Trauma Informed Care (TIC) Data Analysis

Andrew Goldstein, Claire Guo, Erin Lipman,
Zhi Rong Tan, Patrick Walker

Abstract

In effort to address the issue of gun violence on the South Side of Chicago, a new curriculum in Trauma Informed Care (TIC) was developed and taught to healthcare works at the University of Chicago's medical centers.

The training consisted of a 1.5-hour session on (A) safety, (B) screening, (C) contextualizing behavior, (D) avoiding re-traumatization, and (E) discharge planning; participants self-reported their comfort, on a 10-point scale, with each of the five areas before and after training with a 78% completion rate for those that attended.

Here we investigated four questions: (1) whether there was a significant improvement in the overall (summed) score, (2) which of the five sub-categories saw the most and least improvement, (3) how a participant's role, department, and training levels affects the improvement, (4) and which groups of people were most likely to complete both surveys.

What is Trauma Informed Care (TIC)?

- Sensitively providing healthcare to those affected by violence and trauma
- Taught in a 1.5 hour workshop
- Participation was voluntary
- 5 topics:
  a. Safety;
  b. Screening;
  c. Contextualizing behavior;
  d. Avoiding re-traumatization;
  e. Discharge planning.
- Dataset is self-reported scores (1-10) of how comfortable the participant is with each of the 5 topics (before and after workshop)

Dataset (n = 341, post-cleaning)

Variable Name	Variable Type	Example
ID	String	MI161102
Data Attended	Date	8/10/2017
Department	Factor (9)	Emergency Medicine
Role	Factor (9)	MD
Level	Factor (5)	Resident
Complete	Logical	TRUE
Pre(A/B/C/D/E)	Integer (1-10)	8
Post(A/B/C/D/E)	Integer (1-10)	10

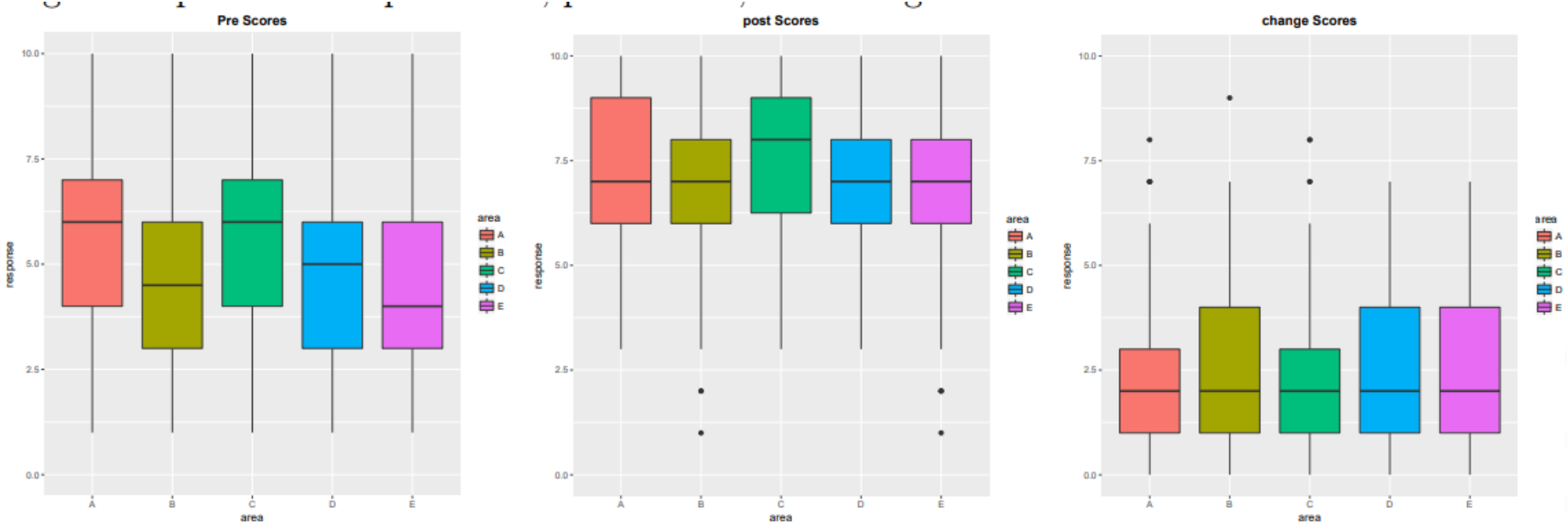
Main Questions

- Did the study improve how comfortable the participants are with each of the 5 topics?
- How does a person’s role, department, etc affect their improvement?
- How does a person’s role, department, etc affect if they completed the workshop?
    - E.g. Attendings are busy, maybe had to leave part-way through

