Data Analytics CA Pair Project - VR Jungian Sandplay

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Contents

Abstract

Aim and Rationale

The aim and rationale of this project is to formulate a single hypothesis based on a set of data we were given on an experiment conducted to attempt to determine the effectiveness of use of VR technology in Jungian Sandbox therapy, comparing the effectiveness of the approaches based on the data we were provided, and cleaning up any data that requires cleanup.

Participants and setting

Participants of this experiment were psychotherapy patients undergoing treatment for PTSD, aged between 18 - 25 years old with no exact ages of the participants recorded. 150 participants were recorded in this study with an equal amount of male and female participants recorded. (Male = 75 / Female = 75) Participants were broken into 3 groups using random sampling.These groups were Control (traditional CBT, w/ No VR), Static (Non-animated model content, w/ VR), Animated (Animated model content, w/ VR)

Experiment design

Each patient spent 50 minutes per week for 12 weeks with a therapist, under three testing groups:

Control: Undergoing traditional CBT with a therapist

Static: Using the VR app with non-animated model content

Animated: Using the VR app with animated content.

Results gathering

Results were tracked in an excel spreadsheet detailing the gender and test group of each participant (Control, Static, Animated) along with their CPSS (Child PTSD Symptom Scale) and OR (Observer Rating) pre and post treatment.

Major findings

We found that the average PTSD rating for each testing group decreased after treatment.

Findings/Implecations

Introduction

Topic and context

Rationale

The Rationale behind this experiment was to determine if using VR technology in a Jungian Sandbox setting could be beneficial in reducing the PTSD levels in patients.

Hypothesis

Method

Participants

Participants of this experiment were young adults aged between 18 - 25 years old with no exact ages of the participants recorded. 150 participants were recorded in this study with an equal amount of male and female participants recorded. (Male = 75 / Female = 75) Participants were broken into 3 groups using random sampling. These groups were Control (traditional CBT, w/ No VR), Static (Non-animated model content, w/ VR), Animated (Animated model content, w/ VR)

Design

Upon first analysis of the data, a missing datum was found for participant 100 in their Pre-Trial Self Reported CPSS. Between the group, we discussed our options. Between ourselves, two conflicting ideas emerged - one, that we ignore the missing data and calculate results without it (deletion), and the other that we replace the missing data with a suitable value and proceed with an adjusted dataset (imputation).

First we analysed the missing datum to be Missing Completely at Random (MCAR), as being the sole unrecorded datum in the set, we can conclude that it being missing has nothing to do with any other observed variables (data Missing at Random), or missing due to the values themselves (Missing Not at Random).

We then discussed how we could impute the missing datum. Based on research, we decided to use the mean of all Pre-Trial Self Reported CPSS values as the missing datum.

Materials

Procedure

Results

Table 1: Patient Data

X	gender	test_group	pre_trial_cpss	post_trial_cpss	pre_trial_or	post_trial_or
1	Male	Static	4.54	5.77	4.48	5.95

X	gender	test_group	pre_trial_cpss	post_trial_cpss	pre_trial_or	post_trial_or
2	Male	Static	6.36	5.29	6.08	5.24
3	Male	Static	5.17	6.86	5.08	6.90
4	Male	Static	4.56	5.59	4.09	5.36
5	Male	Static	3.84	5.43	4.33	5.26
6	Male	Static	7.09	6.92	7.58	6.69
7	Male	Static	4.91	5.46	4.89	5.50
8	Male	Static	7.24	5.65	7.37	5.72
9	Male	Static	6.24	7.54	6.46	7.73
10	Male	Static	8.52	5.51	8.51	5.70
11	Male	Static	5.83	6.10	6.16	6.31
12	Male	Static	7.78	5.18	7.28	5.00
13	Male	Static	5.76	5.11	5.35	5.10
14	Male	Static	6.29	6.19	6.82	6.37
15	Male	Static	7.31	5.18	7.16	5.17
16	Male	Static	6.61	4.19	6.54	4.15
17	Male	Static	5.73	4.43	5.75	4.37
18	Male	Static	6.93	6.46	6.79	6.45
19	Male	Static	7.41	7.91	7.46	7.68
20	Male	Static	7.00	6.13	7.49	6.35
21	Male	Static	7.88	5.47	7.90	5.32
22	Male	Static	6.25	4.97	6.00	5.18
23	Male	Static	5.88	5.12	6.04	4.93
24	Male	Static	5.79	7.24	6.30	7.18
25	Male	Static	7.56	6.47	7.60	6.64
26	Female	Static	6.28	5.72	5.98	5.95
27	Female	Static	5.50	4.65	5.50	4.50
28	Female	Static	5.81	5.07	6.07	5.17
29	Female	Static	5.06	4.03	4.53	3.96
30	Female	Static	6.17	5.58	6.54	5.69
31	Female	Static	6.06	5.41	5.87	5.58
32	Female	Static	6.56	6.11	6.96	6.30
33	Female	Static	5.82	5.09	5.82	4.86
34	Female	Static	6.24	5.67	6.44	5.75
35	Female	Static	5.79	5.05	5.74	5.01
36	Female	Static	5.50	4.65	5.30	4.58
37	Female	Static	5.66	4.87	5.59	5.01
38	Female	Static	4.49	3.24	4.09	3.03
39	Female	Static	6.04	5.39	6.41	5.24
40	Female	Static	6.90	6.59	6.58	6.37
41	Female	Static	6.04	5.39	5.93	5.26
42	Female	Static	5.28	4.34	5.57	4.30
43	Female	Static	6.09	5.46	5.79	5.49
44	Female	Static	4.10	2.70	4.26	2.50
45	Female	Static	6.19	5.61	6.38	5.67
46	Female	Static	6.92	6.61	7.03	6.70
47	Female	Static	5.37	4.47	5.05	4.28
48	Female	Static	6.13	5.52	5.78	5.35
49	Female	Static	4.86	3.76	4.86	3.94
50	Female	Static	5.74	4.97	5.83	4.95
51	Male	Control	5.60	6.53	5.62	6.66
52	Male	Control	4.37	4.86	4.59	4.88
53	Male	Control	6.86	6.24	6.96	6.27

