Connecting for Success: 
The Impact of Student-to-Other Closeness on Performance in Large Scale Engineering Classes

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Large, impersonal classroom environment

Small, collaborative learning environment
Closeness: 
Aron Scale of Inclusion of Other in Self

Arthur and Elaine Aron
• people seek to increase their potential efficacy through relationships in which they include others in the concept of self


Choose the picture below which best describes your relationship with your Professor:
Mechanics Self-Efficacy

Albert Bandura

- Self-Efficacy
- The extent or strength of one's belief in one's own ability to complete tasks and reach goals


How confident are you in your ability to:
- Draw a free-body diagram
- Write the equations of equilibrium for a system
- Carry out the problem-solving process to analyze a system
- Demonstrate the skill and knowledge needed to complete all of the above tasks
How does closeness apply to the engineering classroom?

1. In an introductory engineering course, with whom do students report more (or less) interpersonal connection (closeness)?
2. Does closeness change over an academic term?
3. Does closeness to other social groups in an engineering classroom predict academic success within that class?
Data Collection

<table>
<thead>
<tr>
<th>Class Size</th>
<th>Typical Enrollment</th>
<th>TAs</th>
<th>Students/T A</th>
<th>Research Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large</td>
<td>320</td>
<td>6</td>
<td>~55</td>
<td>281</td>
</tr>
<tr>
<td>Medium</td>
<td>150</td>
<td>4</td>
<td>~38</td>
<td>79</td>
</tr>
<tr>
<td>Small (x3)</td>
<td>80</td>
<td>4</td>
<td>~20</td>
<td>211</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td><strong>571</strong></td>
</tr>
</tbody>
</table>
Variables

- Closeness (IOS)
  - Professor, TA, Friend (6)
  - Section/Pod (1)
  - Lab Group/Bridge (1)
- Mechanics SE (4)
- Business Skills SE (8)
- Class Size (1)
- Empathy/Systemizing (3)
- Lab Satisfaction (6)
- SBL Satisfaction (8)
- HBDI (5)
- Business Vocabulary (20)
  - Pre (10), Post (10)
- Career Intent (6)
- Class Grade (1)
- Year in School (1)
- Mother’s Education (1)
- Father’s Education (1)
- SES – imputed (1)
- First Gen College (1)
- Gender (1)
- Ethnicity (1)
RQ1: With whom do students report more (or less) interpersonal connection (or closeness)?

![Graph showing Aron Scale of Inclusion - Post Course Score](image)

- Professor: 2.14
- TA: 2.42
- Class: 2.34
- Lab Group: 3.47
- Friend: 4.22

Error Bars represent a 95% Confidence Interval.
RQ1: With whom do students report more (or less) interpersonal connection (or closeness)?
**RQ1:** With whom do students report more (or less) interpersonal connection (or closeness)?

![Graph showing the Aron Scale of Inclusion - Post Course Score](image)

- **Professor**
  - Overall: 2.14
  - Females: 2.38
  - URM: 2.60
  - First Generation: 2.42

- **TA**
  - Overall: 2.42
  - Females: 2.61
  - URM: 2.83
  - First Generation: 2.82

- **Class**
  - Overall: 2.34
  - Females: 2.36
  - URM: 2.63
  - First Generation: 2.61

- **Lab Group**
  - Overall: 3.47
  - Females: 3.57
  - URM: 3.76
  - First Generation: 3.46

- **Friend**
  - Overall: 4.22
  - Females: 4.12
  - URM: 4.36
  - First Generation: 4.19

*Error Bars represent a 95% Confidence Interval*
**RQ2:** Does closeness change over an academic term?
**RQ2**: Does closeness change over an academic term?
**RQ3:** Does closeness predict academic success?

