Evaluating the use of 'none of the above' in multiple choice testing

Matt Pachai

McMaster University

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Outline

1) The goal of multiple choice (MC)
2) None of the above (NOTA) in MC
3) The present experiment
4) Future directions and implications

Goals of Testing

- What are your goals in testing students?
  - Assessment?
  - Discrimination?
  - Learning?

MC Guidelines

- Haladyna and Downing (1989a) examined 46 textbook passages on MC
- Produced **43** recommendations for a "good" question

Sample Guidelines

- Use Positives, not Negatives, in the Stem
- Avoid None of the Above
- Avoid complex (Type K) questions

A Bad Question

- Which of the following would not increase obedience in the Milgram experiment?
  - i. Moving the experimenter to another room
  - ii. Moving the experiment to a run down building
  - iii. Dressing the experimenter in dirty clothes
  - iv. Moving the learner closer to the teacher
    - a) i and ii
    - b) ii and iii
    - c) i, ii, and iii
    - d) iii and iv
    - e) None of the above

Empirical Support

- Only **half** of these recommendations were empirically examined
- A clear need for rigorous examination remains

Haladyna and Downing, 1989b

Measurement Tools

- How do we examine our test's ability to achieve our goals?
  - **Difficulty:** Percent Correct
  - **Discrimination:** Point-biserial correlation
  - **Learning:** Retention

Performance

- A simple way to measure knowledge at two levels
- **Students:**
  - How many questions did each student answer correctly?
- **Concepts:**
  - What percentage of students got a particular question correct?

Point-Biserial Correlation

- A measure of a question's ability to discriminate between students

- What is the correlation between the answers for a particular question and each students' final score?

Point-Biserial Correlation

Options

Grade Category	A	B	C*	D
% A	0	0	90	10
% B	5	2	83	11
% C	5	1	66	27
% D	23	5	35	37
% F	32	7	37	24

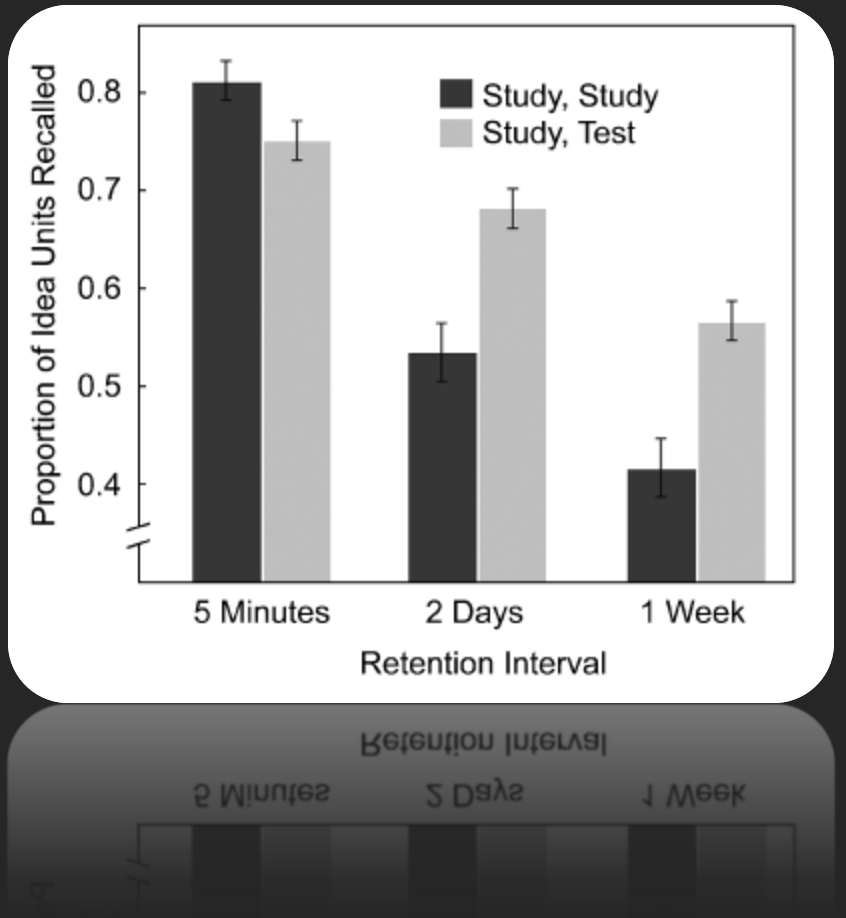
Point-biserial correlation = 0.32

Retention Experiments

- Cognitive psychologists have extensively studied retention of material
- **Basic Paradigm:**
  - Session 1: teach a concept
  - Session 2: test retention after a delay