Statistical Issues

- Participation in the seminars was voluntary
  - E.g. Participants who are unfamiliar with the material chose to attend
- Missing data (not missing at random)
- Subjective survey data might be difficult to compare across individuals
- Survey data might not be very reliable
- Heterogeneity in individuals extends far beyond what is available in the data
- Multiple testing
- Correlated response variables
- Bounded response variables
  - E.g. If you scored yourself a perfect 50 before the workshop, it’s impossible to improve

Analysis of Individual Changes Overview



- The leftmost graph shows the spread of responses on the 5 question pre-training
- The middle shows the spread for post training
- The rightmost the spread of changes.

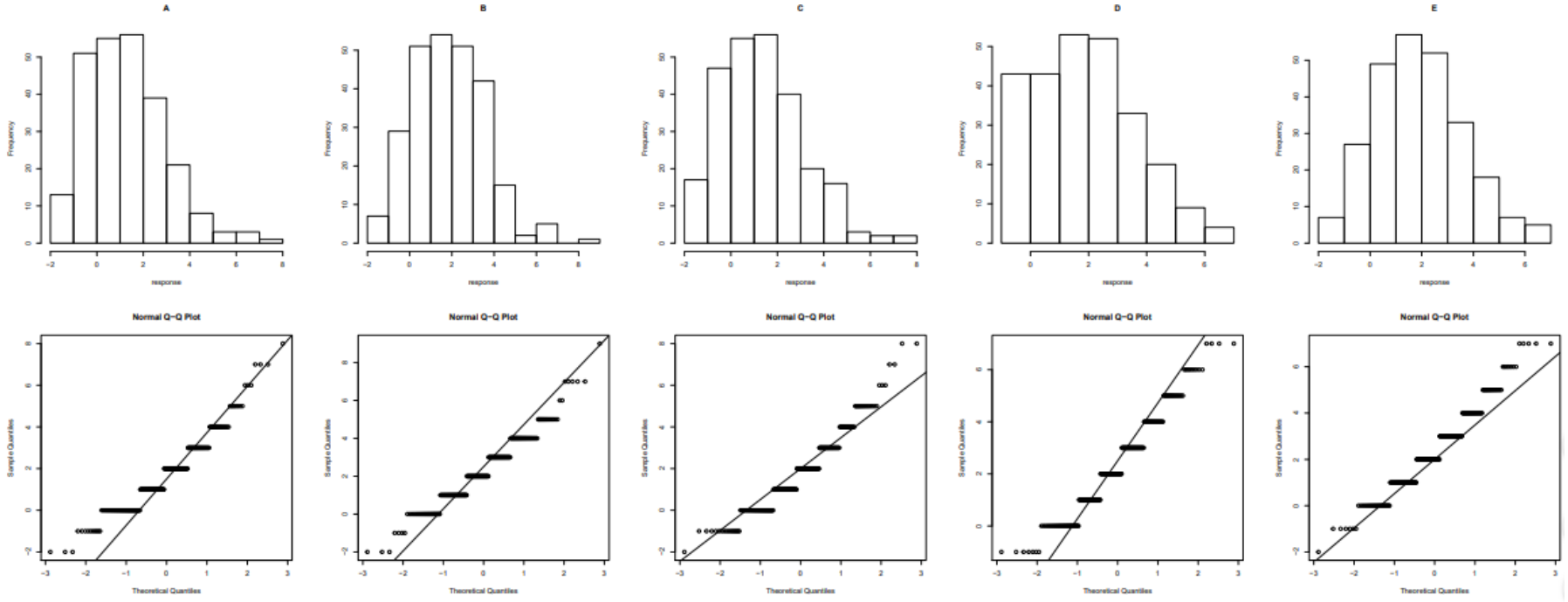
Analysis of Individual Changes

- The change boxplot can be condensed into the following statistics
- We can see that the changes are in general positive, but that the spread ranges from somewhat negative to almost a jump that covers the whole scale
- **We need to ensure that these changes are normally distributed**