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model 1</th>
<th></th>
<th>Model 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>.000</td>
<td>.039</td>
<td>.000</td>
<td>.000</td>
</tr>
<tr>
<td>Mechanics Self-Efficacy</td>
<td>.375</td>
<td>.039</td>
<td>9.647</td>
<td>.000</td>
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<tr>
<td>Closeness: Post – All Measures</td>
<td>.384</td>
<td>.039</td>
<td>9.826</td>
<td>.000</td>
</tr>
<tr>
<td>Closeness: Post-Pre</td>
<td>.128</td>
<td>.054</td>
<td>2.368</td>
<td>.018</td>
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<tr>
<td>Class Size</td>
<td>-.045</td>
<td>.044</td>
<td>-1.013</td>
<td>.311</td>
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<tr>
<td>Empathy Score</td>
<td>.171</td>
<td>.048</td>
<td>3.517</td>
<td>.000</td>
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<tr>
<td>First Gen College</td>
<td>-.062</td>
<td>.038</td>
<td>-1.629</td>
<td>.104</td>
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<tr>
<td>Ethnicity - URM</td>
<td>-.143</td>
<td>.039</td>
<td>-3.642</td>
<td>.000</td>
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<tr>
<td>Gender - Female</td>
<td>-.108</td>
<td>.040</td>
<td>-2.672</td>
<td>.008</td>
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<tr>
<td>Adjusted r²</td>
<td>.141</td>
<td></td>
<td>.207</td>
<td>.066</td>
</tr>
<tr>
<td>Model Difference</td>
<td>.000</td>
<td></td>
<td>.000</td>
<td>.000</td>
</tr>
</tbody>
</table>

Note: Variables have been standardized, df = 562, p < .000. **BOLD** significant @ p < .05.
Structural Equation Modeling

- Closeness Post: TA 0.724
- Closeness Post: Professor 0.596
- Closeness Post: Friend 0.205
- Closeness Post: Lab Group 0.645
- Curriculor Satisfaction 0.803
- Lab Satisfaction 0.820
- Grade Percentile
- Curriculum Construct
- Mechanics Self-Efficacy
- Class Size
- Personal Qualities Construct
- Mother's Education Level -0.424
- First Generation College 0.398
- URM 0.687
- Empathy 0.142

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School of Engineering – Stanford University
Structural Equation Modeling

Closeness Construct
- Closeness Post: TA 0.724
- Closeness Post: Professor 0.596
- Closeness Post: Friend 0.205
- Closeness Post: Lab Group 0.645

Curricular Construct
- Curriculum Satisfaction 0.803
- Lab Satisfaction 0.820

Grade Percentile
- RMSEA = 0.052
- CFI = 0.958

Observed Variables
- Standardized B 0.000
  All significant at p < .05, except denoted by *

Latent Relationships
- Class Size 0.370
- Personal Qualities Construct
  - Mother's Education Level -0.424
  - First Generation College 0.398
  - URM 0.687
- Curricular Construct
  - Mechanics Self-Efficacy 0.343
- Closeness Construct
  - 0.336
  - 0.257
- Empathy 0.142
Summary of Findings

• Closeness varies in the classroom
  – Professor: least close, TA: closer

• Closeness changes over the term
  – Professor: declines, Everyone else: grows

• Closeness does impact grade performance
  – More closeness, better grade performance
Implications and Next Steps

• Professor: potential for great improvement
  – Share personal stories

• TA’s greatest potential to generate closeness
  – Interpersonal relationship training

• Leverage the power of “best friend”
  – Peer-to-peer help, joint projects
Interactive Data Analysis

tiny.cc/closeness

Connecting to Success: The Impact of Individual-to-Group Closeness on Student Performance in Large-Scale Engineering Classes

- Study Overview
- Sample Demographics
- Grades
- Aron Closeness - Post
- Aron Closeness - Post-Pre Change

Wording

- Closeness Post Professor
- Closeness Post Teaching Assistant
- Closeness Post Lab Group
- Closeness Post Section
- Closeness Post Best Friend
- Closeness Post All Measures

Observations

Mean Score

Connect the dots

You

Other

1

2

3

4

5

Cohen's d Value

The number is the mean score for the Aron Scale of Inclusion of Others in Self (Low = 1, High = 5). The circle is the color code for the Cohen's d effect size calculation. The bar is the number of observations at each level of the scale.

You

Other

1

2

3

4

5

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Thank You

- the many Teaching Assistants who worked tirelessly to assist students with the learning process and help collect this data – Jonathon Green, Wendy Boehm, Adrienne Johnson, KJ Chew, Kayla Powers, Peggy Boylan-Ashraf, Beth Rieken and Barbara Karanian.

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Author Team

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Discussion and Questions?