Durably Reducing Transphobia Revisited

A recent paper by Broockman and Kalla asked if individual minds could be changed with respect to contentious political topics, particularly transgender rights. Broockman and Kalla developed a field experiment where individuals were randomly assigned to receive different treatments and their attitudes toward transgender rights were measured before and after the treatment. The paper that describes their findings will be the basis of this excercise:

Broockman, David, and Joshua Kalla (2016). "Durably reducing transphobia: A field experiment on door-to-door canvassing." *Science* 352(6282): 220-224.

Broockman and Kalla were focused on whether perspective-taking – "imagining the world from another's vantage point" – might be particularly effective in reducing intergroup prejudice. Therefore, participants in the treatment group were visited by a canvasser—some of whom were transgender and some of whom were not—and asked to think about a time when they were judged unfairly and were guided to translate that experience to a transgender individual's experience. A placebo group had conversation with canvassers about recycling.

The data you will use, `broockman_kalla_2016.csv`, contains all the variables you will need. The names and descriptions of variables are shown below. You may not need to use all of these variables for this activity. We've kept these unnecessary variables in the dataset because it is common to receive a dataset with much more information than you need. Some of the items appeared on multiple surveys; the `#` sign below will be replaced with the survey number in your analysis:

- the baseline (pre-treatment) survey is survey 0;
- the 3-day survey is survey 1;
- the 3-week survey is survey 2;
- the 6-week survey is survey 3, and;
- the 3-month survey is survey 4.

Name	Description
`vf_age`	Voter file age
`vf_racename`	Voter file race
`vf_female`	`1` if the voter is female, `0` if the voter is male.
`vf_democrat`	`1` if the voter is a Democrat, `0` if the voter is not a Democrat.
`respondent_t#`	`1` if voter responded to the survey at wave 0, 1, 2, 3, or 4 of the study, `0` if voter does not.
`miami_trans_law_t#`	Support or opposition to antidiscrimination law (measured from `-3` (opposed) to `3` (in support))
`therm_trans_t#`	Feeling thermometer towards trans people (0-100).
`treat_ind`	`1` if individual was assigned to treatment, `0` if assigned to placebo.
`exp_actual_convo`	`1` if treatment was actually delivered, `0` if it was not.
`canvasser_trans`	`1` if canvasser identified as transgender or gender non-conforming, `0` if canvasser did not.
`canvasser_id`	Canvasser identifier.
`hh_id`	Household identifier.

Question 1.1

First, load `broockman_kalla_2016.csv` into R and explore the data. How many observations are there? This file includes all of the people that the researchers *attempted* to contact. As we've learned, experiments also experience this noncompliance. However, many of these people did not even respond to the baseline

survey before the experiment was conducted. As such, we are not be able to estimate how the treatment changed these individuals' attitudes, since we don't know where they were to begin with. To deal with these people who were never reached, subset your data so that you are only looking at people who have a valid (non-NA) answer for `therm_trans_t0`, which was collected in the pre-treatment baseline study.

How many observations are you left with? How many are assigned to treatment? Placebo? What do these numbers tell us about the randomization process? You should use this subset for the rest of this questions in this part of the exam.

Answer 1

```
## load data
trans <- read.csv("data/broockman_kalla_2016.csv")

## find total number of observations
original <- nrow(trans)

## subset
trans <- subset(trans, !is.na(therm_trans_t0))

nrow(trans) # number of folks who responded to inital baseline
```

```
## [1] 1825
```

```
## Treatment table
table(trans$treat_ind)
```

```
##
##   0   1
## 913 912
```

There are 68378 observations in the original dataset. 1825 responded to the baseline survey. 913 were assigned to the placebo condition while 912 were assigned to the treatment group. These counts are nearly identical, which suggests that the randomization was properly conducted and the noncompliance does not lead to a large change in this distribution.

Question 1.2

What are the potential issues with getting rid of those people who chose not to respond the baseline survey? Discuss briefly in words. Show analysis / visualizations as you see fit.

Answer 1.2

Any guess is fine, as long as justified. Can also try plotting age / gender / partisanship by missing-ness.

Question 2

To examine the effect of these conversations, Broockman and Kalla compared how people in the treatment and placebo groups evaluated transgender people on a specific type of survey question called a "feeling thermometer," where respondents indicate where their feelings fall on a scale of 0 (very cold) to 100 (very warm). Further, to measure whether the changes persisted, Broockman and Kalla also conducted follow-up surveys up to 3 months after the original treatment. Thus, Brookman and Kalla's study required reaching participants in multiple ways: both for a face-to-face interaction where the treatment would be delivered and through multiple follow-up surveys where the long-term effects of the treatment could be measured.

