What Do Biolans Think Of Torrey Students?
A Survey
Fall 2011

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Executive Summary

This article describes a statistics project completed by two Research Assistants in Fall 2011. The data was compiled by a group of Introduction to Probability Statistics students, in which they surveyed classes at Biola University. The students were asked general questions about themselves as well as their opinions of Torrey students (the honors program at the University). The data was then analyzed using the statistical software R. The results of this study are as follows.

The main information that this data yielded was that Torrey Students are not as arrogant as they appear, from questions 10 and 12 (see page 19). This has an implication for both Torrey students and non-Torrey students. Torrey students need to realize that they are often perceived as arrogant and do their best to change that outlook. Non-Torrey students need to take time to get to know the Torrey students to see them for who they really are, instead of the often-arrogant first impression.

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0. Torrey Survey

Instructions: The purpose of this survey is to get an idea of non-Torrey students’ perception of Torrey students. In this survey, we are asking you to generalize. Even though you may know some Torrey students who are at different ends of the spectrum presented, please respond by giving your personal impression of ALL Torrey students combined. If you know someone you are not certain is a Torrey student, please do not include them when considering your answers. This survey is conducted by both Torrey and non-Torrey students. The results will be shown to Torrey faculty and submitted to the Chimes. Please circle the best response for each item.

1. Are you male or female? Male Female

2. Are you a Torrey student? Yes No

3. How many years have you studied at Biola?
   Less than 1 2 3 4 5+

4. How many Torrey students do you consider acquaintances?
   0 1 2-5 6-10 more than 10

5. How many Torrey students do you know really well?
   0 1 2-5 6-10 more than 10

6. Over your time at Biola, has your opinion of Torrey students:
   Become more favorable Remained the same Become less favorable

7. Torrey students tend to be standoffish or cliquish.
   Strongly disagree Disagree Neutral Agree Strongly agree

8. Torrey students tend to be interested in culturally unusual things.
   Strongly disagree Disagree Neutral Agree Strongly agree

9. Torrey students tend to be more intelligent than other Biola students.
   Strongly disagree Disagree Neutral Agree Strongly agree

10. Torrey students, in reality, tend to be arrogant.
    Strongly disagree Disagree Neutral Agree Strongly agree

11. Torrey students, in reality, tend to be humble.
    Strongly disagree Disagree Neutral Agree Strongly agree

12. Torrey students tend to appear arrogant
    Strongly disagree Disagree Neutral Agree Strongly agree
I. General Overview of Data

Answers to first 2 questions, displaying the breakdown of gender and grade.

These graphs display the amount of Torrey students that those surveyed are acquaintances with and those that they actually know. None represents 0, one represents 1, few represents 2-5, several represents 6-10, and many represents more than 10.

This graph represents how opinions of Torrey students have changed throughout their time at Biola. L represents opinions being less favorable, M represents opinions being more favorable, and S represents opinions remaining the same. The final graph is a general spread of responses to questions 7-12 on the survey. #1-#5 represents degrees of the Likert scale, one being “strongly disagree” and five being “strongly agree.”
General overview of questions 7-12

COMMENTS
From this first section of graphs and overviews, we can see several things:
- More females than males participated in the survey
- Most of the participants were underclassmen (Freshmen and sophomores)
- The participants had a fair amount of Torrey acquaintances, but a low amount of Torrey students they actually knew
- Most of the participants Torrey opinions have not changed
- If Torrey opinions have changed, most of them now have better opinions
- For questions 7-12:
  - Most students have no opinion (Neutral) or do not wish to share their opinions
  - Almost all of the questions have a traditional bell curve spread (#7,9,and 11 especially)
II. Comparison by Gender

**female**

<table>
<thead>
<tr>
<th>Years</th>
<th>Acq</th>
<th>Know</th>
</tr>
</thead>
</table>

**male**

<table>
<thead>
<tr>
<th>Years</th>
<th>Acq</th>
<th>Know</th>
</tr>
</thead>
</table>

**female**

<table>
<thead>
<tr>
<th>#7</th>
<th>#8</th>
<th>#9</th>
<th>#10</th>
<th>#11</th>
<th>#12</th>
</tr>
</thead>
</table>

**male**

<table>
<thead>
<tr>
<th>#7</th>
<th>#8</th>
<th>#9</th>
<th>#10</th>
<th>#11</th>
<th>#12</th>
</tr>
</thead>
</table>
COMMENTS ON GENDER RESPONSES:

- Between the males and females there were no major difference between Know, acquaintances, and years at biola
- Also, no major differences between questions 7-11
- A slight difference with question 12, the males feeling Torrey students do not appear to be arrogant
III. Comparison by Year at Biola

time at biola vs. amount of Torrey students known

Are torrey students perceived as standoffish

culturally unusual?