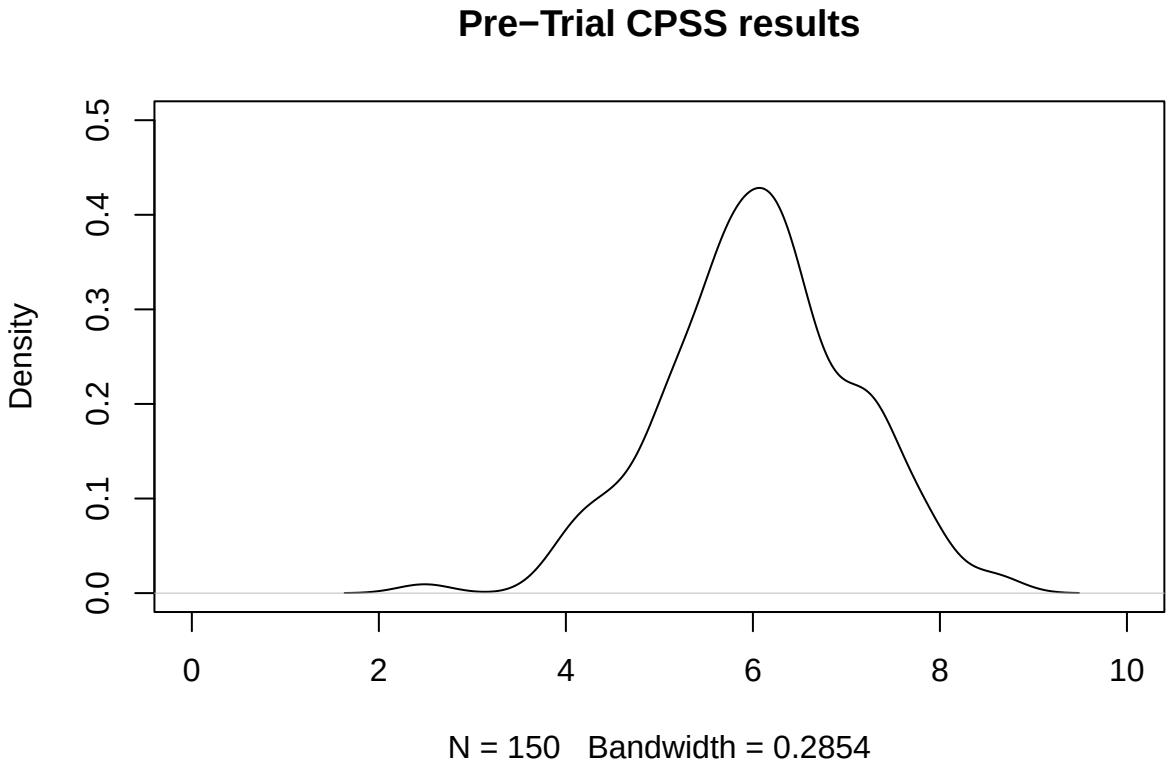
X	gender	test_group	pre_trial_cpss	post_trial_cpss	pre_trial_or	post_trial_or
54	Male	Control	4.97	5.52	4.95	5.75
55	Male	Control	7.40	5.21	7.06	5.45
56	Male	Control	6.66	6.87	7.18	7.08
57	Male	Control	6.17	5.10	6.17	5.13
58	Male	Control	7.24	5.82	7.46	5.61
59	Male	Control	8.00	5.61	8.34	5.49
60	Male	Control	6.30	6.20	6.42	6.25
61	Male	Control	7.23	4.41	6.89	4.46
62	Male	Control	5.73	3.62	5.25	3.69
63	Male	Control	7.90	6.32	7.88	6.23
64	Male	Control	4.93	5.98	5.09	6.14
65	Male	Control	5.09	4.42	4.97	4.59
66	Male	Control	4.03	5.19	4.02	5.02
67	Male	Control	5.37	6.05	5.21	6.12
68	Male	Control	7.85	4.87	7.70	4.80
69	Male	Control	6.65	5.76	7.11	5.69
70	Male	Control	5.56	5.93	6.07	5.71
71	Male	Control	6.83	7.04	7.29	7.25
72	Male	Control	6.21	4.75	6.44	4.58
73	Male	Control	5.75	6.19	6.07	6.17
74	Male	Control	6.06	6.64	5.76	6.67
75	Male	Control	6.75	5.23	7.25	5.35
76	Female	Control	5.14	4.14	5.28	4.04
77	Female	Control	6.45	5.96	6.11	5.95
78	Female	Control	5.03	3.99	5.24	3.90
79	Female	Control	6.33	5.80	6.03	5.68
80	Female	Control	4.66	3.48	5.04	3.51
81	Female	Control	6.20	5.61	6.30	5.57
82	Female	Control	5.68	4.90	5.24	5.01
83	Female	Control	5.02	3.98	5.12	3.94
84	Female	Control	5.74	4.98	5.33	5.20
85	Female	Control	7.27	7.10	7.79	7.16
86	Female	Control	6.73	6.35	6.67	6.35
87	Female	Control	5.57	4.73	5.25	4.94
88	Female	Control	6.49	6.01	6.48	5.82
89	Female	Control	5.50	4.65	6.05	4.45
90	Female	Control	7.10	6.86	7.02	6.88
91	Female	Control	6.16	5.56	6.47	5.65
92	Female	Control	5.17	4.19	4.86	4.05
93	Female	Control	5.89	5.19	6.16	5.02
94	Female	Control	6.47	5.99	6.46	5.87
95	Female	Control	2.49	0.48	2.97	0.25
96	Female	Control	4.18	2.82	4.04	2.71
97	Female	Control	5.30	4.36	5.53	4.16
98	Female	Control	7.64	7.61	7.50	7.54
99	Female	Control	5.93	5.24	6.30	5.11
100	Female	Control	6.06	6.17	7.00	6.30
101	Male	Animated	7.34	4.99	6.85	4.83
102	Male	Animated	6.32	6.18	6.48	6.35
103	Male	Animated	7.62	5.49	7.82	5.27
104	Male	Animated	5.11	6.36	4.75	6.14
105	Male	Animated	7.29	4.64	7.71	4.86

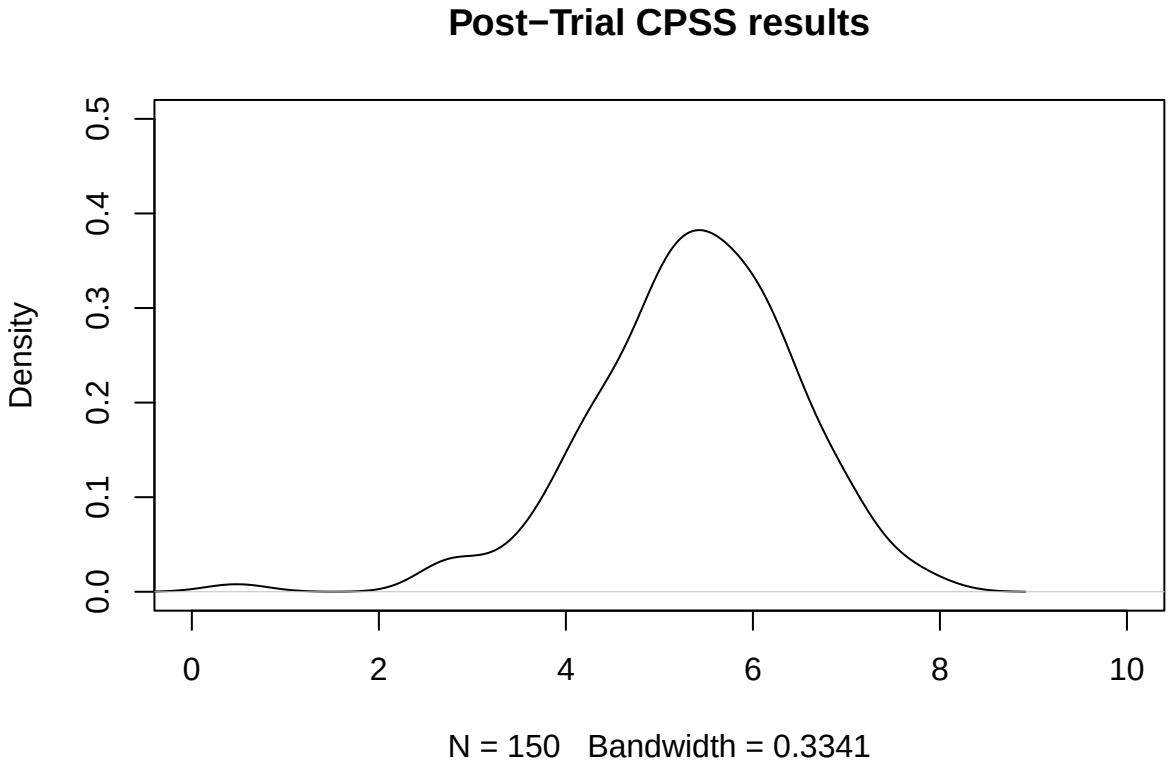
X	gender	test_group	pre_trial_cpss	post_trial_cpss	pre_trial_or	post_trial_or
106	Male	Animated	6.42	4.28	6.79	4.34
107	Male	Animated	6.50	4.29	7.03	4.08
108	Male	Animated	5.29	3.56	5.56	3.46
109	Male	Animated	6.42	6.05	6.84	6.05
110	Male	Animated	5.52	6.38	5.13	6.19
111	Male	Animated	5.59	5.11	5.83	5.35
112	Male	Animated	7.21	3.79	6.90	3.72
113	Male	Animated	5.61	6.79	5.73	6.83
114	Male	Animated	4.63	6.61	4.23	6.73
115	Male	Animated	5.87	6.56	5.60	6.57
116	Male	Animated	4.28	4.87	4.44	4.93
117	Male	Animated	6.10	4.88	5.94	4.98
118	Male	Animated	4.65	4.56	4.99	4.45
119	Male	Animated	8.63	6.13	8.74	5.99
120	Mal	Animated	7.18	6.45	7.22	6.69
121	Male	Animated	7.21	5.49	7.78	5.66
122	Male	Animated	7.83	3.90	8.37	3.65
123	Male	Animated	6.84	6.96	6.33	6.79
124	Male	Animated	5.77	5.82	6.02	5.90
125	Male	Animated	7.41	5.08	7.25	5.17
126	Female	Animated	5.40	4.50	4.99	4.49
127	Female	Animated	5.83	5.10	6.40	5.11
128	Female	Animated	5.87	5.15	5.87	5.22
129	Female	Animated	4.22	2.87	3.98	2.88
130	Female	Animated	5.74	4.98	5.45	5.21
131	Female	Animated	6.24	5.67	5.67	5.82
132	Female	Animated	6.63	6.21	6.33	6.43
133	Female	Animated	5.38	4.48	5.71	4.69
134	Female	Animated	5.96	5.29	6.23	5.34
135	Female	Animated	6.59	6.16	6.35	6.23
136	Female	Animated	6.34	5.80	6.83	5.72
137	Female	Animated	6.57	6.12	6.38	5.89
138	Female	Animated	7.33	7.17	6.81	7.01
139	Female	Animated	4.05	2.64	3.93	2.86
140	Female	Animated	7.22	7.02	7.20	6.80
141	Female	Animated	5.13	4.13	5.51	3.88
142	Female	Animated	5.22	4.26	5.41	4.24
143	Female	Animated	5.10	4.09	5.45	4.08
144	Female	Animated	6.40	5.90	6.62	5.69
145	Female	Animatd	6.51	6.05	7.05	5.89
146	Female	Animated	6.20	5.62	6.66	5.61
147	Female	Animated	5.98	5.31	6.26	5.23
148	Female	Animated	6.31	5.77	6.37	5.73
149	Female	Animated	5.61	4.80	5.95	4.91
150	Female	Animated	6.25	5.69	6.06	5.83