	A	B	C	D	E
change_min	-2	-2	-2	-1	-2
change_q25	0	1	1	1	1
change_median	2	2	2	2	2
change_q75	3	4	3	4	3
change_max	8	9	8	7	7

	A	B	C	D	E
change_mean	1.76	2.34	1.85	2.38	2.39
change_sd	1.72	1.75	1.80	1.79	1.74

Normality of Individual Changes



- The histograms and quantile plots are for the changes of A,B,C,D, and E
- **We can see that the changes are in fact skewed to the right, something that we need to be aware of during out t-tests**

T Tests and CIs for Individual Changes

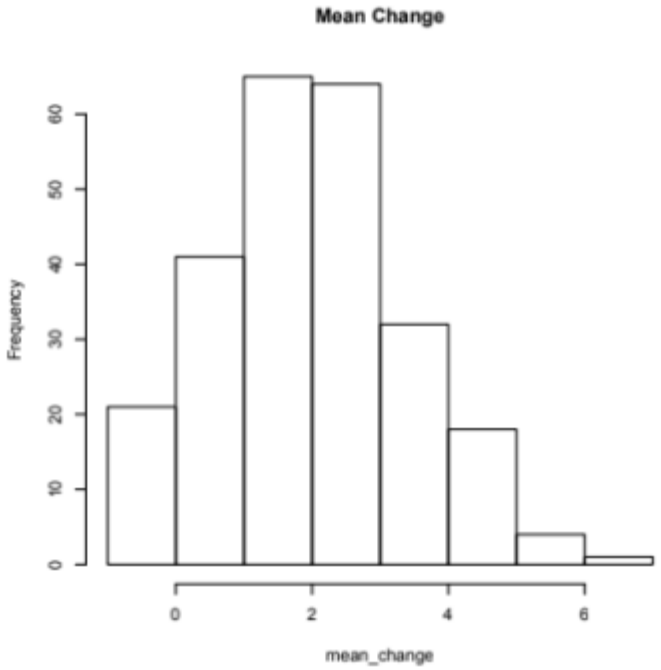
Here we show the 95% confidence intervals for the change in responses and the accompanying p-value for a paired (one-sample) t-test

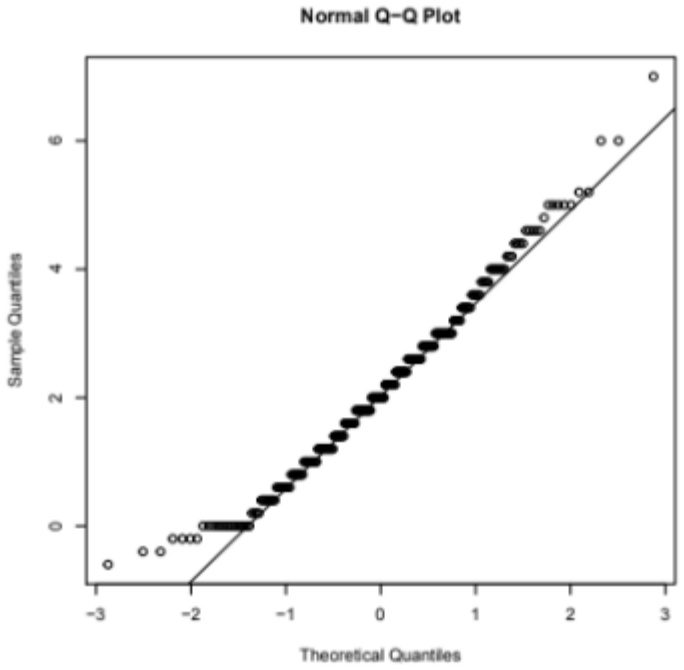
All confidence intervals do not include 0, indicating that the changes are significant