Torrey Students more intelligent

Tend to be arrogant?
in reality are they humble?

appear to be arrogant?
COMMENTS ON COMPARIONS ACCORDING TO YEAR AT BIOLA:
- there were only 2 super seniors in the data, so this is not an accurate account,
  see the combined information (Senior and super senior combined)
IV. Comparison by Year at Biola (Senior and super senior combined)

![Box plots comparing time at Biola vs. amount of Torrey students known.](image)

- Are Torrey students perceived as standish?
- Culturally unusual?
- Torrey Students more intelligent?
- Tend to be arrogant?
- In reality are they humber?
- Appear to be arrogant?
COMMENTS ON YEARS AT BIOLA (SENIOR /SUPER SENIOR COMBINED)
- the longer you have been at biola, the more torrey students you know
- as a whole, the more years at biola resulted in a more negative view of Torrey students
- Seniors felt Torrey students were more arrogant than underclassmen (question #10)
V. Data According to Torrey Students Known

- Are Torrey students perceived as standoffish?
- Culturally unusual?
- Torrey Students more intelligent?
- Tend to be arrogant?
- In reality are they humble?
- Appear to be arrogant?

COMMENTS ACCORDING TO HOW MANY TORREY STUDENTS KNOWN:
- The more Torrey students known, the lesser the opinion of them
- The students that knew more Torrey students, disagreed that Torrey Students tend to be more intelligent than other students (Question #9)
VI. Data According to Torrey Acquaintances

COMMENTS ON TORREY ACQUAINTANCES:
- nothing interesting in this data
- Juniors and Seniors agreed that students tend to be interested in culturally unusual things
VII. Comparison According to Opinion

opinion vs. Know table.

<table>
<thead>
<tr>
<th>Opinion</th>
<th>0</th>
<th>1</th>
<th>3.5</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>L</td>
<td>2</td>
<td>0</td>
<td>9</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>M</td>
<td>7</td>
<td>11</td>
<td>18</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>S</td>
<td>43</td>
<td>34</td>
<td>53</td>
<td>9</td>
<td>5</td>
</tr>
</tbody>
</table>

COMMENTS ON TORREY OPINIONS:
- This is exactly as expected:
  - If the opinion became less favorable towards Torrey Students:
    - An overall negative opinion (more standoffish, more arrogant, less intelligent, more culturally unusual, etc.)
  - If the opinion was more favorable towards Torrey Students:
    - An overall more positive opinion (Less standoffish, less arrogant, more intelligent, etc)
  - Same opinion, neutral responses
VIII. Inventory (Overall Opinion)

The minimum possible value would be 6, meaning that the student consistently put the highest opinion for Torrey students. The highest possible score would be 30, meaning that the student consistently put the lowest opinion of Torrey students. Questions 9 and 11 have been scored opposite to accommodate this.
IX. Further Statistical Testing

**COMMENTS:** Since we performed 21 different tests, the level of significance we are using is .0024, to take into account the large testing fallacy.

**CORRELATIONS**
A. correlation test between Know and X7

```
cor.test(Torrey$Know, Torrey$X7, alternative="two.sided", method="spearman")
```

**OUTPUT:**
Spearman's rank correlation rho

```
data:  Torrey$Know and Torrey$X7
S = 1357495, p-value = 0.05499
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
 0.03357339
```

B. correlation test between Know and X8

```
cor.test(Torrey$Know, Torrey$X8, alternative="two.sided", method="spearman")
```

**OUTPUT:**
Spearman’s rank correlation rho

```
data:  Torrey$Know and Torrey$X8
S = 1134443, p-value = 0.05499
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
 0.1362547
```

