E-411 PRMA

LECTURE 8 - TEST DEVELOPMENT

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TEST CONSTRUCTION

- Now that we know why, we have to know how
- We need a set of rules for assigning numbers in measurement - scaling
- In psychology, scales are instruments used to measure traits, states, or abilities

SCALES

TYPES OF SCALES

- Nominal, ordinal, interval, or ratio
- Examples?

RATING SCALES

- Testtaker indicates their response to an item by selecting among strengths
- Examples: Stealing
- Likert-Type are common rating scales
- Scores from test could be summed (summative) directly; factor analysis or item response theory could be used

SCALE ISSUES

"People should be allowed to use marijuana for medicinal purposes"

Strongly Agree Agree Neither Agree/Nor Disagree Disagree Strongly Disagree

Are the distances the same betwen the choices?

What might affect are choices?

MORE SCALES

- Paired comparsions - choose between two options scored based on some criteria
- Comparative scaling - items are arranged based on some criteria and categorical scaling - items into two or more categories
- Guttman scale - items written in a sequential manner such that someone higher on the trait will agree with the strongest statements through the mildest statments
  - Items need to be unidimensional

LET'S WRITE A TEST!

$$\nabla \cdot \mathbf{E} = \rho/\varepsilon_0$$

$$\nabla \cdot \mathbf{B} = 0$$

$$\nabla \times \mathbf{E} = -\dot{\mathbf{B}}$$

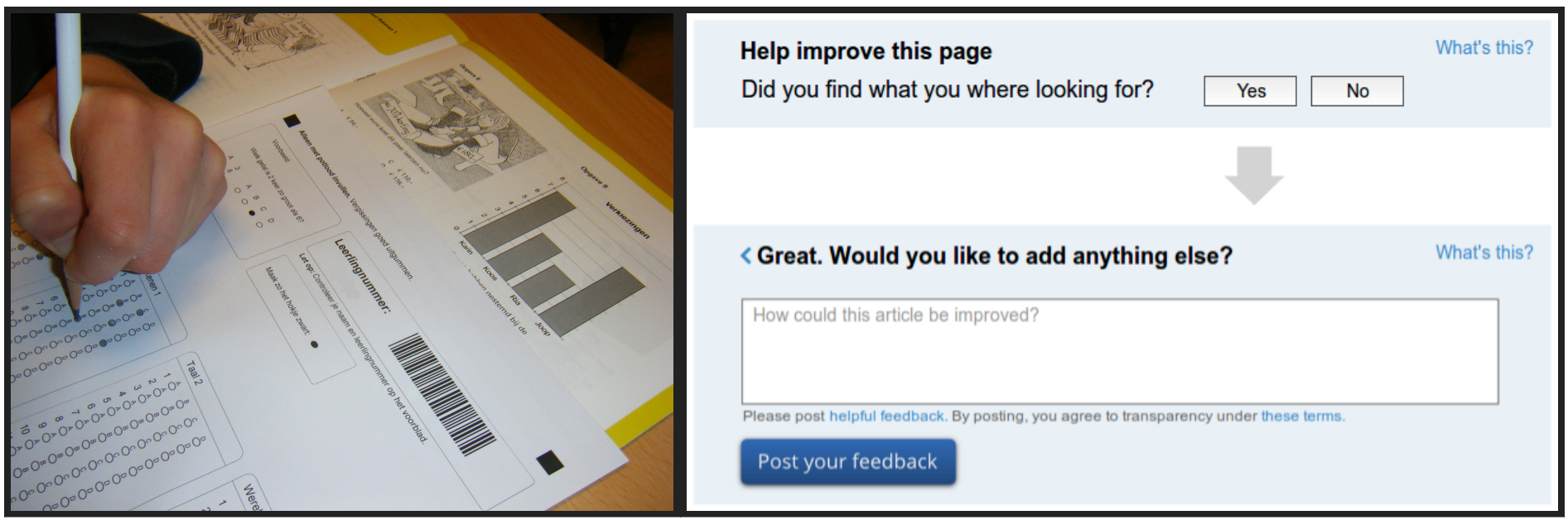
$$\nabla \times \mathbf{B} = \mu_0 \mathbf{j} + \mu_0 \varepsilon_0 \dot{\mathbf{E}}$$