This is further supported by the remarkably low p-values, **indicating that the variables are both significant and mitigating our concern over the non-normality aspects of the changes**

	lower	upper	p
A	1.54	1.97	1.3e-40
B	2.12	2.55	3.9e-59
C	1.63	2.07	3.0e-42
D	2.16	2.60	1.1e-58
E	2.18	2.61	1.6e-60

Analysis of Mean Change - normality checks





Analysis of mean changes - hypothesis tests

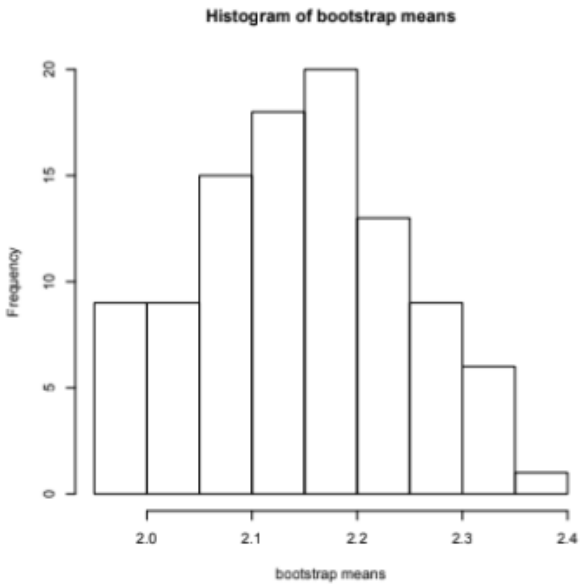
Parametric (T-test)

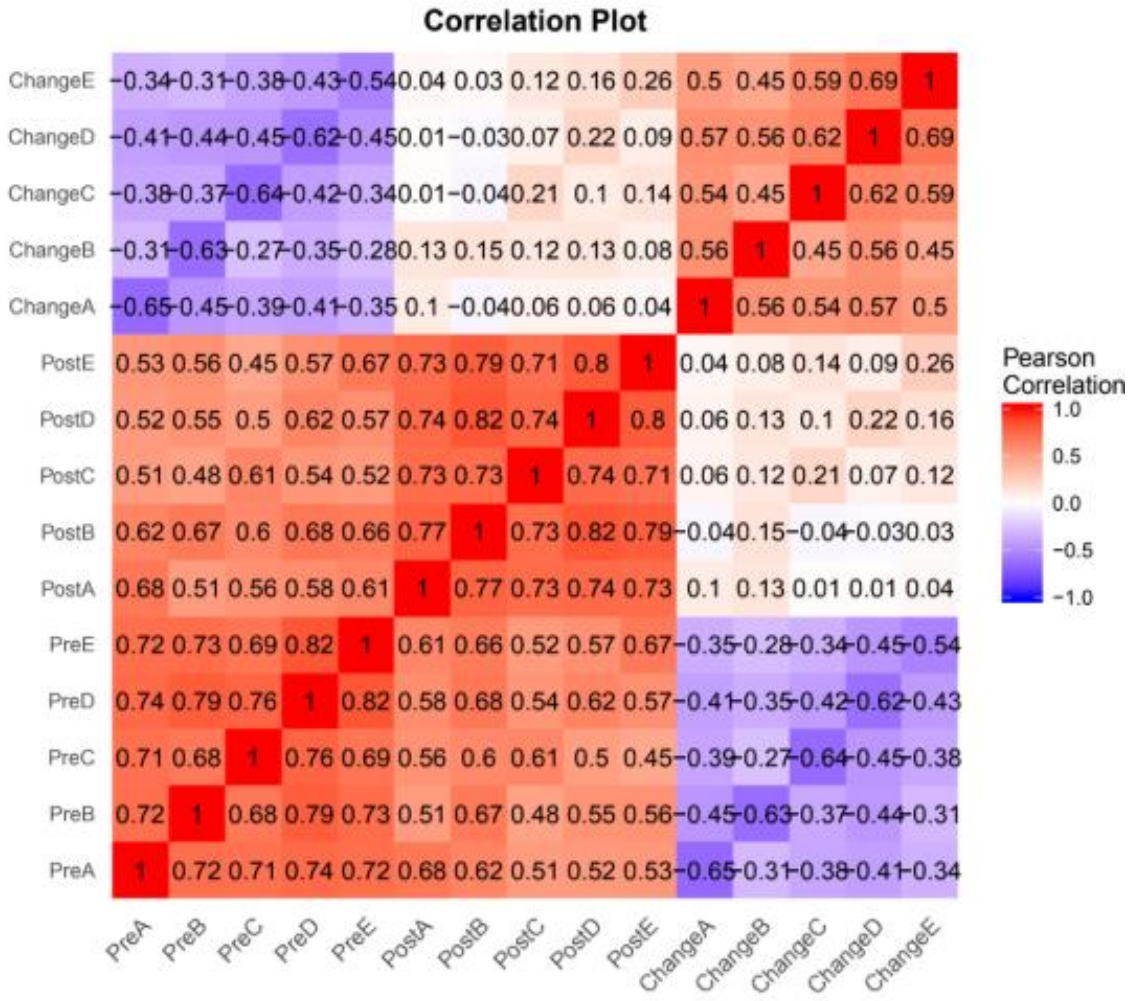
- CI: [1.96, 2.32]
- P-value: 5.5×10^{-65}