C. correlation test between Know and X9

`cor.test(Torrey$Know, Torrey$X9, alternative="two.sided", method="spearman")`

**OUTPUT:**
Spearman’s rank correlation rho
D. correlation test between Know and X10

\[
\begin{align*}
\text{cor.test(Torrey$Know, Torrey$X10, alternative="two.sided", method="spearman")}
\end{align*}
\]

OUTPUT:
Spearman’s rank correlation rho

\[
\begin{align*}
data: Torrey$Know and Torrey$X9 \\
S = 1523725, \textbf{p-value} = 0.02386 \\
\text{alternative hypothesis: true rho is not equal to 0} \\
sample estimates: \\
rho \\
-0.160138
\end{align*}
\]

E. correlation test between Know and X11

\[
\begin{align*}
\text{cor.test(Torrey$Know, Torrey$X11, alternative="two.sided", method="spearman")}
\end{align*}
\]

OUTPUT:
Spearman’s rank correlation rho

\[
\begin{align*}
data: Torrey$Know and Torrey$X10 \\
S = 1270502, \textbf{p-value} = 0.647 \\
\text{alternative hypothesis: true rho is not equal to 0} \\
sample estimates: \\
rho \\
0.03266217
\end{align*}
\]

F. correlation test between Know and X12

\[
\begin{align*}
\text{cor.test(Torrey$Know, Torrey$X12, alternative="two.sided", method="spearman")}
\end{align*}
\]

OUTPUT:
Spearman's rank correlation rho
COMMENTS: We can see from these correlation tests that none of the data was very significant. We were not able to conclude anything from these correlation tests.

PAIRED T-TEST
A. Paired t-test of Know and X12

➤ `t.test(Know, X12, paired=TRUE)`

OUTPUT:
Paired t-test

data:  Know and X12
\[ t = -2.747, \text{df} = 198, \text{p-value} = 0.006569 \]
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
\[-0.9021018 \quad -0.1481494 \]
sample estimates:
mean of the differences
\[-0.5251256 \]

cor.test(Torrey$Know, Torrey$X7, alternative="two.sided", method="spearman")
cor.test(Torrey$Know, Torrey$X8, alternative="two.sided", method="spearman")
cor.test(Torrey$Know, Torrey$X9, alternative="two.sided", method="spearman")
cor.test(Torrey$Know, Torrey$X10, alternative="two.sided", method="spearman")
cor.test(Torrey$Know, Torrey$X11, alternative="two.sided", method="spearman")
cor.test(Torrey$Know, Torrey$X12, alternative="two.sided", method="spearman")

CHI-SQUARED TEST
A. Chi-squared test of independence
\[ d <- \text{table(Know, Years)} \]

<table>
<thead>
<tr>
<th>Years</th>
<th>Know</th>
<th>Underclassmen</th>
<th>Seniors+</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>50</td>
<td>2</td>
</tr>
</tbody>
</table>

\[ S = 1198581, \text{p-value} = 0.2195 \]
alternative hypothesis: true rho is not equal to 0
sample estimates:
rho
\[ 0.08742154 \]
The disagree in the tables is a combination of strongly disagree and disagree, similarly for the agree, combining agree and strongly agree.

B. Chi-squared test Know and X7

d <- table(Know, X7)

<table>
<thead>
<tr>
<th>X7</th>
<th>Know</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>44</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.5</td>
<td>73</td>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>14</td>
<td>8</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

chisq.test(d)

Pearson's Chi-squared test

data: d
X-squared = 23.1009, df = 3, p-value = 3.847e-05

C. Chi-squared Know and X8

d <- table(Know, X8)

<table>
<thead>
<tr>
<th>X8</th>
<th>Know</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>5</td>
<td>29</td>
<td>18</td>
<td></td>
</tr>
</tbody>
</table>

chisq.test(d)

Pearson's Chi-squared test

data: d
X-squared = 4.769, df = 6, p-value = 0.5738
chisq.test(d)

Pearson's Chi-squared test

data:  d
X-squared = 9.0643, df = 6, p-value = 0.17

D. Chi-squared Know and X9

d <- table(Know, X9)