We would like to further check that noncompliance did not meaningfully affect our randomization, since the basis of calculating our treatment effect depends on this. To do this, we can conduct a *placebo test* to ensure

that the average level of support (our outcome) is not meaningfully different between the treatment and control groups *before* treatment was administered (during the baseline survey). Conduct a t-test on support before treatment was administered ($t = 0$) between the treatment and control groups among the subset of people you calculated in question 1. Construct a 95% confidence interval around your estimate. If the null hypothesis is no difference between the two groups, can you reject the null hypothesis?

Answer 2

```
## treatment at time 0
treat <- trans$therm_trans_t0[trans$treat_ind==1]

## control at time 0
control <- trans$therm_trans_t0[trans$treat_ind==0]

(test <- t.test(treat, control, na.action = na.omit))
```

```
##
##  Welch Two Sample t-test
##
## data:  treat and control
## t = 0.48489, df = 1822.9, p-value = 0.6278
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -2.023001  3.351838
## sample estimates:
## mean of x mean of y
##  53.61404  52.94962
```

The estimated difference between the treatment and control groups is 0.66. The confidence interval around this estimate – [-2.02, 3.35] – includes 0 so we cannot reject the null hypothesis that the groups have the same attitudes. This is what we would expect to find because participants were randomly assigned to the treatment and control groups.

Question 3

To simplify our analysis, we will focus on the average treatment effects among the treated (ATT). Kalla and Broockman experienced noncompliance in their study, where individuals assigned to the treatment group refused to engage in conversations with canvassers. Because accounting for this noncompliance statistically is beyond the scope of this class, we will look only at the cases where treatment was actually delivered. In contrast, Broockman and Kalla estimate the average treatment effect of compliers (adjusting for compliance rates). They also include many covariates; we will only include a few. For these reasons and others, our estimates may differ slightly.

Next, let's see if the attitudes in the treatment and placebo changed after the treatment was administered and for how long these differences lasted. Perform four difference-in-means calculations—one for each wave ($t = 1, 2, 3, 4$). When performing each test, remove any NAs in that wave. (These NAs might arise from participants failing to complete different waves of the surveys—a process that social scientists call "attrition"—or for other reasons.) For example, for wave 1, use all cases that don't have missing outcome data in wave 1, and in wave 2, use all cases that don't have missing outcome data in wave 2 (in the `t.test()` function, you can accomplish this with the `na.action = na.omit` argument). Construct 95% confidence intervals for your estimates. At each stage, do we reject or retain the null hypothesis that no difference between the two groups exists? You are welcome to use `t.test()` to calculate these differences and the confidence intervals, but pick one comparison and calculate the estimates by hand (the techniques in Section 7.1 of *QSS* may be helpful).

Answer 3

```
# the t-tests
(t1p <- t.test(trans$therm_trans_t1[trans$treat_ind==1],
             trans$therm_trans_t1[trans$treat_ind==0],
             na.action = na.omit))
```

```
##
##  Welch Two Sample t-test
##
## data:  trans$therm_trans_t1[trans$treat_ind == 1] and trans$therm_trans_t1[trans$treat_ind == 0]
## t = 2.9164, df = 568.86, p-value = 0.00368
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   2.205931 11.305629
## sample estimates:
## mean of x mean of y
##  60.80756  54.05178
```

```
t.test(trans$therm_trans_t2[trans$treat_ind==1], trans$therm_trans_t2[trans$treat_ind==0],
       na.action = na.omit)
```

```
##
##  Welch Two Sample t-test
##
## data:  trans$therm_trans_t2[trans$treat_ind == 1] and trans$therm_trans_t2[trans$treat_ind == 0]
## t = 1.9, df = 564.04, p-value = 0.05795
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.1517094  9.1286473
## sample estimates:
## mean of x mean of y
##  59.06294  54.57447
```

```
t.test(trans$therm_trans_t3[trans$treat_ind==1], trans$therm_trans_t3[trans$treat_ind==0],
       na.action = na.omit)
```

```
##
##  Welch Two Sample t-test
##
## data:  trans$therm_trans_t3[trans$treat_ind == 1] and trans$therm_trans_t3[trans$treat_ind == 0]
## t = 2.7234, df = 559.97, p-value = 0.006662
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##   1.736922 10.724053
## sample estimates:
## mean of x mean of y
##  58.73571  52.50523
```

```
t.test(trans$therm_trans_t4[trans$treat_ind==1], trans$therm_trans_t4[trans$treat_ind==0],
       na.action = na.omit)
```

```
##
##  Welch Two Sample t-test
##
## data:  trans$therm_trans_t4[trans$treat_ind == 1] and trans$therm_trans_t4[trans$treat_ind == 0]
## t = 1.9044, df = 371.67, p-value = 0.05762
```

```
## alternative hypothesis: true difference in means is not equal to 0
## 95 percent confidence interval:
##  -0.172306 10.770451
## sample estimates:
## mean of x mean of y
##  58.72626  53.42718
```

```
## one by hand, compare t1 treatment vs. control
t1 <- subset(trans, subset = !is.na(therm_trans_t1))
t1t <- subset(t1, treat_ind == 1)
t1c <- subset(t1, treat_ind == 0)

est <- mean(t1t$therm_trans_t1) - mean(t1c$therm_trans_t1)
treatSE <- var(t1t$therm_trans_t1) / length(t1t$therm_trans_t1)
controlSE <- var(t1c$therm_trans_t1) / length(t1c$therm_trans_t1)
se <- sqrt(treatSE + controlSE)

## 95% confidence interval
c(est - (se * 1.96), est + (se * 1.96))
```

```
## [1]  2.215528 11.296032
```