Nonparametric (bootstrap)

- CI: [1.98, 2.33]
- P-value: 0

Histogram of bootsrap chan

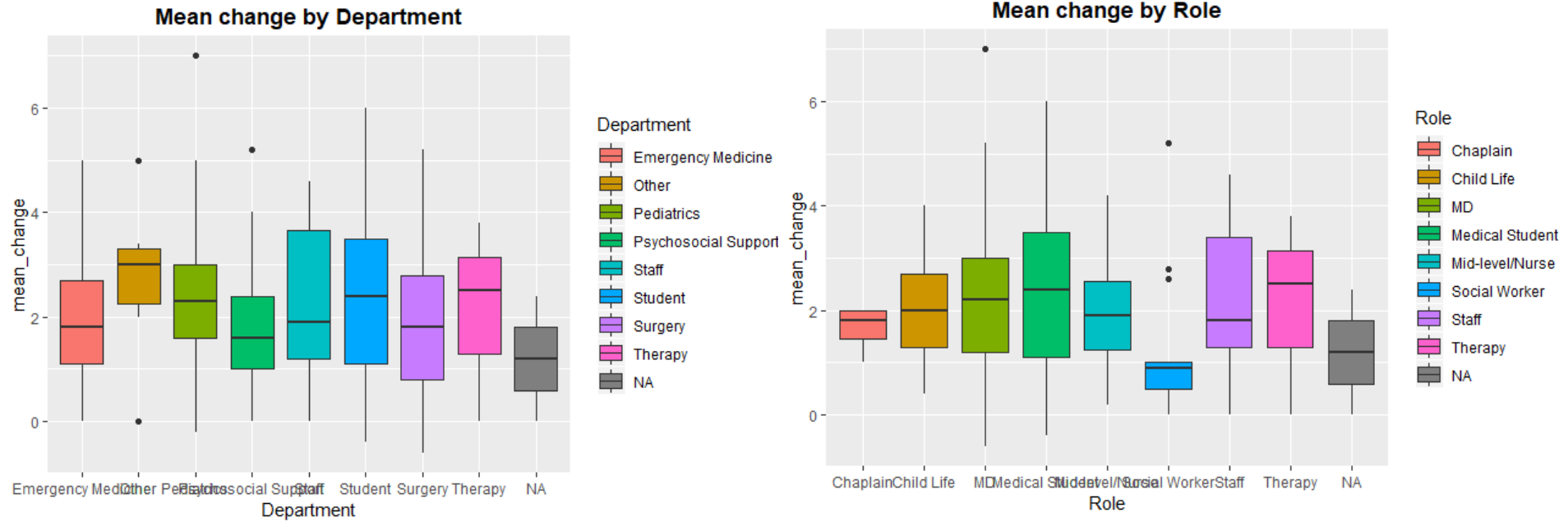



Correlation Plot
ChangeE -0.34 -0.31 -0.38 -0.43 -0.54 0.04 0.03 0.12 0.16 0.26 0.5 0.45 0.59 0.69 1
ChangeD -0.41 -0.44 -0.45 -0.62 -0.45 0.01 -0.03 0.07 0.22 0.09 0.57 0.56 0.62 1 0.69
ChangeC -0.38 -0.37 -0.64 -0.42 -0.34 0.01 -0.04 0.21 0.1 0.14 0.54 0.45 1 0.62 0.59
ChangeB -0.31 -0.63 -0.27 -0.35 -0.28 0.13 0.15 0.12 0.13 0.08 0.56 1 0.45 0.56 0.45
ChangeA -0.65 -0.45 -0.39 -0.41 -0.35 0.1 -0.04 0.06 0.06 0.04 1 0.56 0.54 0.57 0.5
PostE 0.53 0.56 0.45 0.57 0.67 0.73 0.79 0.71 0.8 1 0.04 0.08 0.14 0.09 0.26
PostD 0.52 0.55 0.5 0.62 0.57 0.74 0.82 0.74 1 0.8 0.06 0.13 0.1 0.22 0.16
PostC 0.51 0.48 0.61 0.54 0.52 0.73 0.73 1 0.74 0.71 0.06 0.12 0.21 0.07 0.12
PostB 0.62 0.67 0.6 0.68 0.66 0.77 1 0.73 0.82 0.79 -0.04 0.15 -0.04 -0.03 0.03
PostA 0.68 0.51 0.56 0.58 0.61 1 0.77 0.73 0.74 0.73 0.1 0.13 0.01 0.01 0.04