<table>
<thead>
<tr>
<th>Know</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>12</td>
<td>21</td>
<td>19</td>
</tr>
<tr>
<td>1</td>
<td>13</td>
<td>19</td>
<td>14</td>
</tr>
<tr>
<td>3.5</td>
<td>28</td>
<td>27</td>
<td>24</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

chisq.test(d)

Pearson's Chi-squared test

data:  d
X-squared = 6.3566, df = 6, p-value = 0.3844

E. Chi-squared Know and X10

d <- table(Know, X10)

<table>
<thead>
<tr>
<th>Know</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>14</td>
<td>31</td>
<td>7</td>
</tr>
<tr>
<td>1</td>
<td>20</td>
<td>23</td>
<td>3</td>
</tr>
</tbody>
</table>
chisq.test(d)

Pearson’s Chi-squared test

data:  d
X-squared = 15.4563, df = 6, p-value = 0.01699

F. Chi-squared Know and X11

d <- table(Know, X11)

<table>
<thead>
<tr>
<th>Know</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>6</td>
<td>40</td>
<td>6</td>
</tr>
<tr>
<td>1</td>
<td>5</td>
<td>29</td>
<td>12</td>
</tr>
<tr>
<td>3.5</td>
<td>18</td>
<td>47</td>
<td>14</td>
</tr>
<tr>
<td>8</td>
<td>9</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

chisq.test(d)

Pearson’s Chi-squared test

data:  d
X-squared = 20.0506, df = 6, p-value = 0.002712

G. Chi-squared Know and X12

d <- table(Know, X12)

<table>
<thead>
<tr>
<th>Know</th>
<th>Disagree</th>
<th>Neutral</th>
<th>Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10</td>
<td>26</td>
<td>16</td>
</tr>
<tr>
<td>1</td>
<td>16</td>
<td>21</td>
<td>9</td>
</tr>
<tr>
<td>3.5</td>
<td>19</td>
<td>27</td>
<td>33</td>
</tr>
<tr>
<td>8</td>
<td>6</td>
<td>6</td>
<td>10</td>
</tr>
</tbody>
</table>

chisq.test(d)

Pearson’s Chi-squared test
PAIRED T-TEST
A. Paired t-test between X10 and X12

```
t.test(TorreyKY$X10, TorreyKY$X12, alternative='two.sided', conf.level=.95, paired=TRUE)
```

Paired t-test

```
data:  TorreyKY$X10 and TorreyKY$X12
t = -5.9632, df = 198, p-value = 1.119e-08
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.4212768 -0.2118891
sample estimates:
mean of the differences -0.3165829
```

COMMENT: Torrey students are not as arrogant as they appear.

SAMPLE T-TEST
A. Welch’s two sample t-test for Gender and Years

```
t.test(Years~Gender, alternative='two.sided', conf.level=.95, var.equal=FALSE, data=Torrey)
```

Welch Two Sample t-test

```
data:  Years by Gender
t = 0.9877, df = 153.991, p-value = 0.3249
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-0.1425685  0.4276525
sample estimates:
mean in group F mean in group M
2.105042  1.962500
```

Comments: This means that there is a good cross section (same ratio male and female as they have been at school longer)
X. Inventory analysis

**COMMENTS:** Inventory is a combination of the responses to questions 7-12. A high score is a more negative opinion and a low score is a more positive opinion.

**Welch Two Sample t-test**

data: inv by Gender
t = -0.2717, df = 145.089, p-value = 0.7863
alternative hypothesis: true difference in means is not equal to 0
95 percent confidence interval:
-1.1508990 0.8727477
sample estimates:
mean in group F mean in group M
18.31092 18.45000

> Anova(AnovaModel.3)

Anova Table (Type II tests)

Response: inv

<table>
<thead>
<tr>
<th></th>
<th>Sum Sq</th>
<th>Df</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CATacq</td>
<td>47.99</td>
<td>4</td>
<td>1.0393</td>
<td>0.3881</td>
</tr>
<tr>
<td>Residuals</td>
<td>2227.83</td>
<td>193</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

> tapply(TorreyOpinion2$inv, list(CATacq=TorreyOpinion2$CATacq), mean, + na.rm=TRUE) # means

