Week 4: Theories, Hypothesis framing and Testing

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Bummer Dude.

Make an appropriate graphical representation of each of these. You have 3 minutes.

**Colors:** \{Red, Red, Red, Red, Blue, Blue, Green\}

**Ages:** \{16, 16, 17, 18, 22, 40, 51, 52, 53\}
Theories

- A **Theory** is a broad statement about how, and why the world works in a specific way.

- A **Hypothesis** is an empirically testable statement that derives from (is logically entailed by) a theory.
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- A **Hypothesis** is an empirically testable statement that derives from (is logically entailed by) a theory.
  - Think about this in terms of Evolutionary Theory, or the Big Bang Theory.
  - Scientists do not *directly* test theories, but rather they test the Hypotheses that are entailed by their theories.
  - Theorizing, rather than getting stoned and talking about “*It’s like Maaaaaarx said bro...*” is a rigorous task.
Briefly, Independent and Dependent Variables

We want to know what is causing “things”, right?

- “Things” are the **Dependent Variable**
  - Voting
  - Grades
  - School Admissions

- The factors that cause “things” are the **Independent Variable**
  - Education, Income, Gender, Race
  - Study Habits, Income, Gender, Race, Tutoring
  - Grades, Test Scores
Three Steps to Theorizing

1. Identify the effect we want to explain. What Variable (DV) do I want to understand?

2. Identify the possible factors (IVs) that could be causing changes in the Variable I am interested in.

3. What is the logical connection between the two sets?
A Formal Hypothesis

A hypothesis is a conditional statement that declares what we should find in our data if our theory is correct.

- Form of a conditional statement: If \{\ldots\}, then \{\ldots\}.
- \(X \rightarrow Y\)
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- Form of a conditional statement: If \{\ldots\}, then \{\ldots\}.
- \(X \rightarrow Y\)
- If an election is fair, then no more that 20% of ballots cast will be time stamped after 5:00pm local time.
- If someone has more education, then she is more likely to be politically active.
- If the Detroit Lions win another game this season, then a miracle has occurred.
A Little Logic

This form of a conditional statement is a statement of implication. It holds that the presence of $X$ implies the presence of $Y$.

- 5th year with surfboard $\rightarrow$ stoner
- Fixed Gear bicycle $\rightarrow$ hipster
- Drakar Noir and St...St...Stunner Shades $\rightarrow$ Frat Boys

Note that Frat boys, hipsters, and losers all may be present without cheap cologne, leg shredders, and scent of desperation.

*Note the direction of the implication arrow.*
A Little Logic

To disprove a conditional statement of the above form, it is not sufficient to show the absence of both $X$ and $Y$. The presence of $X$ must be shown with the absence of $Y$.

- 5th year with surfboard $\rightarrow$ Teaching homeless to surf
- Fixed Gear bicycle $\rightarrow$ Olympic qualifying sprint cyclist
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- Drakar Noir and Stunner Shades $\rightarrow$ ... Frat Boys
Political Science Examples

▶ **Democratic Peace**: Because democracy fosters a brotherhood of empowerment and mutual respect: In the case the two democratic countries have a dispute, it is less likely to develop into militarized conflict.

▶ What are the Independent and Dependent Variables here?
Political Science Examples

- **Democratic Peace**: Because democracy fosters a brotherhood of empowerment and mutual respect: In the case the two democratic countries have a dispute, it is less likely to develop into militarized conflict.

- $H_0$: Likelihood that two democratic countries are at war with each other is the same as any two randomly sampled dyads.

- $H_A$: Likelihood that two democratic countries are at war with each other is **NOT** the same as any two randomly sampled dyads.

- **What are the Independent and Dependent Variables here?**
Coin Toss for Buying Beer

- H₀: Alex has a fair coin. P(H) = P(T) = 0.5
- Hₐ: Alex is a cheapskate, will cheat his friends, and has a loaded coin. P(H) ≠ P(T).

Alex flips heads and the other TAs buy him beers 6 times in a row.
Coin Toss for Buying Beer

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Alex flips heads and the other TAs buy him beers 6 times in a row.

- $P(H) = 0.5$
- $P(H, H) = (0.5)(0.5) = (0.5)^2$
- $P(H, H, H, H, H, H) = (0.5)^6 = 0.0156$
Example on Board.
Causality

1. Temporal Precedence
2. Empirical Correllational Pattern
3. Causal Theory
4. No other plausible causes – omitted variables, intervening variables.

These are necessary conditions, but are by NO means sufficient to establish convincing causality in all cases.