The Importance of Random Assortment and Blinding in Qualitative Data Analysis

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Qualitative Data Analysis Contains Some Degree of Error

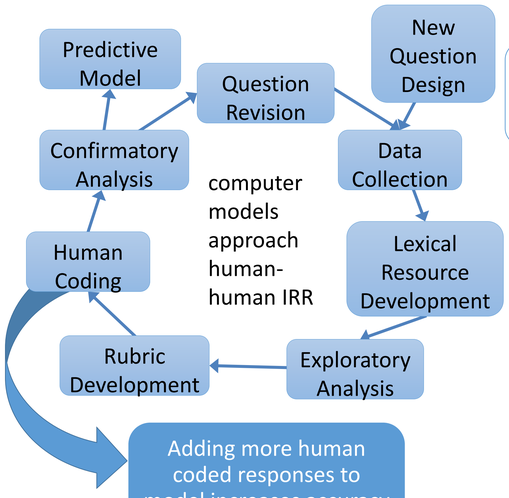
- Goal is to have error that is randomly/equally distributed
- Bias creates systematic error, which mispresents the truth

Confirmation Bias
- Common form of bias
- Prior knowledge leading researchers to confirm what they believe they know is true

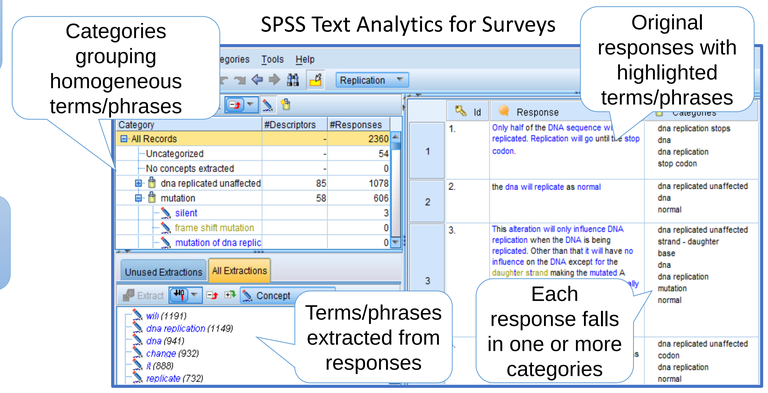
AACR Develops Computerized Coding Models

What does AACR do?

- Construct research-based Constructed Response items to evaluate students' understanding of scientific concepts
- Use computer automated techniques for Lexical and Statistical analysis of these items



How does AACR work?



Adding more human coded responses to model increases accuracy of model

How do we make the human coding process more time efficient?

Possible Solution: Instead of coding responses blindly, run responses through model and verify the codes produced by the model

But, **will having the computer codes visible (i.e., no blinding) and putting the responses in the order of the codes (i.e., no random assortment) introduce bias?**

Four Treatments to Test Effects of Blinding and Random Assortment

	No Blinding	Blinding
No Random Assortment	1. Computer codes are visible and responses are in the order of the computer codes	2. Computer codes are not visible and responses are in the order of the computer codes
Random Assortment	3. Computer codes are visible and responses are in a random order	4. Computer codes are not visible and responses are in a random order

Coded Responses to AACR Question

AACR Question

The following DNA sequence occurs near the middle of the coding region of a gene:
DNA 5' A A T G A A T G G* G A G C C T G A A G G A 3'

There is a G to A base change at the position marked with an asterisk. Consequently, a codon normally encoding an amino acid becomes a stop codon.

I. How will this alteration influence DNA replication?
II. How will this alteration influence transcription?
III. How will this alteration influence translation?

AACR question based on Genetic Concept Assessment items (GCA, Smith *et al*. 2008, *CBE, 7*, 422-430)

~2,000 responses per question
~500 responses per treatment x3

Holistic Rubric
- Correct
- Partially Correct/Incomplete
- Incorrect

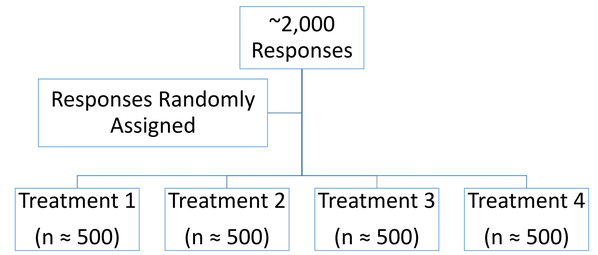
Coders met inter-coder reliability (Cohen's Kappa = 0.61 – 0.81)