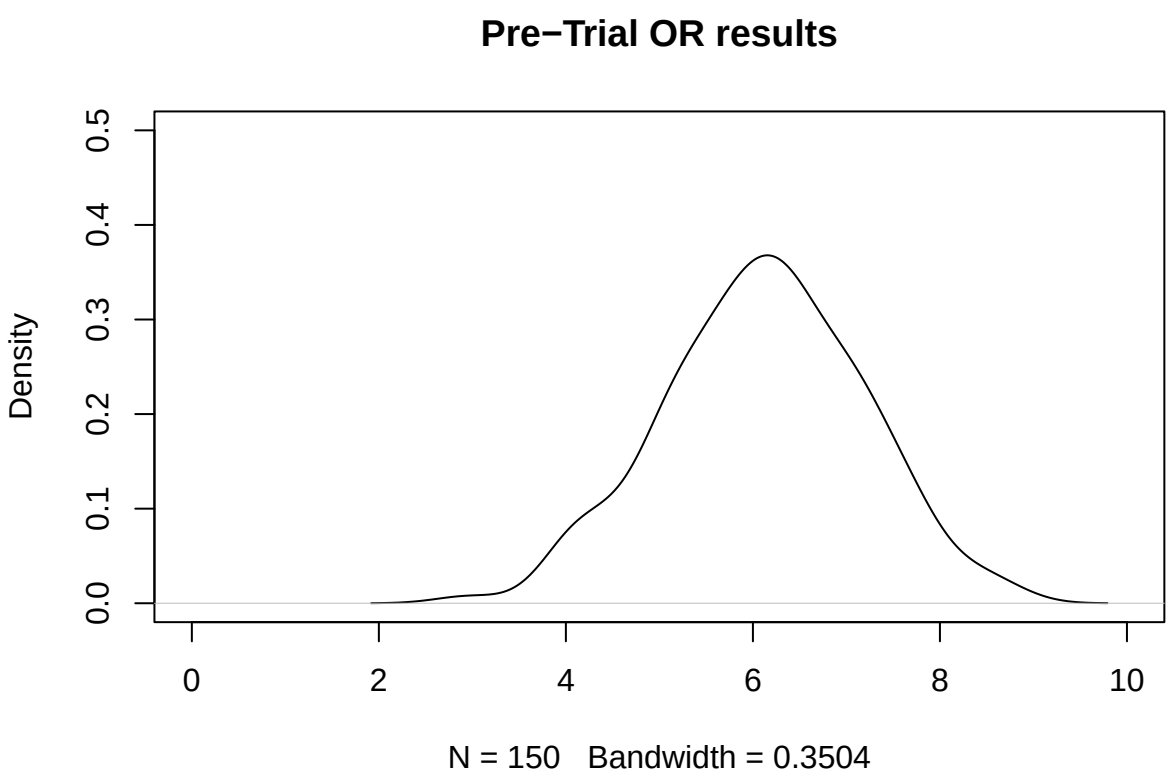
```
##        X              gender           test_group        pre_trial_cpss
##  Min.   :  1.00   Length:150         Length:150         Min.   :2.490
##  1st Qu.: 38.25   Class :character   Class :character   1st Qu.:5.500
##  Median : 75.50   Mode  :character   Mode  :character   Median :6.077
##  Mean   : 75.50                                         Mean   :6.063
##  3rd Qu.:112.75                                         3rd Qu.:6.657
```

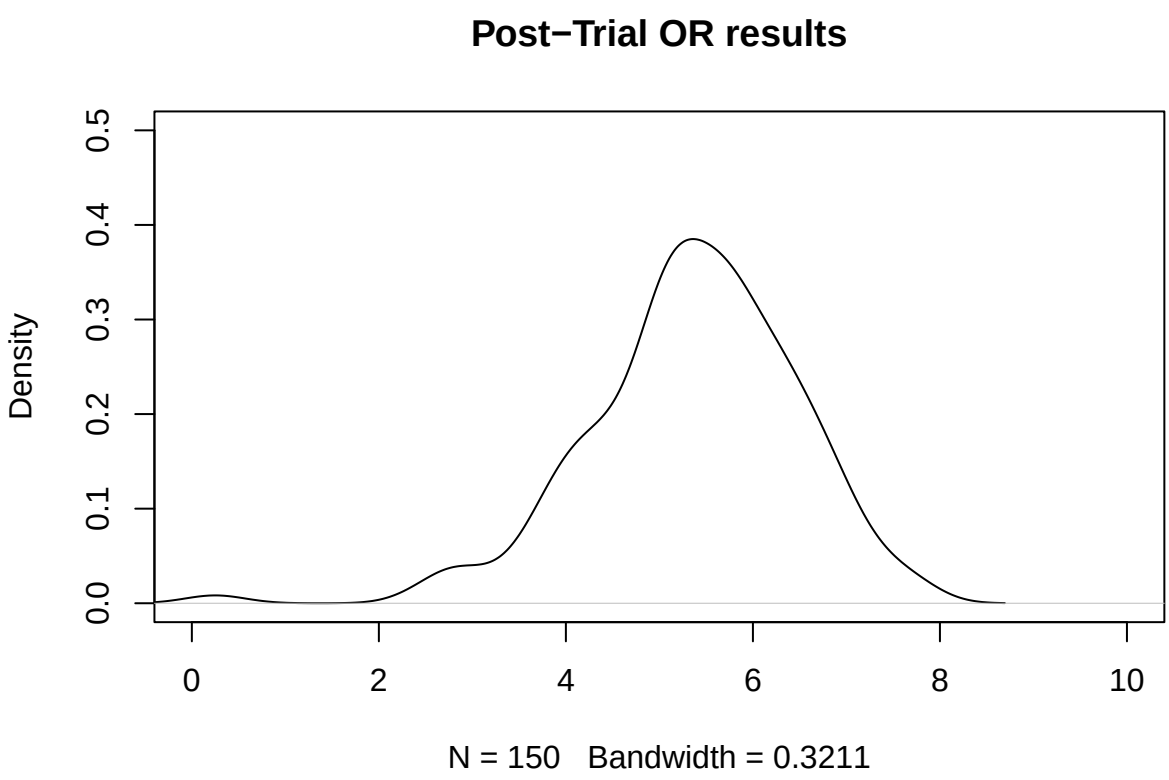
```
##  Max.   :150.00                                          Max.   :8.630
##  post_trial_cpss  pre_trial_or   post_trial_or
##  Min.   :0.480   Min.   :2.970   Min.   :0.250
##  1st Qu.:4.763   1st Qu.:5.420   1st Qu.:4.838
##  Median :5.460   Median :6.095   Median :5.355
##  Mean   :5.364   Mean   :6.115   Mean   :5.357
##  3rd Qu.:6.117   3rd Qu.:6.848   3rd Qu.:6.140
##  Max.   :7.910   Max.   :8.740   Max.   :7.730
```

