966e+00   7.696 2.01e-14 ***
## subject.id28              -5.850e+00  2.966e+00  -1.972 0.048675 *
## subject.id29               8.475e+00  2.966e+00   2.857 0.004306 **
## subject.id30               1.120e+01  2.966e+00   3.776 0.000163 ***
## subject.id31              -5.250e-01  2.966e+00  -0.177 0.859515
## subject.id32              -1.092e+01  2.966e+00  -3.683 0.000235 ***
## subject.id33               5.390e-13  2.966e+00   0.000 1.000000
## subject.id34               1.608e+01  2.966e+00   5.420 6.54e-08 ***
## subject.id35              -1.500e+00  2.966e+00  -0.506 0.613082
## subject.id36               2.000e+01  2.966e+00   6.743 1.92e-11 ***
## subject.id37              -4.375e+00  2.966e+00  -1.475 0.140317
## subject.id38               4.175e+00  2.966e+00   1.408 0.159359
## subject.id39               2.875e+01  2.966e+00   9.693  < 2e-16 ***
## subject.id40              -1.850e+00  2.966e+00  -0.624 0.532849
## subject.id41              -1.612e+01  2.966e+00  -5.437 5.96e-08 ***
## subject.id42              -4.250e-01  2.966e+00  -0.143 0.886070
## subject.id43               2.653e+01  2.966e+00   8.943  < 2e-16 ***
## subject.id44               2.213e+01  2.966e+00   7.460 1.19e-13 ***
## subject.id45               2.785e+01  2.966e+00   9.390  < 2e-16 ***
## subject.id46               1.730e+01  2.966e+00   5.833 6.15e-09 ***
```

```
## subject.id47                -3.050e+00  2.966e+00  -1.028 0.303888
## subject.id48                 1.513e+01  2.966e+00   5.100 3.66e-07 ***
## subject.id49                 3.238e+01  2.966e+00  10.916  < 2e-16 ***
## subject.id50                 3.570e+01  2.966e+00  12.037  < 2e-16 ***
## subject.id51                 3.463e+01  2.966e+00  11.674  < 2e-16 ***
## subject.id52                 3.458e+01  2.966e+00  11.657  < 2e-16 ***
## subject.id53                 4.113e+01  2.966e+00  13.866  < 2e-16 ***
## subject.id54                 3.500e+01  2.966e+00  11.801  < 2e-16 ***
## subject.id55                 4.320e+01  2.966e+00  14.565  < 2e-16 ***
## subject.id56                 2.368e+01  2.966e+00   7.982 2.17e-15 ***
## subject.id57                 4.825e+00  2.966e+00   1.627 0.103905
## subject.id58                -2.425e+00  2.966e+00  -0.818 0.413654
## subject.id59                 1.438e+01  2.966e+00   4.847 1.33e-06 ***
## subject.id60                 2.338e+01  2.966e+00   7.881 4.81e-15 ***
## subject.id61                 1.843e+01  2.966e+00   6.212 6.11e-10 ***
## subject.id62                 2.405e+01  2.966e+00   8.109 7.94e-16 ***
## subject.id63                 8.825e+00  2.966e+00   2.975 0.002954 **
## subject.id64                 5.073e+01  2.966e+00  17.103  < 2e-16 ***
## Adv:Stage_2_indicator        2.292e+00  1.712e+00   1.338 0.180924
## Disadv:Stage_2_indicator     9.927e-01  1.712e+00   0.580 0.562154
## Symm_1_3:Stage_2_indicator   1.068e+00  1.712e+00   0.624 0.532999
## Symm_3_1:Stage_2_indicator -1.884e+00  1.712e+00  -1.100 0.271247
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 13.26 on 2487 degrees of freedom
## Multiple R-squared:  0.6423, Adjusted R-squared:  0.6319
## F-statistic: 62.02 on 72 and 2487 DF,  p-value: < 2.2e-16
```

