

August 2011 IASE 1

## All Statistics are Socially Constructed

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[www.StatLit.org/pdf/2011SchieldIASE6up.pdf](http://www.StatLit.org/pdf/2011SchieldIASE6up.pdf)

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## Statistical Literacy courses: The Next Big Thing?

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2009: Survey of all US four-year colleges found that 19% of respondents offered a statistical literacy course.

2010: Wired Magazine said, "*Statistical literacy: A course you should have taken in college.*"

2011: US Supreme Court finds statistical significance is not necessary for causation.

2011: Eight college faculty completed the Augsburg College statistical-literacy teacher-training course online. These teachers analyzed 14 news stories.

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## #1 All Statistics are Socially Constructed

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*"All statistics, from the best to the worst, are socially constructed.*

*All statistics are products of choices and compromises that inevitably shape, limit, and distort the outcome."*

Joel Best (2002)

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## #2 Four Kinds of Influence on Statistics Take CARE

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**Context:** Influence of factors that were – and were not – taken into account (multivariate analysis)

**Assembly:** Influence of choices in defining, measuring, comparing and presenting statistics

**Randomness:** Influence of chance based on choices in type and size of sample

**Error (Bias):** Influence of factors generating systematic differences between observed and reality.

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## Statistical-Inference Courses Cover Randomness and Error

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Statistical educators generally teach that statistics can be influenced by human choices:

**Randomness:** size and type of sample (random vs. convenience), sampling distribution, etc.

**Error/bias:** Choices that produce *subject-response bias, measurement bias and sampling bias*. E.g., the target population, the sampled population, the sampling method, the handling of non-responses

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## #3. Statistics Are Influenced by "Context"

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Statistical educators agree that statistics are numbers in context, but they don't generally teach that statistics can be influenced by human choices involving "context": choices in

- what to take into account using tables, series, ratios, comparisons and comparisons of ratios
- how to model data
- what factors not taken into account (potential confounders)

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### Hyatt: Close to the US Capital



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### Loudest Animal on Earth



#### Pond insect 'loudest animal on Earth'

A tiny 'water boatman' insect is the world's loudest animal relative to its body size, according to a new study.

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### Two Per Cent Milk



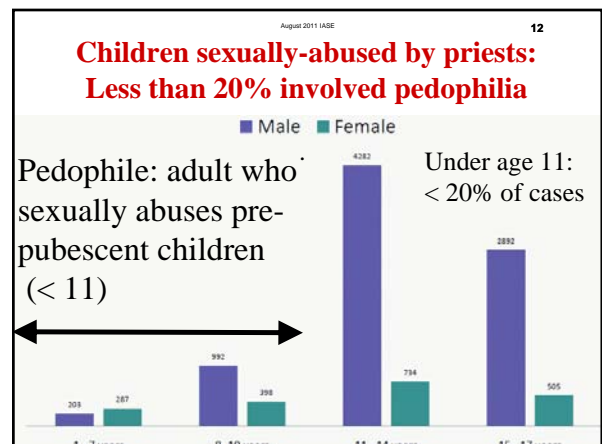
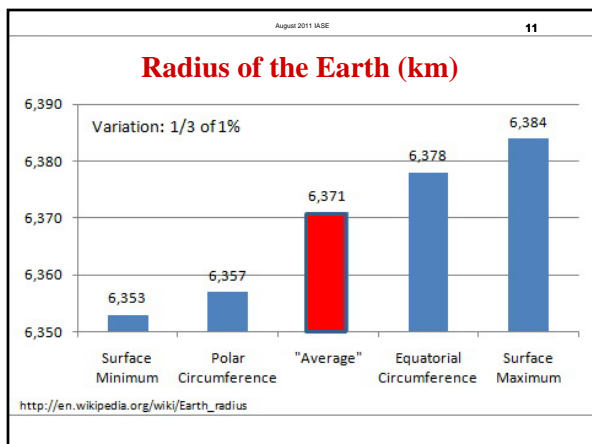
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### #4 Statistics are Influenced by "Assembly"

Statistical educators don't generally teach that statistics can be influenced by human choices in "Assembly": choices in

- definitions of groups/measures\*
- comparisons (# more vs. % more)
- presentation (pie chart vs. bar graph)

\* aside from mean vs. median...



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**Pure Assembly!!**

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**How to Teach Context and Assembly?**

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**Must involve problems that can be assessed.**

Augsburg's Statistical Literacy course has created:

- over 300 involving *Context*
- over 100 exercises involving *Assembly*

Consider ways to teach assembly using definitions

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**Definitions of statistics  
Can be Classified on a Spectrum**

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**Two Extremes for Comparisons:**

**Formal:** Need no knowledge of ideas

- Fewer tall smokers than smokers...