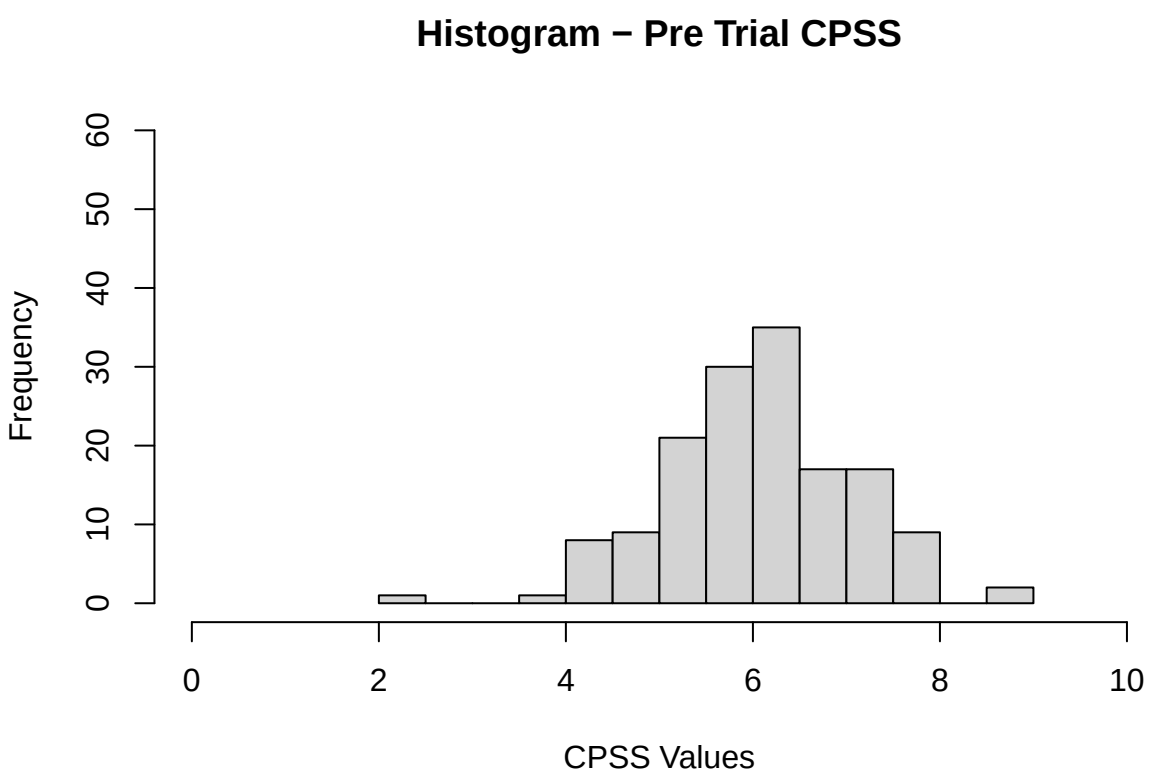
Graphs

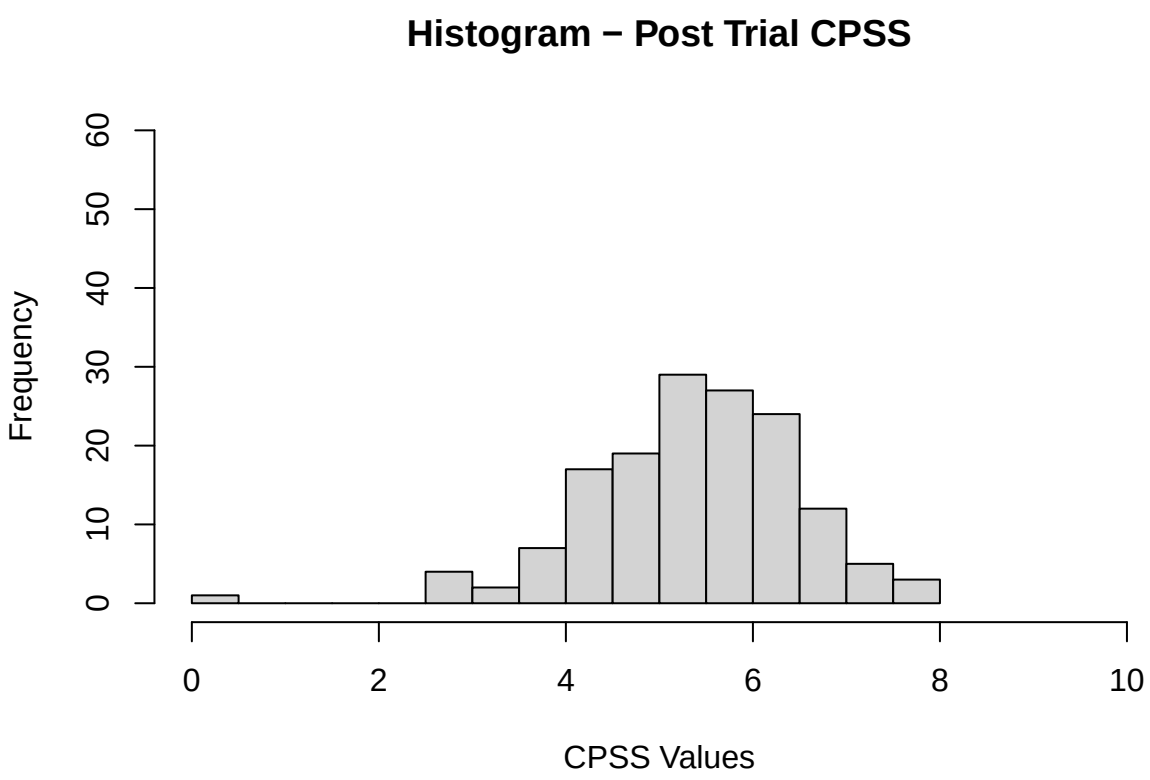

Pre−Trial CPSS results
Density
0.0
0.1
0.2
0.3
0.4
0.5
0
2
4
6
8
10
N = 150 Bandwidth = 0.2854

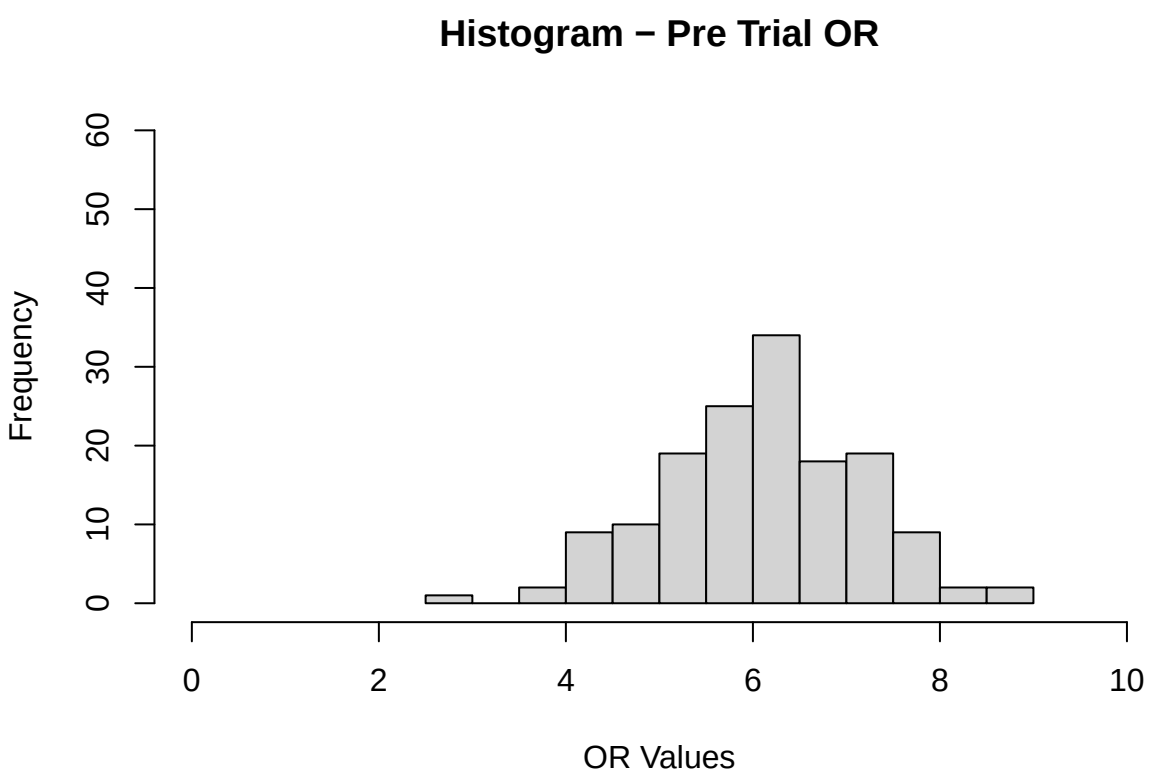

Post−Trial CPSS results
Density
0.0
0.1
0.2
0.3
0.4
0.5
0
2
4
6
8
10
N = 150 Bandwidth = 0.3341