PreE 0.72 0.73 0.69 0.82 1 0.61 0.66 0.52 0.57 0.67 -0.35 -0.28 -0.34 -0.45 -0.54
PreD 0.74 0.79 0.76 1 0.82 0.58 0.68 0.54 0.62 0.57 -0.41 -0.35 -0.42 -0.62 -0.43
PreC 0.71 0.68 1 0.76 0.69 0.56 0.6 0.61 0.5 0.45 -0.39 -0.27 -0.64 -0.45 -0.38
PreB 0.72 1 0.68 0.79 0.73 0.51 0.67 0.48 0.55 0.56 -0.45 -0.63 -0.37 -0.44 -0.31
PreA 1 0.72 0.71 0.74 0.72 0.68 0.62 0.51 0.52 0.53 -0.65 -0.31 -0.38 -0.41 -0.34
PreA PreB PreC PreD PreE PostA PostB PostC PostD PostE ChangeA ChangeB ChangeC ChangeD ChangeE
Pearson Correlation
1.0
0.5
0.0
-0.5
-1.0

Correlation analysis

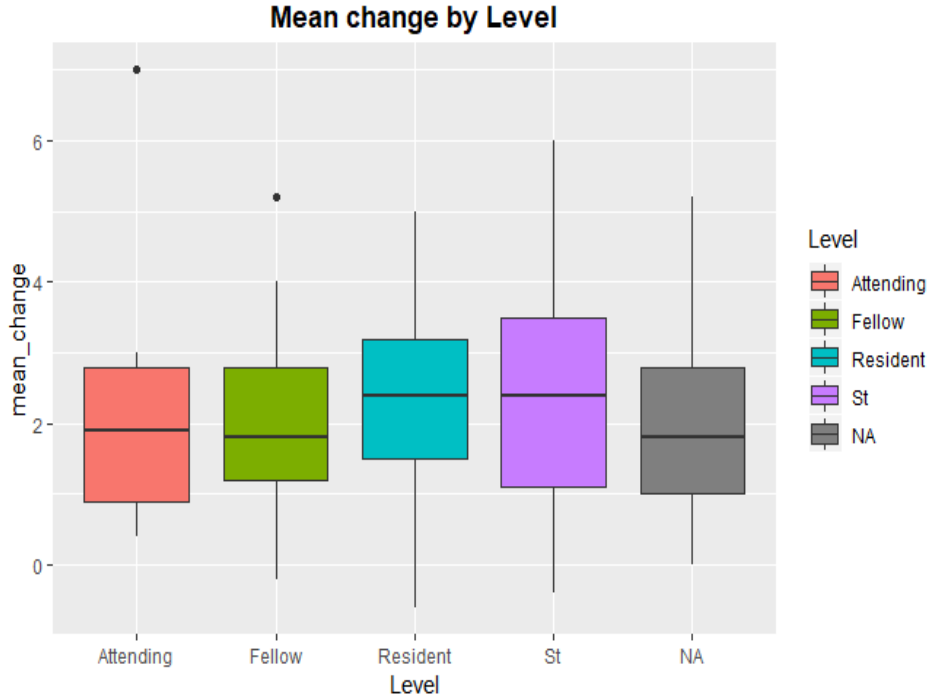
- High positive correlation within **pre** blocks
- High positive correlation within **post** blocks
- Moderate positive correlation within **change** block
- Positive correlations between **pre** and **post** scores (especially diagonal)
- **Pre** and **change** are moderately negatively correlated (especially diagonal)
- Little correlation between **post** and **change** (small positive on diagonal)