```
##
## % Table created by stargazer v.5.2.2 by Marek Hlavac, Harvard University. E-mail: hlavac at fas.harva
## % Date and time: Mon, Jan 10, 2022 - 16:14:55
## \begin{table}[!htbp] \centering
##   \caption{Map Impact with Stage 2 Indicator (FE and Clustereed SE)}
##   \label{Tab:stage_1to2_with_and_without_learning_FE_CSE}
## \begin{tabular}{@{\extracolsep{5pt}}lcc}
## \\[-1.8ex]\hline
## \hline \\[-1.8ex]
##  & \multicolumn{2}{c}{\textit{Dependent variable:}} \\
## \cline{2-3}
## \\[-1.8ex] & \multicolumn{2}{c}{Effort} \\
##  & w/out learning & w/ learning \\
## \\[-1.8ex] & (1) & (2)\\
## \hline \\[-1.8ex]
##  Adv & $-$1.470$^{*}$ (0.831) & $-$1.547 (1.049) \\
##   Disadv & $-$3.656$^{***}$ (0.831) & $-$4.425$^{***}$ (1.049) \\
##   Symm\_1\_3 & 1.417$^{*}$ (0.831) & 1.172 (1.049) \\
##   Symm\_3\_1 & 7.189$^{***}$ (0.831) & 6.666$^{***}$ (1.049) \\
##   Stage\_2\_indicator & $-$5.405$^{***}$ (1.223) & $-$4.271$^{***}$ (1.211) \\
##   Adv:Stage\_2\_indicator & 2.215 (1.730) & 2.292 (1.712) \\
##   Disadv:Stage\_2\_indicator & 0.224 (1.730) & 0.993 (1.712) \\
##   Symm\_1\_3:Stage\_2\_indicator & 0.822 (1.730) & 1.068 (1.712) \\
##   Symm\_3\_1:Stage\_2\_indicator & $-$2.408 (1.730) & $-$1.884 (1.712) \\
##   Constant & 38.543$^{***}$ (1.921) & 30.168$^{***}$ (2.209) \\
```

```
##  \hline \\[-1.8ex]
## Observations & 4,160 & 2,560 \\
## R$^{2}$ & 0.558 & 0.642 \\
## Adjusted R$^{2}$ & 0.551 & 0.632 \\
## Residual Std. Error & 14.864 (df = 4087) & 13.264 (df = 2487) \\
## F Statistic & 71.773$^{***}$ (df = 72; 4087) & 62.021$^{***}$ (df = 72; 2487) \\
## \hline
## \hline \\[-1.8ex]
## \textit{Note:}  & \multicolumn{2}{r}{$^{*}$p$<$0.1; $^{**}$p$<$0.05; $^{***}$p$<$0.01} \\
## \end{tabular}
## \end{table}
```