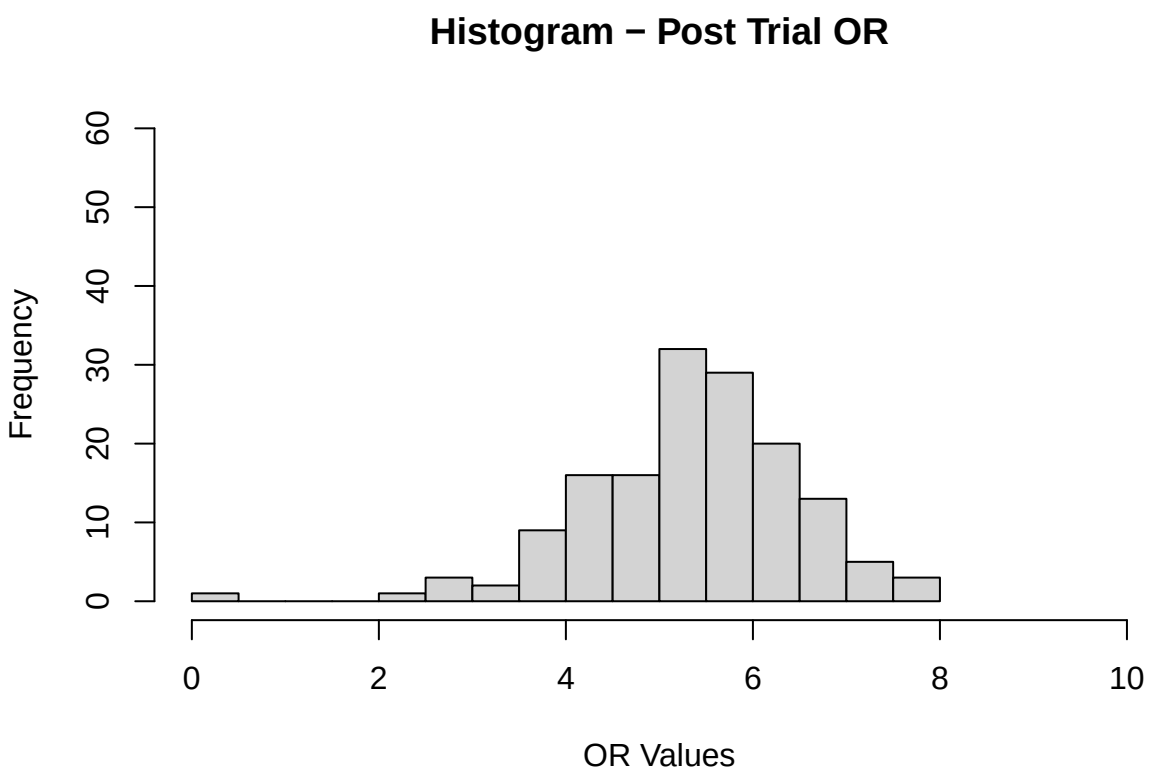

Pre−Trial OR results
Density
0.0
0.1
0.2
0.3
0.4
0.5
0
2
4
6
8
10
N = 150 Bandwidth = 0.3504

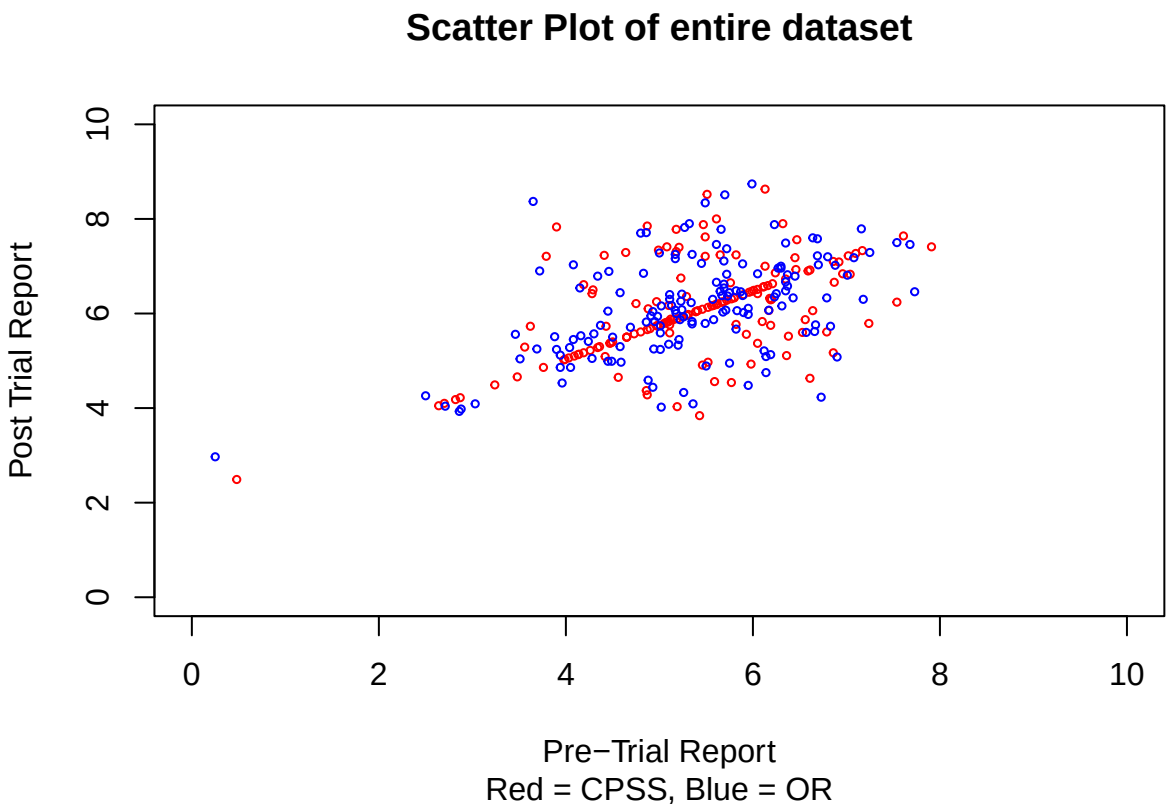

Post−Trial OR results
Density
0.0
0.1
0.2
0.3
0.4
0.5
0
2
4
6
8
10
N = 150 Bandwidth = 0.3211