The Positive Testing Effect

- Numerous studies suggest testing improves learning



Carpenter et al., 2008; Roediger and Karpicke (2006)

The Impact of Flaws

- Flawed questions are more difficult (Downing, 2005)
- Test flaws may hurt high achieving students more than low (Tarrant and Ware, 2008)

Specific Flaws

- Previous studies classify flawed questions based on a large number of guidelines
- Hard to decipher which specific flaws have which specific effects

The Case of NOTA

- In a recent review, **48%** of textbook authors agreed that NOTA should be avoided (Haladyna et al., 2002)

Empirical Evidence

- The few studies examining NOTA have produced mixed results
- NOTA may:
  - increase difficulty and discrimination
  - not change difficulty and discrimination
  - increase difficulty but not discrimination

Mixed Messages

- “When NOTA is correct… it rewards examinees with serious knowledge deficiencies or misinformation” … “Any stem or option format that reduces an item’s ability to distinguish between candidates with full and misinformation should not be used” (Gross, 1994)

Mixed Messages

- “NOTA should remain an option in the item-writer’s toolbox, as long as its use is appropriately considered. However, given the complexity of its effects, NOTA should generally be avoided by novice item writers.” (Haladyna et al., 2002)

General Questions

- What effect does NOTA have on:
  - Assessment?
  - Discrimination?
  - Learning? (not addressed today)

Our Study

- We examined NOTA on two of our Introductory Psychology examinations (approx **3000** students/year)
- Advantages of our population:
  - A large class
  - Highly motivated students
  - Topical questions, basic and applied

Test Design

- Five versions of each test were produced
- Each test contained 5 experimental questions, randomly distributed

Conditions

- Each test version had one question in each of the following conditions:
  - No NOTA (control)
  - NOTA as key
  - NOTA replacing distractor #1
  - NOTA replacing distractor #2
  - NOTA replacing distractor #3

Summary of Design

	FORM 1
Q1	Normal
Q2	NOTA D3
Q3	NOTA D2
Q4	NOTA D1
Q5	NOTA key

Sample Question: Normal

- **Harlow's** studies of infant monkeys raised with **surrogate** mothers indicated that infants became attached to the surrogate mother:
  a) from which **food** was most often delivered.
  b) that provided the most contact comfort.
  c) that was present when **danger** was presented.
  d) that was present for the greatest amount of **time**.

Sample Question: NOTA Key

- **Harlow's** studies of infant monkeys raised with **surrogate** mothers indicated that infants became attached to the surrogate mother:
  a) from which **food** was most often delivered.
  b) that was present when **danger** was presented.
  c) that was present for the greatest amount of **time**.
  d) None of the above

Sample Question: NOTA D1

- **Harlow's** studies of infant monkeys raised with **surrogate** mothers indicated that infants became attached to the surrogate mother:
  - a) **that provided the most contact comfort.**
  - b) that was present when **danger** was presented.
  - c) that was present for the greatest amount of **time**.
  - d) None of the above

Sample Question: NOTA D2

- **Harlow's** studies of infant monkeys raised with **surrogate** mothers indicated that infants became attached to the surrogate mother:
  a) from which **food** was most often delivered.
  b) that provided the most contact comfort.
  c) that was present for the greatest amount of **time**.
  d) None of the above

Sample Question: NOTA D3

- **Harlow's** studies of infant monkeys raised with **surrogate** mothers indicated that infants became attached to the surrogate mother:
  a) from which **food** was most often delivered.
  b) that provided the most contact comfort.
  c) that was present when **danger** was presented.
  d) None of the above