```
## R^2= 0.55839
##
##                               Estimate   Std. Error       t value    Pr(>|t|)
## (Intercept)                 38.5427885 9.845131e-01  3.914909e+01 0.000000000
## Adv                         -1.4703125 1.222883e+00 -1.202333e+00 0.229234449
## Disadv                      -3.6562500 1.727221e+00 -2.116840e+00 0.034273458
## Symm_1_3                     1.4171875 6.552844e-01  2.162706e+00 0.030563792
## Symm_3_1                     7.1890625 2.267956e+00  3.169842e+00 0.001525217
## Stage_2_indicator           -5.4052083 1.741236e+00 -3.104236e+00 0.001907713
## subject.id2                  5.3538462 9.196474e-13  5.821629e+12 0.000000000
## subject.id3                  7.7384615 9.080653e-13  8.521922e+12 0.000000000
## subject.id4                 -9.1076923 9.928682e-13 -9.173114e+12 0.000000000
## subject.id5                 20.4923077 9.536565e-13  2.148814e+13 0.000000000
## subject.id6                 15.5692308 9.381255e-13  1.659611e+13 0.000000000
## subject.id7                -18.8923077 9.461160e-13 -1.996828e+13 0.000000000
## subject.id8                 -1.9846154 9.366980e-13 -2.118736e+12 0.000000000
## subject.id9                 -4.4923077 9.469748e-13 -4.743851e+12 0.000000000
## subject.id10               -11.9384615 9.690640e-13 -1.231958e+13 0.000000000
## subject.id11                15.6153846 9.776832e-13  1.597183e+13 0.000000000
## subject.id12                38.7384615 8.083010e-13  4.792579e+13 0.000000000
## subject.id13                24.5846154 9.375862e-13  2.622118e+13 0.000000000
## subject.id14               -27.3846154 9.496593e-13 -2.883625e+13 0.000000000
## subject.id15                 6.8923077 9.506447e-13  7.250141e+12 0.000000000
## subject.id16                17.8461538 9.070146e-13  1.967571e+13 0.000000000
## subject.id17                21.5076923 9.903792e-13  2.171662e+13 0.000000000
## subject.id18                41.9692308 9.519807e-13  4.408622e+13 0.000000000
## subject.id19                 5.9538462 9.335136e-13  6.377889e+12 0.000000000
## subject.id20                12.6153846 8.598217e-13  1.467209e+13 0.000000000
## subject.id21                10.3538462 9.693374e-13  1.068136e+13 0.000000000
## subject.id22                27.2923077 9.654181e-13  2.826994e+13 0.000000000
## subject.id23                25.8461538 9.685800e-13  2.668458e+13 0.000000000
## subject.id24                14.9230769 9.095070e-13  1.640787e+13 0.000000000
## subject.id25               -11.8000000 9.018343e-13 -1.308444e+13 0.000000000
## subject.id26                -7.1846154 9.150110e-13 -7.851944e+12 0.000000000
## subject.id27                14.8153846 9.480748e-13  1.562681e+13 0.000000000
## subject.id28               -15.4461538 1.030827e-12 -1.498424e+13 0.000000000
## subject.id29                -1.6153846 9.711762e-13 -1.663328e+12 0.000000000
## subject.id30                -1.3846154 9.911589e-13 -1.396966e+12 0.000000000
## subject.id31                -8.1230769 9.643608e-13 -8.423276e+12 0.000000000
## subject.id32               -12.1692308 9.684353e-13 -1.256587e+13 0.000000000
## subject.id33                 0.5076923 9.313891e-13  5.450915e+11 0.000000000
## subject.id34                11.7846154 9.338362e-13  1.261957e+13 0.000000000
```