WRITING ITEMS

- What content should the items cover?
- What should the format of the items be?
- How many items should be written and for each content area?
- Book recommends writing 2x the number of items for the item bank/pool . . . seems a bit excessive

TYPES OF ITEMS

Selected-response vs constructed response



SELECTED-RESPONSE

- Types
  - Multiple-choice
  - Binary-choice
  - Matching
- Each item will have a stem, correct chioce, and distractors

- A good multiple-choice item in achievement test
  - Only one correct choice
  - Grammatically parallel alternatives
  - Alternatives of similar length
  - Alternatives that fit grammatically with the stem
  - Include as much information in the stem as possible to avoid repetiiton
  - Avoids ridiculous distractors
  - Is not excessively long

FINAL THOUGHTS ON SELECTED-RESPONSE

- There are more than just true/false for binary-choice items
- Matching bank should have more answers choices than items and/or be used more than once
- Guessing is a problem in an achievement setting
- Always forcing a choice in a non-achievement setting

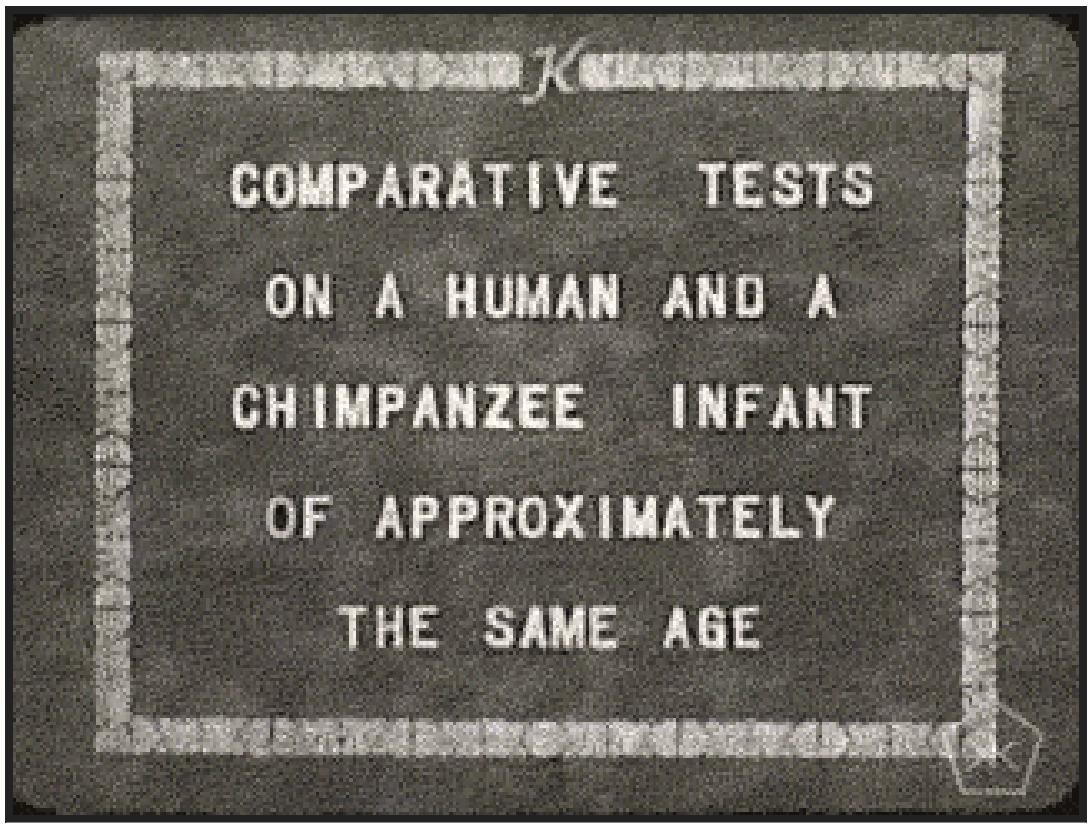
CONSTRUCTED RESPONSE

- Completion items are fill-in-the blank responses
- Short-answer items require a response of a few sentences
- Essay items are long short-answer items demonstrating deeper, more thorough knowledge
- More deeply probe a specific portion of a construct, require more time
- Subjectivity in scoring essays
- What reliability statistic would we report here?