Statistical Data Analysis to Compare Treatments

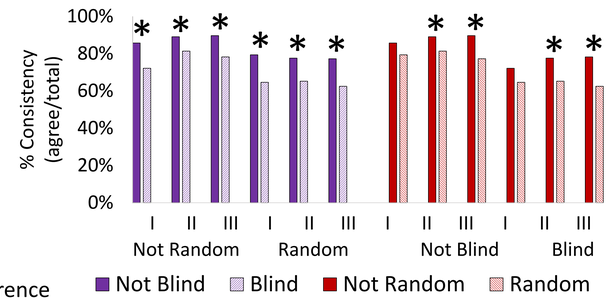
- Compared no blinding to blinding and no random assortment to random assortment using two-proportion z-test
- α = 0.05; Bonferroni Correction; 12 tests completed for each coder; significant p-value = 0.004167

Phase 1 : One Coder

Methods



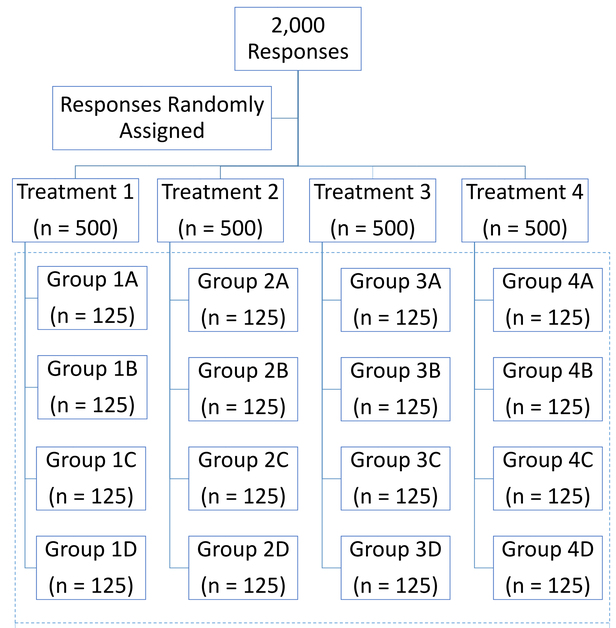
Results



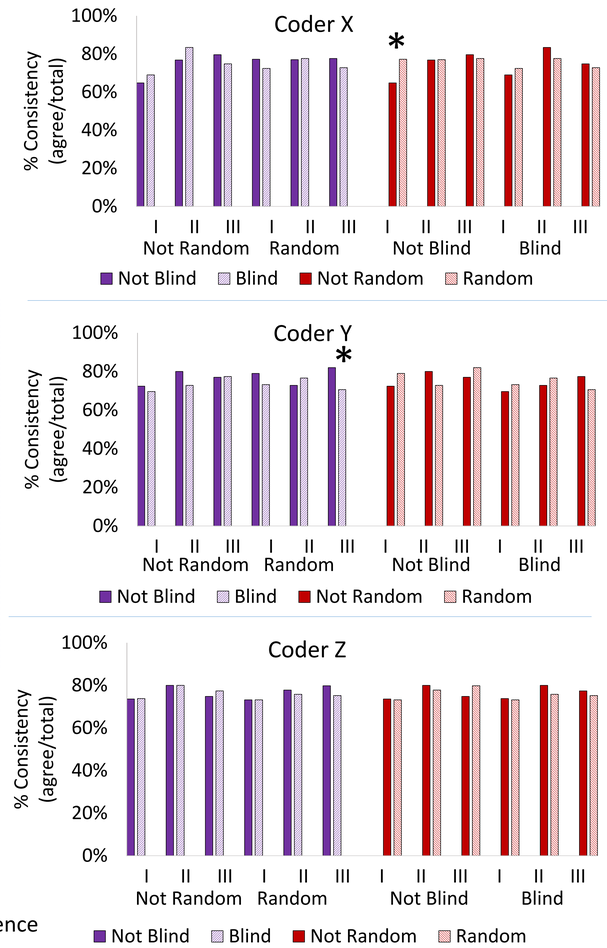
* = statistically significant difference

Phase 2: Three Coders, More Clearly Defined Rubric, and Split-Plot Design

Methods



Results



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Multiple Techniques May Reduce Bias Effects

- Phase 1: Coder agreed with the computer scores significantly more when responses were not blinded and when responses were in the order of the codes than when responses were blinded and randomly assorted.
- Phase 2: Random assortment and blinding had little to no effect on every coder.

- Blinding and random assortment may be effective methods for reducing bias in coding students' responses.
- Bias may be reduced by 1) knowing about one's own bias, 2) developing better defined rubric, or 3) using split-plot design

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