```
## subject.id35                -9.3384615 9.276173e-13 -1.006715e+13 0.000000000
## subject.id36                19.3230769 9.358129e-13  2.064844e+13 0.000000000
## subject.id37                -5.8769231 9.732001e-13 -6.038761e+12 0.000000000
## subject.id38                -8.0000000 9.685502e-13 -8.259768e+12 0.000000000
## subject.id39                26.4153846 9.734036e-13  2.713713e+13 0.000000000
## subject.id40                -1.9076923 9.740275e-13 -1.958561e+12 0.000000000
## subject.id41               -22.0307692 9.264437e-13 -2.377993e+13 0.000000000
## subject.id42                -6.6461538 9.278806e-13 -7.162725e+12 0.000000000
## subject.id43                19.3076923 9.286940e-13  2.079015e+13 0.000000000
## subject.id44                12.8923077 9.266836e-13  1.391231e+13 0.000000000
## subject.id45                12.5692308 9.761839e-13  1.287588e+13 0.000000000
## subject.id46                 9.7076923 9.806497e-13  9.899245e+12 0.000000000
## subject.id47               -16.4461538 9.772374e-13 -1.682923e+13 0.000000000
## subject.id48                10.4000000 9.772557e-13  1.064205e+13 0.000000000
## subject.id49                19.3538462 9.325039e-13  2.075471e+13 0.000000000
## subject.id50                25.1076923 9.295864e-13  2.700953e+13 0.000000000
## subject.id51                27.0461538 9.296916e-13  2.909153e+13 0.000000000
## subject.id52                28.4000000 9.321244e-13  3.046804e+13 0.000000000
## subject.id53                33.0461538 9.768751e-13  3.382843e+13 0.000000000
## subject.id54                28.7384615 9.762274e-13  2.943829e+13 0.000000000
## subject.id55                35.4769231 9.761634e-13  3.634322e+13 0.000000000
## subject.id56                17.2307692 9.766177e-13  1.764331e+13 0.000000000
## subject.id57                 1.2461538 9.310818e-13  1.338394e+12 0.000000000
## subject.id58                -2.2769231 9.377359e-13 -2.428107e+12 0.000000000
## subject.id59                15.5538462 9.326790e-13  1.667653e+13 0.000000000
## subject.id60                13.1230769 9.447575e-13  1.389042e+13 0.000000000
## subject.id61                10.7692308 9.747545e-13  1.104815e+13 0.000000000
## subject.id62                13.5230769 9.734321e-13  1.389216e+13 0.000000000
## subject.id63                 9.7076923 9.748685e-13  9.957951e+12 0.000000000
## subject.id64                41.5692308 9.666091e-13  4.300521e+13 0.000000000
## Adv:Stage_2_indicator        2.2151042 9.597216e-01  2.308069e+00 0.020995274
## Disadv:Stage_2_indicator     0.2239583 1.341444e+00  1.669531e-01 0.867406930
## Symm_1_3:Stage_2_indicator   0.8223958 9.053729e-01  9.083504e-01 0.363693146
## Symm_3_1:Stage_2_indicator  -2.4078125 2.153952e+00 -1.117858e+00 0.263627597
```

```
## R^2= 0.64229
##
##                                 Estimate   Std. Error       t value
## (Intercept)                 3.016836e+01 7.950977e-01  3.794296e+01
## Adv                        -1.546875e+00 1.581049e+00 -9.783851e-01
## Disadv                     -4.425000e+00 1.506296e+00 -2.937670e+00
## Symm_1_3                    1.171875e+00 7.824549e-01  1.497690e+00
## Symm_3_1                    6.665625e+00 2.245541e+00  2.968383e+00
## Stage_2_indicator          -4.270833e+00 9.920502e-01 -4.305058e+00
## subject.id2                 1.650000e+01 4.168045e-13  3.958690e+13
## subject.id3                 1.225000e+01 3.517696e-13  3.482393e+13
## subject.id4                 1.775000e+00 4.371651e-13  4.060251e+12
## subject.id5                 1.647500e+01 3.725725e-13  4.421959e+13
## subject.id6                 2.872500e+01 4.537340e-13  6.330802e+13
## subject.id7                -1.250000e+01 4.134259e-13 -3.023516e+13
## subject.id8                 4.675000e+00 3.974073e-13  1.176375e+13
## subject.id9                -6.250000e-01 4.049700e-13 -1.543324e+12
## subject.id10               -1.272500e+01 4.023429e-13 -3.162725e+13
## subject.id11                2.417500e+01 4.003400e-13  6.038617e+13
```