Analysis of Response by Department, Level & Role



Box Plot of Mean Change separated by Department and Role

Analysis of Response by Department, Level & Role



Box Plot of mean change separated by Level

Only observations where Roles = "MD" or "Student" have Level

Role= "Student" → Level = "St"

One-Way ANOVA

- Are mean changes affected by any of the 3 factors?

  Department, Level, Role

- Ran one-way linear regression model for mean change on either one of the factors, and performed ANOVA on them
- From the high p-values in each of the ANOVA tables, no evidence any of these factors (on their own) is significant predictor of change

Factor	Department	Role	Level
ANOVA P-Value	0.2113	0.3443	0.644

Analysis of Variance Tables (One-Way)

ANOVA Table for Department

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
tic$Department	7	19.44	2.7767	1.3873	0.2113
Residuals	236	472.35	2.0015		

ANOVA Table for Role

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
tic$Role	7	15.96	2.2802	1.1309	0.3443
Residuals	236	475.83	2.0162		

ANOVA Table for Level

	Df	Sum Sq	Mean Sq	F value	Pr(>F)
tic$Level	3	3.81	1.2696	0.5572	0.644
Residuals	155	353.15	2.2784		

Two-Way ANOVA

- Are mean changes affected by 2-way interactions of the factors?
- Ran two-way linear regression model for mean change on pairs of the factors, and performed ANOVA on them
- From the high p-values in each of the ANOVA tables, no evidence any pair of these factors is significant predictor of change