After treatment, we see a jump in feeling thermometer scores of 6.76, and with a p-value of 0.004 we reject the null that no difference exists. At the second follow up, the treatment effect diminishes a bit and is no longer statistically significant, but it is significant again at the 3rd follow up. Finally, at the fourth follow-up, the results just miss conventional levels of statistical significance, so we cannot reject the null hypothesis. But, it is worth noting that even at fourth follow-up, the difference in feeling thermometer scores is still relatively large.

Question 4

Let's focus on the difference-in-means test at time $t = 1$. If the null hypothesis is that there is no difference between the groups, what would it mean to make a type I error? What would it mean to make a type II error? If we did something to increase the statistical power of the study, would we increase or decrease the probability of a type II error?

Answer 4

In the context of this problem, if we commit a type I error we would incorrectly conclude that there is an effect of a difference between the two groups where there is not a difference (i.e., rejecting the null hypothesis when it is true). In other words, a type I error is like a false positive. In this case, a type I error would mean we conclude that the treatment and placebo groups differ in their feelings towards transgender people three days after the initial treatment when there is no difference.

In the context of this problem, if we commit a type II error we would incorrectly fail to conclude there is a true difference between the groups when there is a difference (i.e., failing to reject the null hypothesis when it is false). In other words, a type II error is like a false negative. In this case, a type II error would mean we conclude that the treatment and placebo groups do not differ in their feelings towards transgender people three days after the initial treatment when in fact there is a difference. If we increased the power of the study we would decrease the probability of type II error.

Question 5

Finally, let's approximate the estimation strategy used by Broockman and Kalla in their analysis. To estimate the average treatment effect, they use a regression framework. Regress the feeling thermometer dependent variable (measure at time $t = 3$) on treatment assignment. To further alleviate concerns of imbalances

between treatment and control groups, adjust for an individual's feeling thermometer scores at time $t = 0$, her age, gender, race, and political party. Further, to account for possible differences between the more than 50 canvassers, please include in your model a fixed effect (i.e., dummy variable) for each canvasser. What is the estimated treatment effect (be sure to mention units)? Is this estimate statistically significant at the 0.05 level? Conduct the same analysis for surveys three months after treatment ($t = 4$) and compare the effects and statistical significance. Provide a substantive interpretation of the results.