```
## subject.id12               4.737500e+01 4.153494e-13  1.140606e+14
## subject.id13               3.387500e+01 4.068416e-13  8.326336e+13
## subject.id14              -1.790000e+01 4.095845e-13 -4.370282e+13
## subject.id15               1.412500e+01 4.033839e-13  3.501628e+13
## subject.id16               2.330000e+01 4.047632e-13  5.756452e+13
## subject.id17               3.087500e+01 4.028779e-13  7.663611e+13
## subject.id18               5.087500e+01 4.526353e-13  1.123973e+14
## subject.id19               1.610000e+01 4.028260e-13  3.996762e+13
## subject.id20               2.677500e+01 4.371028e-13  6.125562e+13
## subject.id21               1.980000e+01 4.030075e-13  4.913060e+13
## subject.id22               4.450000e+01 4.121824e-13  1.079619e+14
## subject.id23               3.680000e+01 4.124885e-13  8.921461e+13
## subject.id24               2.377500e+01 4.037652e-13  5.888324e+13
## subject.id25               3.375000e+00 4.025623e-13  8.383795e+12
## subject.id26              -4.000000e-01 4.309090e-13 -9.282703e+11
## subject.id27               2.282500e+01 3.983110e-13  5.730446e+13
## subject.id28              -5.850000e+00 3.747282e-13 -1.561132e+13
## subject.id29               8.475000e+00 3.992546e-13  2.122706e+13
## subject.id30               1.120000e+01 4.066346e-13  2.754316e+13
## subject.id31              -5.250000e-01 4.011703e-13 -1.308671e+12
## subject.id32              -1.092500e+01 4.061987e-13 -2.689570e+13
## subject.id33               5.389973e-13 4.025890e-13  1.338828e+00
## subject.id34               1.607500e+01 4.038534e-13  3.980405e+13
## subject.id35              -1.500000e+00 4.012201e-13 -3.738596e+12
## subject.id36               2.000000e+01 3.993421e-13  5.008237e+13
## subject.id37              -4.375000e+00 4.050389e-13 -1.080143e+13
## subject.id38               4.175000e+00 4.033498e-13  1.035082e+13
## subject.id39               2.875000e+01 4.022354e-13  7.147556e+13
## subject.id40              -1.850000e+00 4.038317e-13 -4.581116e+12
## subject.id41              -1.612500e+01 4.039709e-13 -3.991625e+13
## subject.id42              -4.250000e-01 4.027741e-13 -1.055182e+12
## subject.id43               2.652500e+01 4.021568e-13  6.595686e+13
## subject.id44               2.212500e+01 4.048931e-13  5.464405e+13
## subject.id45               2.785000e+01 4.038095e-13  6.896816e+13
## subject.id46               1.730000e+01 4.029689e-13  4.293135e+13
## subject.id47              -3.050000e+00 4.031603e-13 -7.565228e+12
## subject.id48               1.512500e+01 4.030493e-13  3.752643e+13
## subject.id49               3.237500e+01 4.024555e-13  8.044368e+13
## subject.id50               3.570000e+01 4.034883e-13  8.847839e+13
## subject.id51               3.462500e+01 4.027303e-13  8.597565e+13
## subject.id52               3.457500e+01 4.024546e-13  8.591031e+13
## subject.id53               4.112500e+01 4.038814e-13  1.018245e+14
## subject.id54               3.500000e+01 4.026085e-13  8.693309e+13
## subject.id55               4.320000e+01 4.038372e-13  1.069738e+14
## subject.id56               2.367500e+01 4.055419e-13  5.837868e+13
## subject.id57               4.825000e+00 3.996588e-13  1.207280e+13
## subject.id58              -2.425000e+00 4.029783e-13 -6.017693e+12
## subject.id59               1.437500e+01 4.050162e-13  3.549241e+13
## subject.id60               2.337500e+01 3.977082e-13  5.877425e+13
## subject.id61               1.842500e+01 4.126513e-13  4.465029e+13
## subject.id62               2.405000e+01 4.053529e-13  5.933102e+13
## subject.id63               8.825000e+00 4.024747e-13  2.192685e+13
## subject.id64               5.072500e+01 4.054579e-13  1.251055e+14
## Adv:Stage_2_indicator      2.291667e+00 1.057756e+00  2.166536e+00
```