<table>
<thead>
<tr>
<th>CATacq</th>
<th>mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>17.76923</td>
</tr>
<tr>
<td>1</td>
<td>16.85714</td>
</tr>
<tr>
<td>3.5</td>
<td>18.36559</td>
</tr>
<tr>
<td>8</td>
<td>18.82000</td>
</tr>
<tr>
<td>10</td>
<td>18.57143</td>
</tr>
</tbody>
</table>

> tapply(TorreyOpinion2$inv, list(CATacq=TorreyOpinion2$CATacq), sd, + na.rm=TRUE) # std. deviations

<table>
<thead>
<tr>
<th>CATacq</th>
<th>sd</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.423250</td>
</tr>
<tr>
<td>1</td>
<td>2.957575</td>
</tr>
<tr>
<td>3.5</td>
<td>3.556332</td>
</tr>
<tr>
<td>8</td>
<td>3.055206</td>
</tr>
<tr>
<td>10</td>
<td>4.167143</td>
</tr>
</tbody>
</table>

> tapply(TorreyOpinion2$inv, list(CATacq=TorreyOpinion2$CATacq), function(x) + sum(!is.na(x))) # counts

<table>
<thead>
<tr>
<th>CATacq</th>
<th>count</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>13</td>
</tr>
<tr>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>3.5</td>
<td>93</td>
</tr>
<tr>
<td>8</td>
<td>50</td>
</tr>
<tr>
<td>10</td>
<td>28</td>
</tr>
</tbody>
</table>

> Anova(AnovaModel.4)

Anova Table (Type II tests)

Response: inv
> tapply(TorreyOpinion2$inv, list(CATknow=TorreyOpinion2$CATknow), mean, +   na.rm=TRUE) # means
> tapply(TorreyOpinion2$inv, list(CATknow=TorreyOpinion2$CATknow), sd, +   na.rm=TRUE) # std. deviations
> tapply(TorreyOpinion2$inv, list(CATknow=TorreyOpinion2$CATknow), +   function(x) sum(!is.na(x))) # counts

> AnovaModel.5 <- (lm(inv ~ Opinion, data=TorryOpinion2))

> Anova(AnovaModel.5)

Anova Table (Type II tests)

Response: inv

<table>
<thead>
<tr>
<th>Sum Sq</th>
<th>Df</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opinion</td>
<td>426.68</td>
<td>2</td>
<td>22.608</td>
</tr>
<tr>
<td>Residuals</td>
<td>1849.54</td>
<td>196</td>
<td></td>
</tr>
</tbody>
</table>

---

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> tapply(TorreyOpinion2$inv, list(Opinion=TorreyOpinion2$Opinion), mean, +   na.rm=TRUE) # means
> tapply(TorreyOpinion2$inv, list(Opinion=TorreyOpinion2$Opinion), sd, +   na.rm=TRUE) # std. deviations

> AnovaTable <- (lm(inv ~ Opinion, data=TorryOpinion2))

> Anova(AnovaTable)

Anova Table (Type II tests)

Response: inv

<table>
<thead>
<tr>
<th>Sum Sq</th>
<th>Df</th>
<th>F value</th>
<th>Pr(&gt;F)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Opinion</td>
<td>426.68</td>
<td>2</td>
<td>22.608</td>
</tr>
<tr>
<td>Residuals</td>
<td>1849.54</td>
<td>196</td>
<td></td>
</tr>
</tbody>
</table>

---

Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

> tapply(TorreyOpinion2$inv, list(Opinion=TorreyOpinion2$Opinion), mean, +   na.rm=TRUE) # means
> tapply(TorreyOpinion2$inv, list(Opinion=TorreyOpinion2$Opinion), sd, +   na.rm=TRUE) # std. deviations
> tapply(TorreyOpinion2$inv, list(Opinion=TorreyOpinion2$Opinion),
      function(x) sum(!is.na(x))) # counts

Opinion   L   M   S
12  43 144

X11r = 6 - X11
X9r= 6- X9
TorreyOpinion2 = data.frame(TorreyOpinion,X11r)
inv = X7+X8+X9r+X10+X11r+X12
TorreyOpinion2 = data.frame(TorreyOpinion2,inv)
summary(inv)
hist(inv)