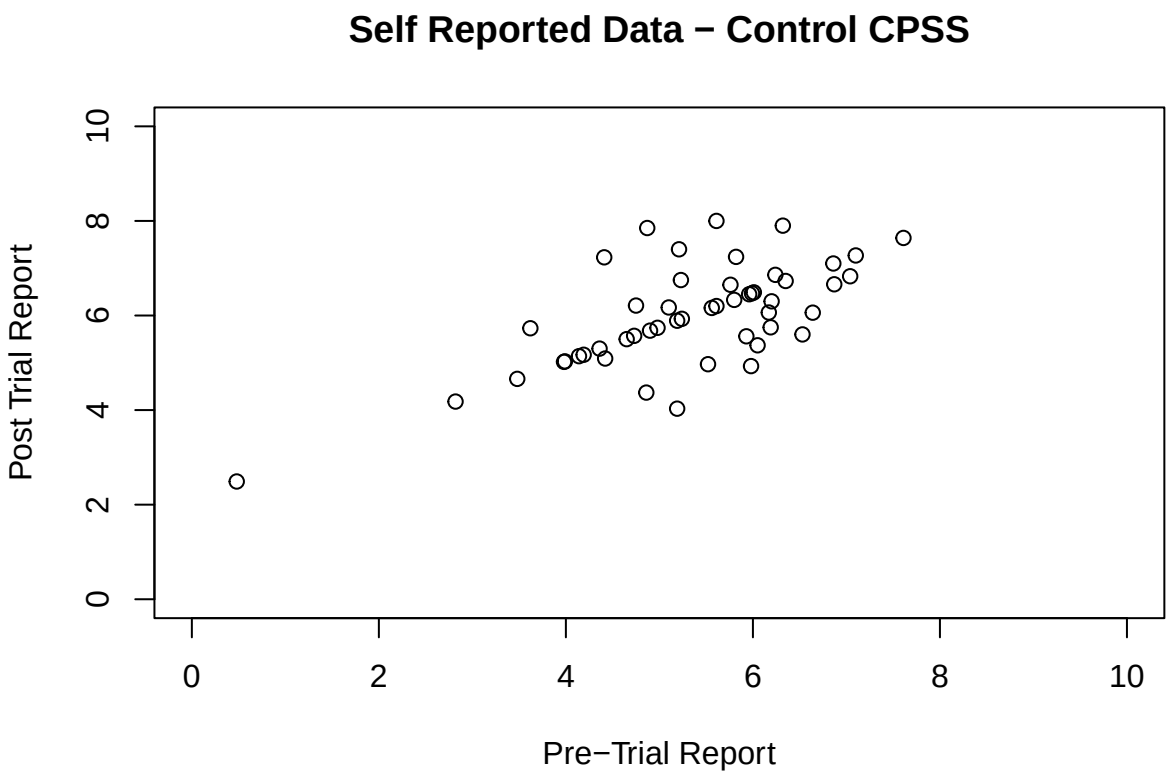

Histogram − Pre Trial CPSS
Frequency
0
10
20
30
40
50
60
0
2
4
6
8
10
CPSS Values

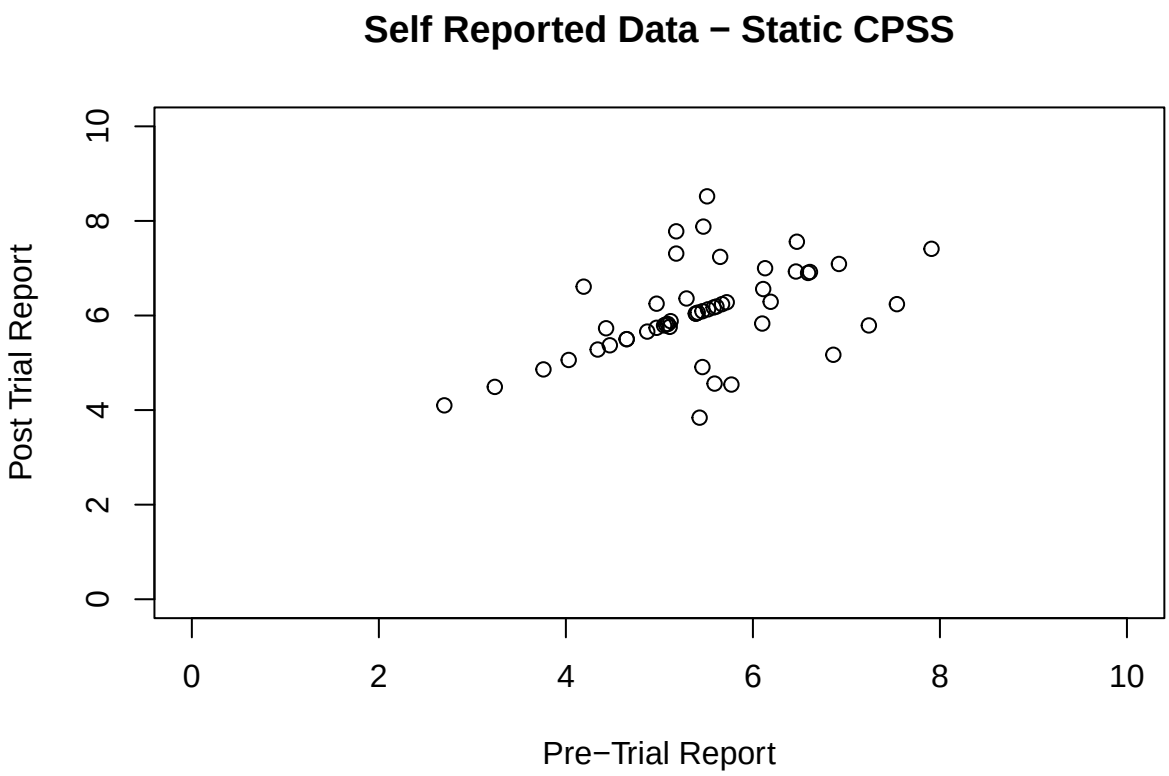

Histogram − Post Trial CPSS
Frequency
0
10
20
30
40
50
60
0
2
4
6
8
10
CPSS Values