SCORING THE ITEMS

- Cumulative model - sum up the items on the test
- Class scoring - based on pattern of responses placed with similar testtakers
- Ipsative scoring - score on a scale within a test compared to score on another scale on same test
  - Edwards Personal Preference Schedule - measures relative strength of different psychological needs
- Could look at both the cumlative scores on seperate scales and the pattern of these scores, profile analysis

PILOTING THE TEST



ITEM ANALYSIS

- Many different ways to analyze items
- Can focus on
  - Difficulty of item
  - Reliability of item
  - Validity of item
  - Discrimination of item

ITEM DIFFICULTY

- Proportion of testtakers that get the item correct
- Higher the item difficulty, the easier the item
  - item-endorsement index
- Can calculate average item difficulty for the test
- Optimal value = $\frac{\Pr(\text{Guess})+1}{2}$

ITEM DIFFICULTY - EXAMPLE

Administer an item to 10 students and 4 students get the item correct

What is the item's difficulty?

If the item was a multiple choice with 5 options, what is the optimal item difficulty?

ITEM RELIABILITY

- Internal consistency of the test
- Software often calculates changes in a reliability index (e.g. coefficient alpha) when item is deleted
- Examine factor loadings
- Calculate item-reliability index = $s_i * r_{i,\text{ttscore}}$
  - s_i, the standard deviation of item *i*
  - $r_{i,\text{ttscore}}$, correlation between item *i* and total test score

ITEM RELIABILITY INDEX - EXAMPLE

Item 1	Total Test Score
1	17
0	15
0	18
1	19
1	18

Assume correlation between item 1 and total test score is 0.7

R-CODE

```
> item <- c(1,0,0,1,1)
> ttest <- c(17,15,18,19,18)
> r <- cor(item,ttest)
> sigma <- sd(item)
> r * sigma
[1] 0.2967212
```

ITEM VALIDITY

- Item-validity index = $s_i * r_{i,\text{crit}}$
  - s_i, the standard deviation of item *i*
  - $r_{i,\text{crit}}$, correlation between item *i* and criterion measure

ITEM DISCRIMINATION

- Point-biserial correlations - Are testtakers with higher abilities more likely to get the item correct?
- IRT's discrimination parameter
- Item discrimination index
  1. Discretize total test scores into upper and lower 27%
  2. Calculate number of "high" scores that got item correct and number of "low" scores that got item correct
  3. Calculate difference
- Examine distractor functioning

Example in R

See lecture7.R

ISSUES IN TEST DEVELOPMENT

Guessing

Bias in favor of one group - differential item functioning

Test length and duration of testing session

ALTERNATIVES TO ITEM ANALYSIS

Think Alouds

Expert Panels

Interviews

Qualitative Methods

TEST REVISION

- On what basis should we revise our items?
- Too easy or too hard items?
- Items with similar difficulty that are measuring the same concept?
- Items with negative point-biserial correlations?
- Items that on a second/third read through seem unrelated to the construct?
- Items with low factor loadings?
- Based on IRT?

STANDARDIZATION

- We settle on our revisions
- Administer revised version to new sample
- This becomes our comparsion group, our standardization sample

REVISING OLD TESTS

- Tests need to be revised when the domain has significantly changed
- Content of the items is not understood or changed
- Test norms are no longer adequate
- Theory underlying the domain has changed
- Reliability and validity of the instrument can be improved

CROSS- AND CO-VALIDATION

- Cross-validation - revalidation of a test on a seperate, independent sample of testtakers
- Item validities should shrink during this process (validity shrinkage)
- Co-validation - test validation conducted on two or more tests with the same sample of testtakers
- Creating norms, co-norming
- Cheaper, reduces sampling error by norming on the same sample