Answer 5

```
## estimating thermometer t=3
therm.ate3 <- lm(trans$therm_trans_t3~trans$treat_ind + trans$therm_trans_t0 +
                   trans$vf_age + trans$vf_racename + trans$vf_female +
                   trans$vf_democrat + factor(trans$canvasser_id))

summary(therm.ate3)
```

```
##
## Call:
## lm(formula = trans$therm_trans_t3 ~ trans$treat_ind + trans$therm_trans_t0 +
##     trans$vf_age + trans$vf_racename + trans$vf_female + trans$vf_democrat +
##     factor(trans$canvasser_id))
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.221 -10.050  -0.223   9.071  78.142
##
## Coefficients:
##                                Estimate Std. Error t value Pr(>|t|)
## (Intercept)                    27.82415   12.53682   2.219  0.02714 *
## trans$treat_ind                 5.72587    2.16235   2.648  0.00848 **
## trans$therm_trans_t0            0.60871    0.04038  15.076  < 2e-16 ***
## trans$vf_age                   -0.14653    0.06877  -2.131  0.03384 *
## trans$vf_racenameAsian         15.61608   12.24680   1.275  0.20316
## trans$vf_racenameCaucasian      4.45887    3.98614   1.119  0.26412
## trans$vf_racenameHispanic       3.85934    3.43961   1.122  0.26266
## trans$vf_female                 5.78262    2.22011   2.605  0.00961 **
## trans$vf_democrat               2.24058    2.47712   0.905  0.36638
## factor(trans$canvasser_id)2   -12.80378   13.43151  -0.953  0.34115
## factor(trans$canvasser_id)3    -8.18123   13.82315  -0.592  0.55435
## factor(trans$canvasser_id)4   -12.83483   12.40667  -1.035  0.30165
## factor(trans$canvasser_id)5    -6.58821   12.55680  -0.525  0.60016
## factor(trans$canvasser_id)6     2.58312   13.78436   0.187  0.85147
## factor(trans$canvasser_id)7   -11.19595   18.31853  -0.611  0.54150
## factor(trans$canvasser_id)8    -8.61693   12.35697  -0.697  0.48608
## factor(trans$canvasser_id)9   -16.68449   16.42500  -1.016  0.31046
## factor(trans$canvasser_id)10 -23.10029   18.14525  -1.273  0.20388
## factor(trans$canvasser_id)11  14.49494   23.00829   0.630  0.52914
## factor(trans$canvasser_id)12   4.36242   22.58611   0.193  0.84696
## factor(trans$canvasser_id)13  -7.11176   15.41529  -0.461  0.64485
## factor(trans$canvasser_id)14  -9.55663   12.91529  -0.740  0.45985
## factor(trans$canvasser_id)15 -49.49333   18.10440  -2.734  0.00660 **
## factor(trans$canvasser_id)16   1.55882   15.26688   0.102  0.91874
## factor(trans$canvasser_id)17 -20.62140   15.36513  -1.342  0.18048
## factor(trans$canvasser_id)18  19.80292   22.79805   0.869  0.38568
```

```
## factor(trans$canvasser_id)19  -3.17007   12.69017  -0.250  0.80289
## factor(trans$canvasser_id)20   6.06910   14.64836   0.414  0.67891
## factor(trans$canvasser_id)21 -14.89250   17.92385  -0.831  0.40664
## factor(trans$canvasser_id)22  -6.94841   13.01973  -0.534  0.59392
## factor(trans$canvasser_id)23 -11.08474   17.96392  -0.617  0.53762
## factor(trans$canvasser_id)24  -8.51676   17.90501  -0.476  0.63463
## factor(trans$canvasser_id)25  -5.97541   14.67016  -0.407  0.68404
## factor(trans$canvasser_id)26   2.20306   14.03568   0.157  0.87537
## factor(trans$canvasser_id)28  -6.19404   16.40538  -0.378  0.70600
## factor(trans$canvasser_id)29   4.13013   18.12193   0.228  0.81986
## factor(trans$canvasser_id)30  -8.00078   16.34369  -0.490  0.62479
## factor(trans$canvasser_id)31  -7.51387   12.43126  -0.604  0.54597
## factor(trans$canvasser_id)32  -6.27350   14.64805  -0.428  0.66872
## factor(trans$canvasser_id)33 -10.37436   18.15207  -0.572  0.56803
## factor(trans$canvasser_id)34   0.80605   18.22757   0.044  0.96475
## factor(trans$canvasser_id)35  -7.65358   12.51504  -0.612  0.54125
## factor(trans$canvasser_id)36 -14.68915   22.78088  -0.645  0.51950
## factor(trans$canvasser_id)37   3.05952   13.93007   0.220  0.82629
## factor(trans$canvasser_id)38 -16.09578   13.88110  -1.160  0.24707
## factor(trans$canvasser_id)39  -7.98823   12.47068  -0.641  0.52225