**Material:** Need detailed knowledge of ideas

- More autistic boys than autistic girls...

**In between:** Need some knowledge of ideas

- Men are taller than women on average.
- Women live longer than men on average.

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**Statistical educators should teach  
definitions as part of study design**

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- **Should teach formal comparisons of operational definitions.** Little knowledge of ideas is needed. Like logic/math.
- **Might delay teaching material comparisons of operational definitions.** Requires a detailed knowledge of specialized ideas. Leave this to SMEs.
- **Could selectively teach in-between comparisons of operational definitions.** At least show sensitivity of some statistics to small changes in definition.

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**Formal Compare: Operational Definitions  
Counts: Criteria-based**

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**Examples: Which count/total is larger?**

- US population; US male population?
- Not employed; Not employed *and* looking for work?
- Use of physical force ; Use *or* threat of physical force?

**Principles involving counts or totals:**

- *And* phrases and modifiers restrict options – smaller total
- *Or* phrases increase options – larger total

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**Formal Compare: Operational Definitions  
Counts: Frequency-based**

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**Examples: Which count is bigger?**

1a. Smoker: smokes *more than* five cigarettes a day  
1b. Smoker: smokes *more than* two cigarettes a day

2a. Sober: consume *less than* 3 drinks in past week  
2b. Sober: consume *less than* 1 drink in past week

**Principles involving ranges:**

- *More than X.* Larger X gives smaller count.
- *Less than X.* Larger X gives bigger count.

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**Formal Compare: Operational Definitions**  
*Counts: Duration-based*

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**Examples: Which count is bigger?**

- 1a. Smoker: smoked in the past 2 weeks
- 1b. Smoker: smoked in the past 4 weeks
- 2a. Sober: No alcohol in past 2 weeks
- 2b. Sober: No alcohol in past 4 weeks

**Principles involving time periods:**

- Event in past X periods: Bigger X, bigger number.
- Event-free in past X periods: Bigger X, smaller #.

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**Formal Compare: Operational Definitions**  
*Ratios: Compare Numerators*

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**Which ratio is larger in each group?**

1. **Percentage of US citizens** who are adults; who are adult males; who are adults or are males?
2. The US death rate due to suicide; the US death rate; the US death or emigration rate

**Principles: Changes in the Numerator:**

*And* phrases and modifiers restrict – smaller ratios  
*Or* phrases increase options – larger ratios

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**Between Compare: Operational Definitions**  
**Part-Whole Ratios**

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**General:** Minimal knowledge of ideas is needed

Examples: Which ratio is bigger?

1. US birth rate: per 1,000 adults or per 1,000 women?
- 2a. Percentage of US males who are in the military
- 2b. Percentage of the US military who are male
- 3a. Percentage of US oil **imports** that are from OPEC
- 3b. Percentage of US oil **usage** that is from OPEC

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**Study Between Operational Definitions:**  
**Part-Whole Ratios**

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**General:** Minimal knowledge of ideas is needed

Examples: Which ratio is bigger?

- 1a. Percentage of auto accidents that involve a death
- 1b. Percentage of auto death that involve an accident
- 2a. Accidental death rate per 1,000 US males
- 2b. Male-death rate per 1,000 US accidents
- 3a. Percentage of US adult prisoners who have low IQ
- 3b. Percentage of US low-IQ adults who are in prison

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**Recommendation**

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Statistical educators must go beyond chance and bias in analyzing the influences on a statistic.

We should encourage *critical thinking* about the choices that could have been made in creating statistics and how sensitive the statistics are to those choices.

We should start with the simple question: “*Where do statistics come from?*” Once people realize that all statistics are constructs, socially-constructed tools, then we can teach statistical literacy as a liberal art (an inductive activity) rather than as a mathematical skill.

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**References**

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Joel Best Articles Page: [www.StatLit.org/Best.htm](http://www.StatLit.org/Best.htm)

Schild, Milo (2007). Teaching the Social Construction of Statistics, 2007 Midwest Sociological Society, Chicago. See [www.StatLit.org/pdf/2007SchildMSS.pdf](http://www.StatLit.org/pdf/2007SchildMSS.pdf)

Schild, Milo (2010). Assessing Statistical Literacy: TAKE CARE in *Assessment Methods in Statistical Education: An International Perspective*. Edited by P. Bidgood, N. Hunt and F. Joliffe. Wiley Publishers, Ch. 11, p. 133-152.