```
## Disadv:Stage_2_indicator    9.927083e-01 1.724712e+00  5.755793e-01
## Symm_1_3:Stage_2_indicator  1.067708e+00 7.970404e-01  1.339591e+00
## Symm_3_1:Stage_2_indicator -1.884375e+00 1.942176e+00 -9.702389e-01
##                               Pr(>|t|)
## (Intercept)                0.000000e+00
## Adv                        3.278839e-01
## Disadv                     3.306893e-03
## Symm_1_3                   1.342138e-01
## Symm_3_1                   2.993711e-03
## Stage_2_indicator          1.669423e-05
## subject.id2                0.000000e+00
## subject.id3                0.000000e+00
## subject.id4                0.000000e+00
## subject.id5                0.000000e+00
## subject.id6                0.000000e+00
## subject.id7                0.000000e+00
## subject.id8                0.000000e+00
## subject.id9                0.000000e+00
## subject.id10               0.000000e+00
## subject.id11               0.000000e+00
## subject.id12               0.000000e+00
## subject.id13               0.000000e+00
## subject.id14               0.000000e+00
## subject.id15               0.000000e+00
## subject.id16               0.000000e+00
## subject.id17               0.000000e+00
## subject.id18               0.000000e+00
## subject.id19               0.000000e+00
## subject.id20               0.000000e+00
## subject.id21               0.000000e+00
## subject.id22               0.000000e+00
## subject.id23               0.000000e+00
## subject.id24               0.000000e+00
## subject.id25               0.000000e+00
## subject.id26               0.000000e+00
## subject.id27               0.000000e+00
## subject.id28               0.000000e+00
## subject.id29               0.000000e+00
## subject.id30               0.000000e+00
## subject.id31               0.000000e+00
## subject.id32               0.000000e+00
## subject.id33               1.806268e-01
## subject.id34               0.000000e+00
## subject.id35               0.000000e+00
## subject.id36               0.000000e+00
## subject.id37               0.000000e+00
## subject.id38               0.000000e+00
## subject.id39               0.000000e+00
## subject.id40               0.000000e+00
## subject.id41               0.000000e+00
## subject.id42               0.000000e+00
## subject.id43               0.000000e+00
## subject.id44               0.000000e+00
## subject.id45               0.000000e+00
```

```
## subject.id46               0.000000e+00
## subject.id47               0.000000e+00
## subject.id48               0.000000e+00
## subject.id49               0.000000e+00
## subject.id50               0.000000e+00
## subject.id51               0.000000e+00
## subject.id52               0.000000e+00
## subject.id53               0.000000e+00
## subject.id54               0.000000e+00
## subject.id55               0.000000e+00
## subject.id56               0.000000e+00
## subject.id57               0.000000e+00
## subject.id58               0.000000e+00
## subject.id59               0.000000e+00
## subject.id60               0.000000e+00
## subject.id61               0.000000e+00
## subject.id62               0.000000e+00
## subject.id63               0.000000e+00
## subject.id64               0.000000e+00
## Adv:Stage_2_indicator      3.027029e-02
## Disadv:Stage_2_indicator   5.648996e-01
## Symm_1_3:Stage_2_indicator 1.803783e-01
## Symm_3_1:Stage_2_indicator 3.319274e-01
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv - Disadv = 0
##
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 0.9636     0.3263
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 170.92  < 2.2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
```

```
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 1.5305      0.216
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 - Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: map_impact_on_stage_1_no_learning_FE
##
##   Df  Chisq Pr(>Chisq)
## 1
## 2  1 10.642   0.001105 **
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
## Hypothesis:
## Adv - Disadv = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df    RSS Df Sum of Sq     F  Pr(>F)
## 1   1596 701777
## 2   1595 700451  1    1325.4 3.018 0.08254 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1   1596 712921
## 2   1595 700451  1     12470 28.395 1.131e-07 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_3_1 = 10
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
```

```
##
##   Res.Df    RSS Df Sum of Sq      F  Pr(>F)
## 1   1596 702230
## 2   1595 700451  1    1778.9 4.0507 0.04432 *
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
## Linear hypothesis test
##
## Hypothesis:
## Symm_1_3 - Symm_3_1 = 0
##
## Model 1: restricted model
## Model 2: Effort ~ Adv + Disadv + Symm_1_3 + Symm_3_1
##
##   Res.Df    RSS Df Sum of Sq      F    Pr(>F)
## 1   1596 705280
## 2   1595 700451  1      4829 10.996 0.0009335 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```