## factor(trans$canvasser_id)40   2.19597   13.09091   0.168  0.86688
## factor(trans$canvasser_id)41   7.18245   18.13194   0.396  0.69227
## factor(trans$canvasser_id)42  -9.02301   14.03448  -0.643  0.52072
## factor(trans$canvasser_id)43  -5.13485   12.78902  -0.402  0.68831
## factor(trans$canvasser_id)44  -6.20969   12.34677  -0.503  0.61534
## factor(trans$canvasser_id)45  -4.01981   13.23160  -0.304  0.76147
## factor(trans$canvasser_id)46 -16.29136   13.25034  -1.230  0.21975
## factor(trans$canvasser_id)47  -5.02679   15.07838  -0.333  0.73906
## factor(trans$canvasser_id)49  -8.24025   12.80451  -0.644  0.52032
## factor(trans$canvasser_id)50  -2.88157   14.76439  -0.195  0.84538
## factor(trans$canvasser_id)51   1.34668   13.56017   0.099  0.92095
## factor(trans$canvasser_id)52 -11.11579   12.57676  -0.884  0.37742
## factor(trans$canvasser_id)53  -3.29082   18.21361  -0.181  0.85673
## factor(trans$canvasser_id)54  -7.08443   16.34065  -0.434  0.66490
## factor(trans$canvasser_id)55   2.97081   14.52154   0.205  0.83803
## factor(trans$canvasser_id)56  -1.96280   13.34512  -0.147  0.88316
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 19.5 on 332 degrees of freedom
##   (1431 observations deleted due to missingness)
## Multiple R-squared:  0.5413, Adjusted R-squared:  0.4571
## F-statistic: 6.423 on 61 and 332 DF,  p-value: < 2.2e-16
```

```
## t=4
therm.ate4 <- lm(trans$therm_trans_t4~trans$treat_ind + trans$therm_trans_t0 +
                   trans$vf_age + trans$vf_racename + trans$vf_female +
                   trans$vf_democrat + factor(trans$canvasser_id))
summary(therm.ate4)
```

```
##
## Call:
## lm(formula = trans$therm_trans_t4 ~ trans$treat_ind + trans$therm_trans_t0 +
##     trans$vf_age + trans$vf_racename + trans$vf_female + trans$vf_democrat +
##     factor(trans$canvasser_id))
```

```
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -55.48 -10.07  -0.20  10.24  51.07
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)                   28.67281   10.36111   2.767  0.00599 **
## trans$treat_ind                4.51476    2.30751   1.957  0.05130 .
## trans$therm_trans_t0           0.65616    0.04287  15.304  < 2e-16 ***
## trans$vf_age                  -0.03560    0.07188  -0.495  0.62080
## trans$vf_racenameAsian        -7.99270   12.72814  -0.628  0.53050
## trans$vf_racenameCaucasian    -0.60572    4.10724  -0.147  0.88285
## trans$vf_racenameHispanic     -2.17873    3.58886  -0.607  0.54424
## trans$vf_female                3.49229    2.34967   1.486  0.13822
## trans$vf_democrat              0.38190    2.59292   0.147  0.88300
## factor(trans$canvasser_id)2  -32.57760   11.86439  -2.746  0.00639 **
## factor(trans$canvasser_id)3   -8.17730   12.11938  -0.675  0.50035
## factor(trans$canvasser_id)4  -17.27679   10.39594  -1.662  0.09755 .
## factor(trans$canvasser_id)5   -6.80529   10.39528  -0.655  0.51318
## factor(trans$canvasser_id)6   -8.17502   12.07019  -0.677  0.49873
## factor(trans$canvasser_id)7    1.48855   17.25695   0.086  0.93132
## factor(trans$canvasser_id)8   -9.91062   10.40580  -0.952  0.34163
## factor(trans$canvasser_id)9   -0.28181   17.22547  -0.016  0.98696
## factor(trans$canvasser_id)10 -18.68666   17.08214  -1.094  0.27484
## factor(trans$canvasser_id)11  -1.54314   22.33757  -0.069  0.94497
## factor(trans$canvasser_id)12  29.74527   21.92584   1.357  0.17589
## factor(trans$canvasser_id)13  19.52045   15.14513   1.289  0.19840
## factor(trans$canvasser_id)14  -8.06592   11.11685  -0.726  0.46866
## factor(trans$canvasser_id)15 -11.28963   17.07325  -0.661  0.50895
## factor(trans$canvasser_id)16   7.20024   15.01114   0.480  0.63181
## factor(trans$canvasser_id)17  -9.63452   13.92911  -0.692  0.48965
## factor(trans$canvasser_id)18  34.65840   22.18902   1.562  0.11932
## factor(trans$canvasser_id)19  -5.85545   10.69360  -0.548  0.58438
## factor(trans$canvasser_id)20  -9.10462   13.11025  -0.694  0.48791