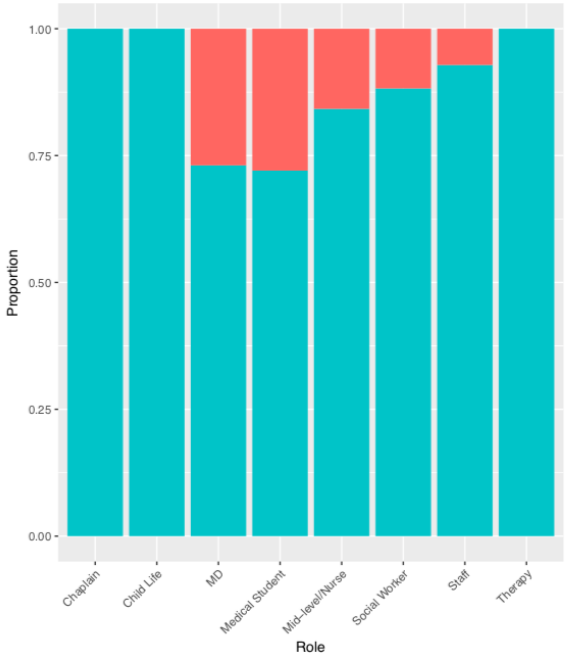
Department:Role

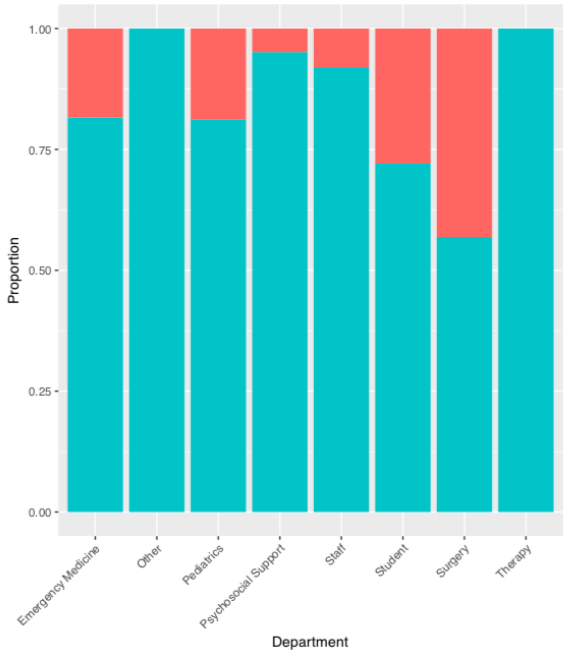
```
Response: mean_change
                      Df Sum Sq Mean Sq F value Pr(>F)
tic$Department          7  19.44 2.77674  1.3784 0.2153
tic$Role                4   7.82 1.95576  0.9708 0.4242
tic$Department:tic$Role 2   1.20 0.59861  0.2972 0.7432
Residuals             230 463.33 2.01449
```

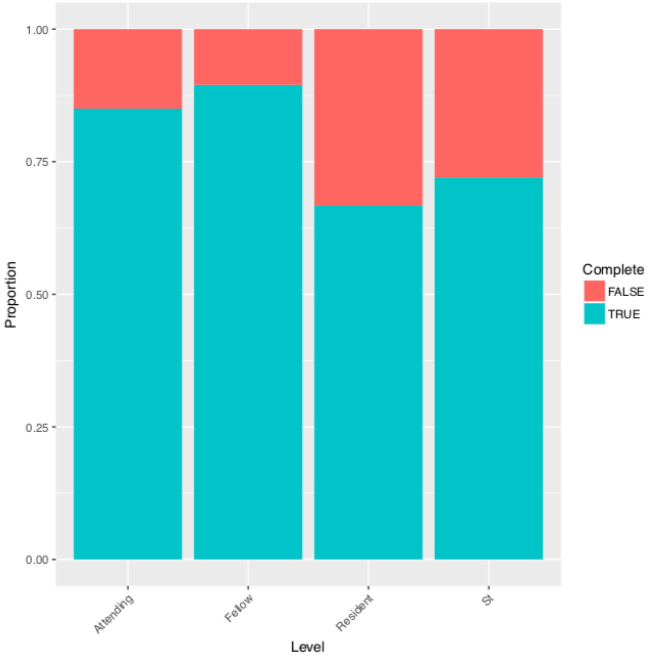
Department:Level

```
Response: mean_change
                       Df  Sum Sq Mean Sq F value  Pr(>F)
tic$Department           4  15.819  3.9548  1.8364 0.12493
tic$Level                2   2.786  1.3930  0.6469 0.52518
tic$Department:tic$Level 6  23.937  3.9894  1.8525 0.09289
Residuals              146 314.417  2.1535
```

Analysis of completion rates







Chi-Squared Tests

- Are certain characteristics associated with completeness?
  - Department
  - Role
  - Level
  - MD Students vs. all others
  - Doctors vs. all others
  - Doctors and MD students vs. all others
  - Doctor, MD student, and nurses vs. all others
  - Surger, Pediatrics, Emergency Medicine, and students vs. all other departments
  - Surgery vs. all others

Chi-Squared Tests

- Are certain characteristics associated with completeness?
  - Department: p-value = $3.9 * 10^{-5}$
  - Role: p-value = 0.009
  - Level
  - MD Students vs. all others
  - Doctors vs. all others: p-value = 0.053
  - Doctors and MD students vs. all others: p-value = $8.4 * 10^{-5}$
  - Doctor, MD student, and nurses vs. all others: p-value = 0.0001
  - Surgery, Pediatrics, Emergency Medicine, and students vs. all other departments
  - Surgery vs. all others: p-value = $4.8 * 10^{-5}$
- Bonferroni correction for multiple testing: p-value/# of tests
  - 11 tests → almost all stay significant
  - New threshold approx p=0.005

Summary

1) The changes in each content area were found to be positive at a 0.05 significance level using one-sample t-tests backed up by a nonparametric bootstrap
2) The overall change was not found to be impacted by department, level, or role in one and two-way ANOVA regression
3) The completion rate was found to be affected by Department, being a doctor/student/nurse, and being in surgery by using chi-squared tests on two-way tables, and correcting for multiple comparisons