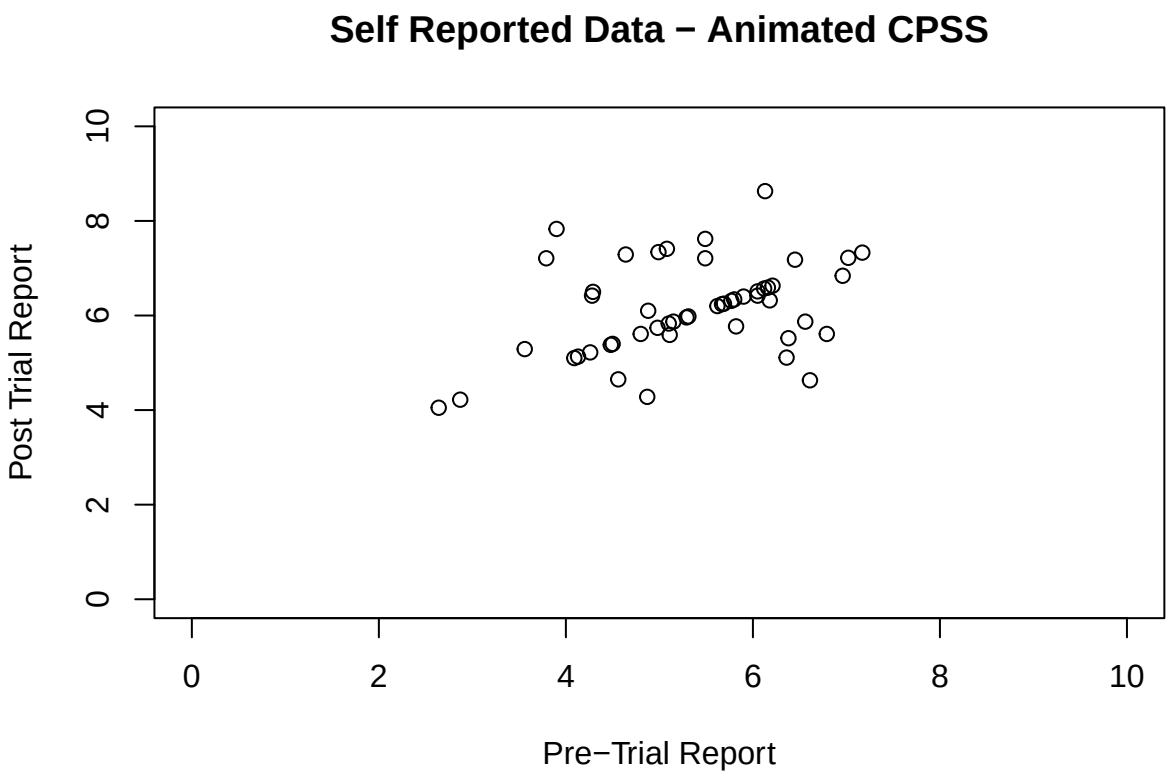

Histogram − Pre Trial OR
Frequency
0
10
20
30
40
50
60
0
2
4
6
8
10
OR Values

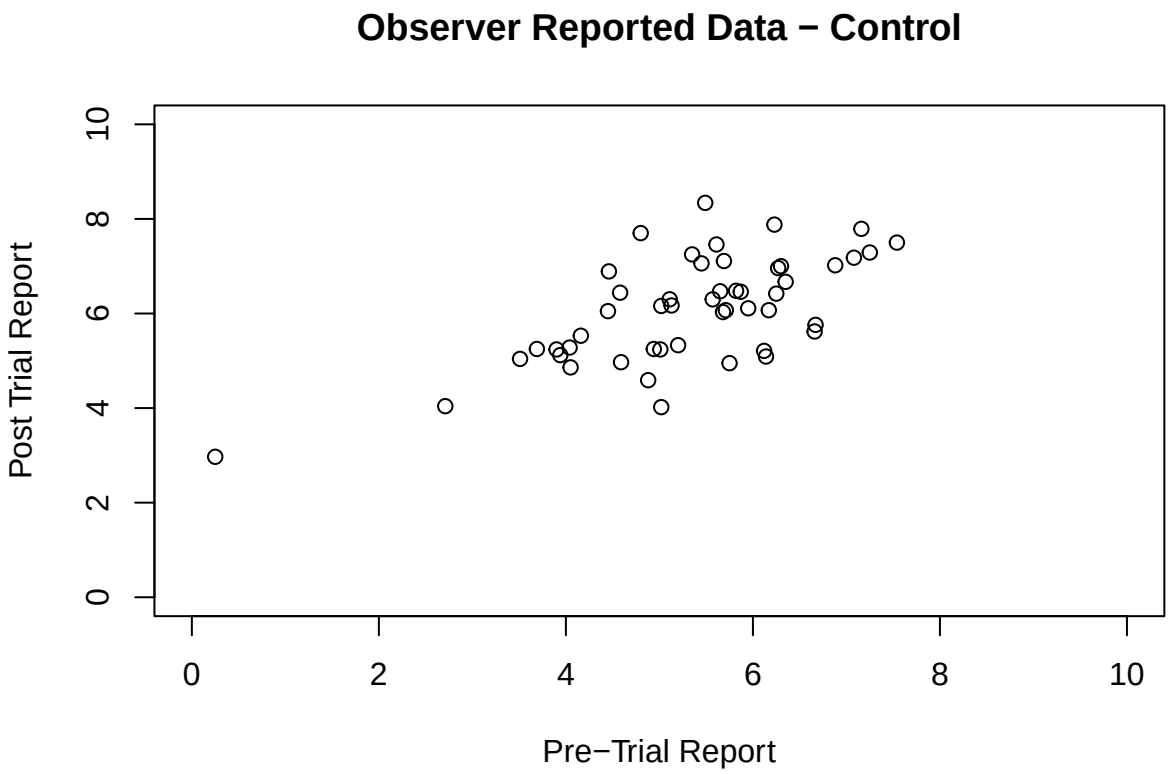

Histogram − Post Trial OR
Frequency
0
10
20
30
40
50
60
0
2
4
6
8
10
OR Values

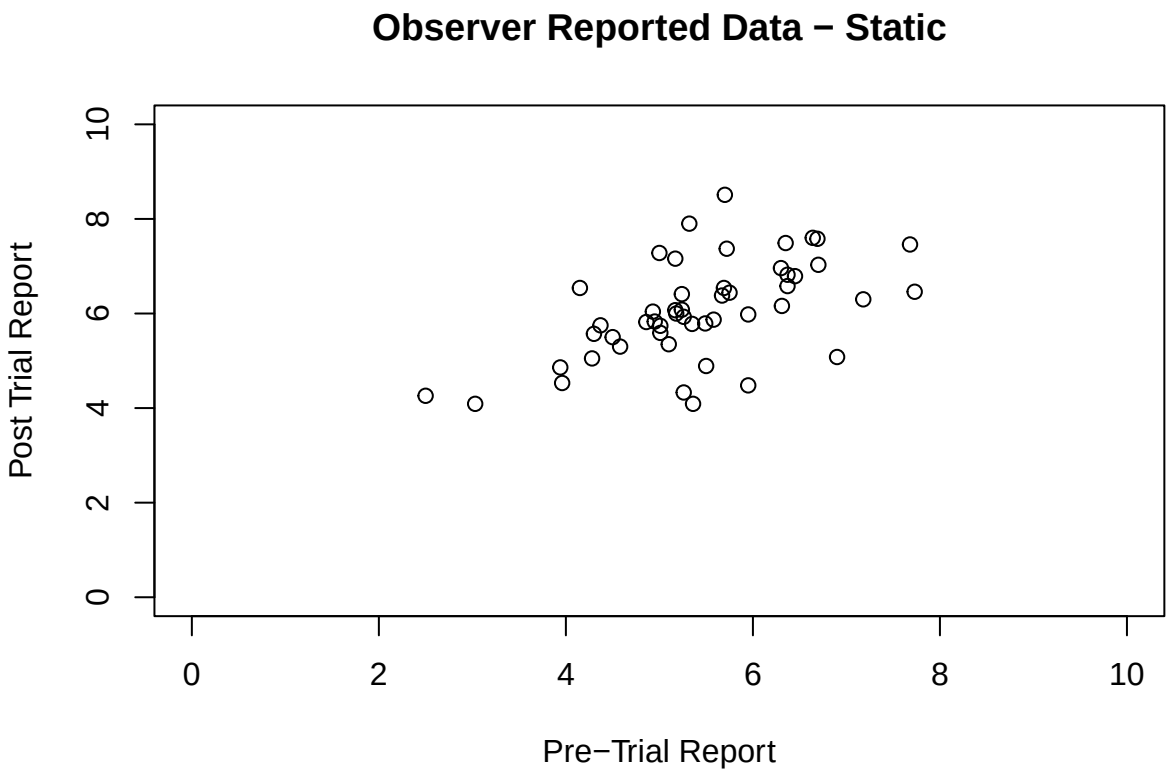

Scatter Plot of entire dataset
Post Trial Report
0
2
4
6
8
10
Pre−Trial Report
Red = CPSS, Blue = OR

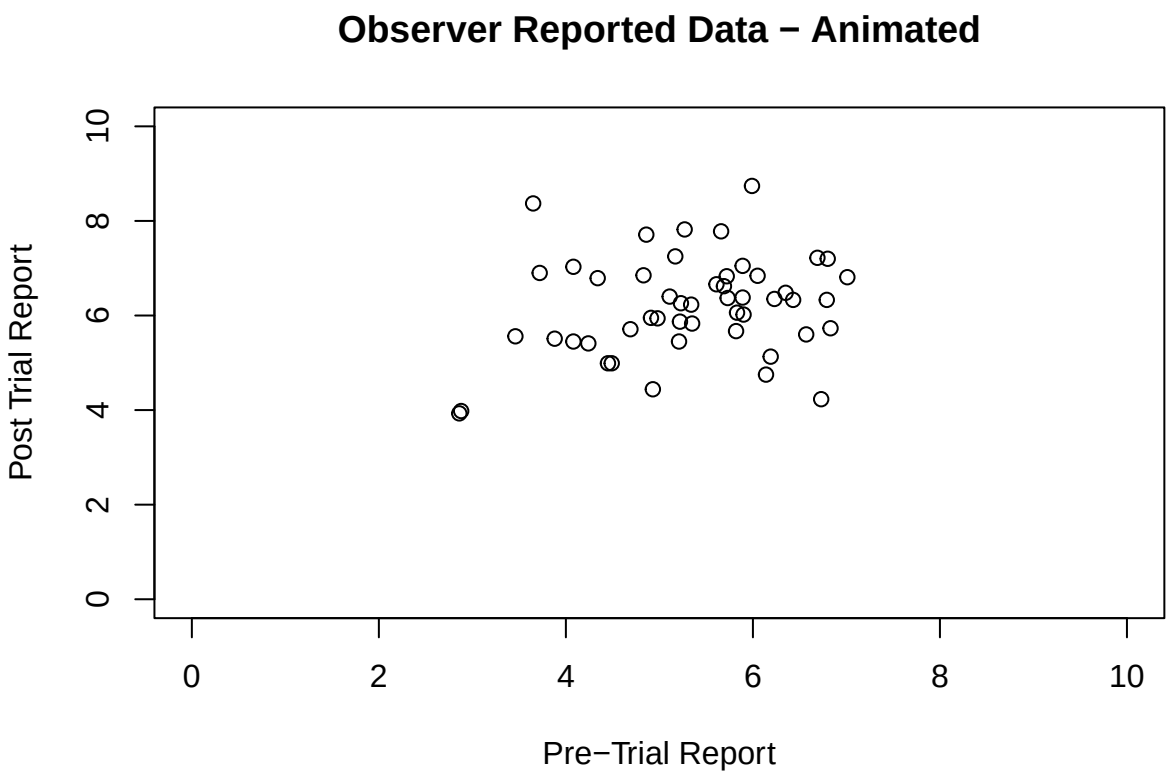

Self Reported Data − Control CPSS
Post Trial Report
Pre−Trial Report
0
2
4
6
8
10