## factor(trans$canvasser_id)21  12.77432   22.27093   0.574  0.56666
## factor(trans$canvasser_id)22 -12.52634   11.12411  -1.126  0.26101
## factor(trans$canvasser_id)23 -20.08055   16.80357  -1.195  0.23299
## factor(trans$canvasser_id)24 -13.46830   16.78949  -0.802  0.42306
## factor(trans$canvasser_id)25   2.50551   15.02770   0.167  0.86769
## factor(trans$canvasser_id)26  -6.21565   11.96636  -0.519  0.60383
## factor(trans$canvasser_id)27  16.63792   22.31522   0.746  0.45648
## factor(trans$canvasser_id)28  -0.84080   13.71540  -0.061  0.95116
## factor(trans$canvasser_id)29  29.11435   17.01538   1.711  0.08807 .
## factor(trans$canvasser_id)30  -5.35433   17.17059  -0.312  0.75538
## factor(trans$canvasser_id)31 -15.68492   10.40512  -1.507  0.13272
## factor(trans$canvasser_id)32 -13.22136   13.08283  -1.011  0.31300
## factor(trans$canvasser_id)33 -17.00054   17.16959  -0.990  0.32287
## factor(trans$canvasser_id)34   8.23787   22.44232   0.367  0.71382
## factor(trans$canvasser_id)35  -7.77747   10.71611  -0.726  0.46853
## factor(trans$canvasser_id)36  16.86233   22.18860   0.760  0.44786
## factor(trans$canvasser_id)37   8.33456   12.23167   0.681  0.49613
## factor(trans$canvasser_id)38 -14.59941   12.15681  -1.201  0.23070
## factor(trans$canvasser_id)39   0.04770   10.51373   0.005  0.99638
```

```
## factor(trans$canvasser_id)40  -0.66996   11.24142  -0.060  0.95251
## factor(trans$canvasser_id)41  -7.05839   17.09535  -0.413  0.67998
## factor(trans$canvasser_id)42  -1.79537   14.17376  -0.127  0.89928
## factor(trans$canvasser_id)43 -13.12117   10.91575  -1.202  0.23027
## factor(trans$canvasser_id)44  -2.32768   10.34129  -0.225  0.82206
## factor(trans$canvasser_id)45  -9.26721   11.14157  -0.832  0.40618
## factor(trans$canvasser_id)46 -18.44245   11.41426  -1.616  0.10717
## factor(trans$canvasser_id)47 -11.13626   12.77672  -0.872  0.38410
## factor(trans$canvasser_id)48  42.14590   22.25471   1.894  0.05918 .
## factor(trans$canvasser_id)49  -2.39979   10.84487  -0.221  0.82502
## factor(trans$canvasser_id)50  -0.50614   12.66727  -0.040  0.96815
## factor(trans$canvasser_id)51   6.80286   12.09005   0.563  0.57406
## factor(trans$canvasser_id)52 -10.07330   10.70080  -0.941  0.34725
## factor(trans$canvasser_id)53 -31.19789   22.30299  -1.399  0.16287
## factor(trans$canvasser_id)54 -10.05481   17.11208  -0.588  0.55724
## factor(trans$canvasser_id)55 -12.26216   13.65576  -0.898  0.36991
## factor(trans$canvasser_id)56 -16.25048   12.14990  -1.337  0.18204
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 19.95 on 310 degrees of freedom
##   (1451 observations deleted due to missingness)
## Multiple R-squared:  0.5556, Adjusted R-squared:  0.4653
## F-statistic: 6.153 on 63 and 310 DF,  p-value: < 2.2e-16
```

Holding all our controls constant and adding fixed effects, the coefficient on the $t = 3$ treatment indicator variable is 5.73. This means that our estimated treatment effect is an increase of 5.73 points on the feeling thermometer scale six weeks after treatment. Our p-value on this coefficient is well below 0.05, so statistical significance holds. Substantively, this means that treated subjects claimed to be, on average, 5.73 points on the feeling thermometer higher than the control group even six weeks after receiving the treatment. The effects of the perspective taking exercise were large and persisted several weeks after treatment.

Survey 4 was administered 3 months after the treatment. Surprisingly, the treatment effect estimate is still quite large at 4.51. Although the $t = 4$ analysis loses its statistical significance, the p-value is only barely larger than 0.05 at 0.051, which is impressive given the length of time that passed. Our results imply that the perspective-taking treatment causes people to have more positive feelings about transgender individuals immediately after treatment and at least up to six weeks after receiving treatment.