Self Reported Data − Static CPSS
Post Trial Report
Pre−Trial Report
0
2
4
6
8
10


Self Reported Data − Animated CPSS
Post Trial Report
Pre−Trial Report
0
2
4
6
8
10


Observer Reported Data − Control
Post Trial Report
Pre−Trial Report
0
2
4
6
8
10


Observer Reported Data − Static
Post Trial Report
Pre−Trial Report
0
2
4
6
8
10



Descriptive statistics

Static Pre trial cpss mean = 6.0616

Static Post trial cpss mean = 5.4424

Control Pre trial cpss mean = 5.9942685

Control Post trial cpss mean = 5.3302

Animated Pre trial cpss mean = 6.1344

Animated Post trial cpss mean = 5.32

Static Pre trial or mean = 6.0682

Static Post trial or mean = 5.4338

Control Pre trial or mean = 6.0798

Control Post trial or mean = 5.322

Animated Pre trial or mean = 6.196

Animated Post trial or mean = 5.3154

Inferential statistics

Statistical tests

A Shapiro-Wilk normality test was conducted on each of the data sets

Pre-trial CPSS SW Result = 0.5579

Post-trial CPSS SW Result = 0.0029

Pre-trial OR SW Result = 0.9345

Post-trial OR SW Result = 9×10^{-4}

From the output obtained we can assume normality for the pre and post trial CPSS as the p-value is greater than 0.05 while the OR data fails this normality test.

Confidence Intervals

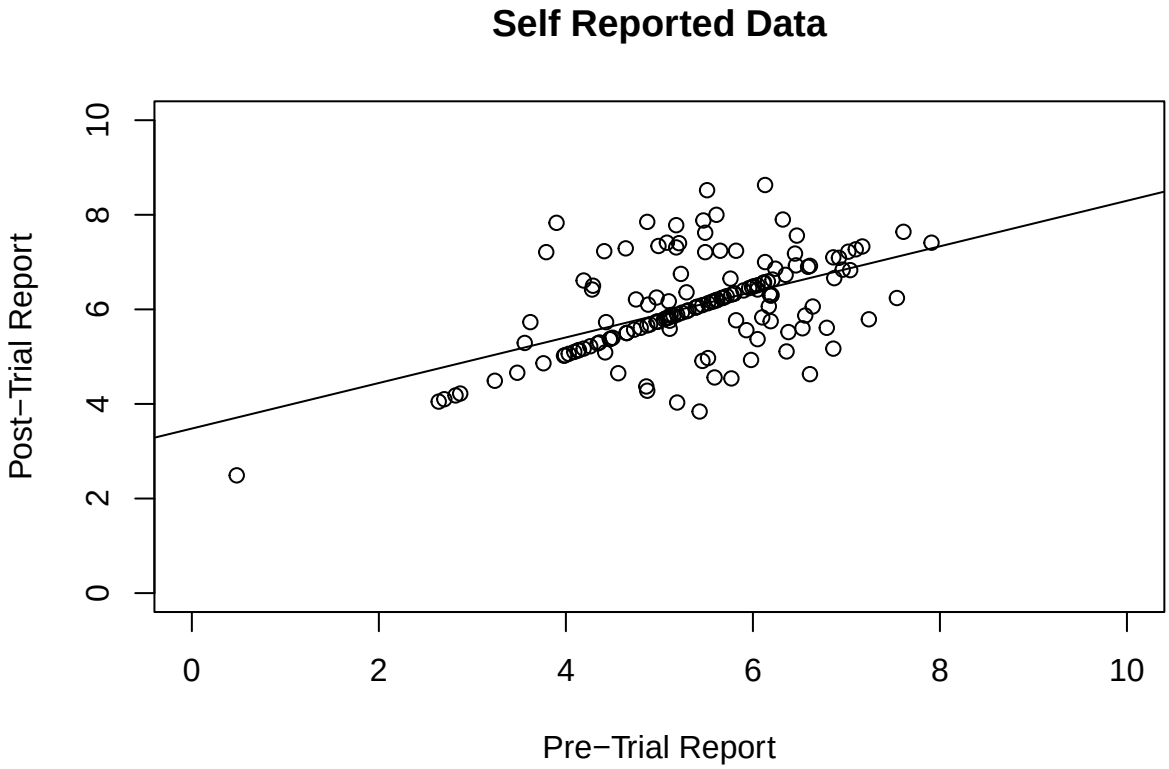
95% CI for pre-trial CPSS = (5.8999085 , 6.2269371)

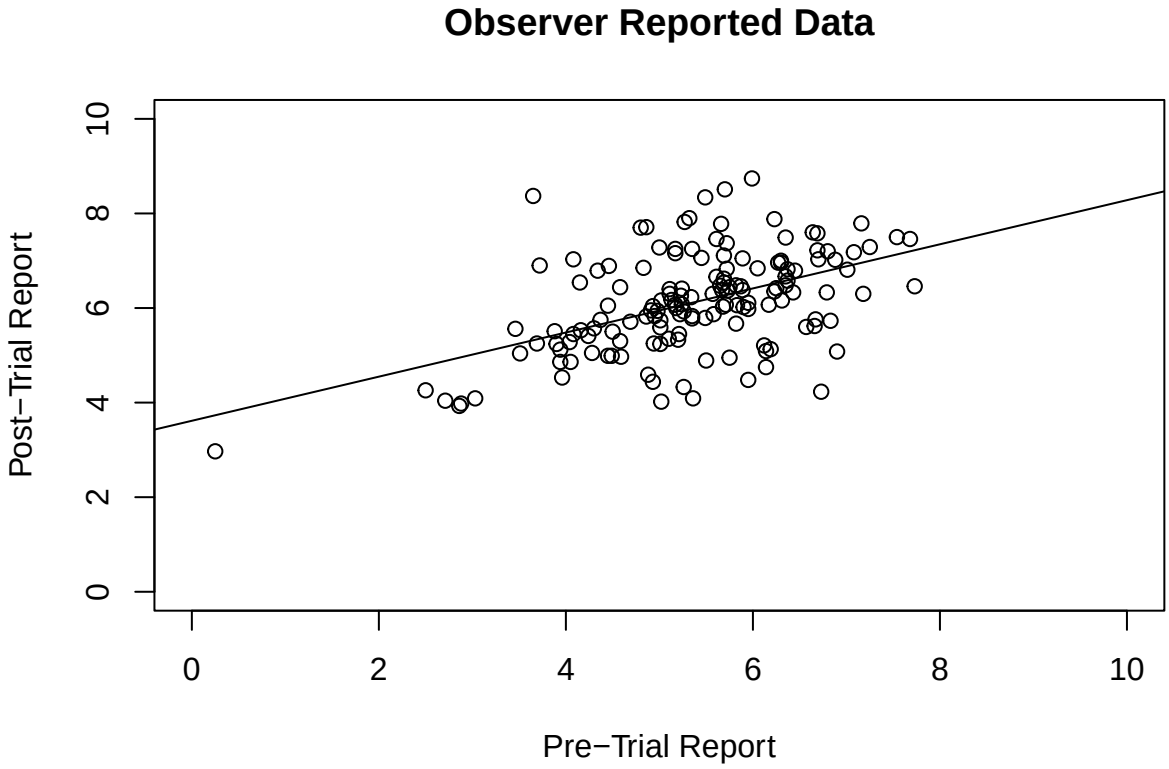
95% CI for post-trial CPSS = (5.1872644 , 5.5411356)

95% CI for pre-trial OR = (5.9435466 , 6.2857867)

95% CI for post-trial OR = (5.1758137 , 5.5383196)

Magnitude and direction of results





Discussion

Outline findings and relation to the hypothesis

Limitations (if confounding variables are clearly identified by your group)

References

Help with getting mean of data while data is missing from column *Stack Overflow

Removing Na's by Column *GeeksforGeeks

How to Handle Missing Data in a Dataset *freeCodeCamp

How to Impute Missing Values in R? *GeeksforGeeks

First 10 entries in a bar plot *StackOverflow

Calculate confidence interval *Cyclismo

How to Create a Scatterplot with a Regression Line in R? *GeeksforGeeks