Recoding Distractors

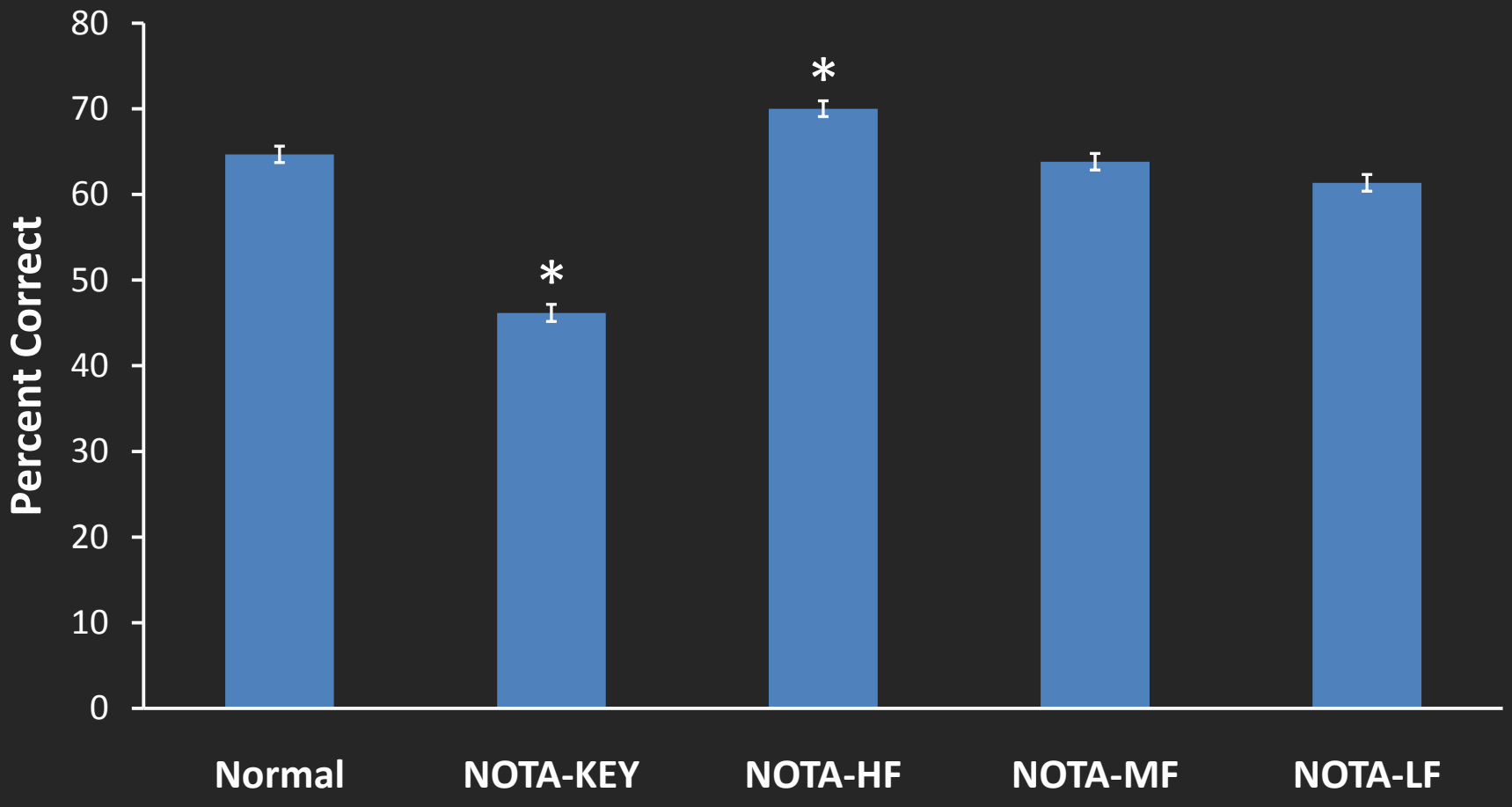
- Distractors were recoded as either high frequency, middle frequency, or low frequency selections

- **Harlow's** studies of infant monkeys raised with **surrogate** mothers indicated that infants became attached to the surrogate mother:
  a) from which **food** was most often delivered. (**HF:** 19%)
  b) that provided the most contact comfort.
  c) that was present when **danger** was presented. (**LF:** 4%)
  d) that was present for the greatest amount of **time**. (**MF:** 17%)

Analysis

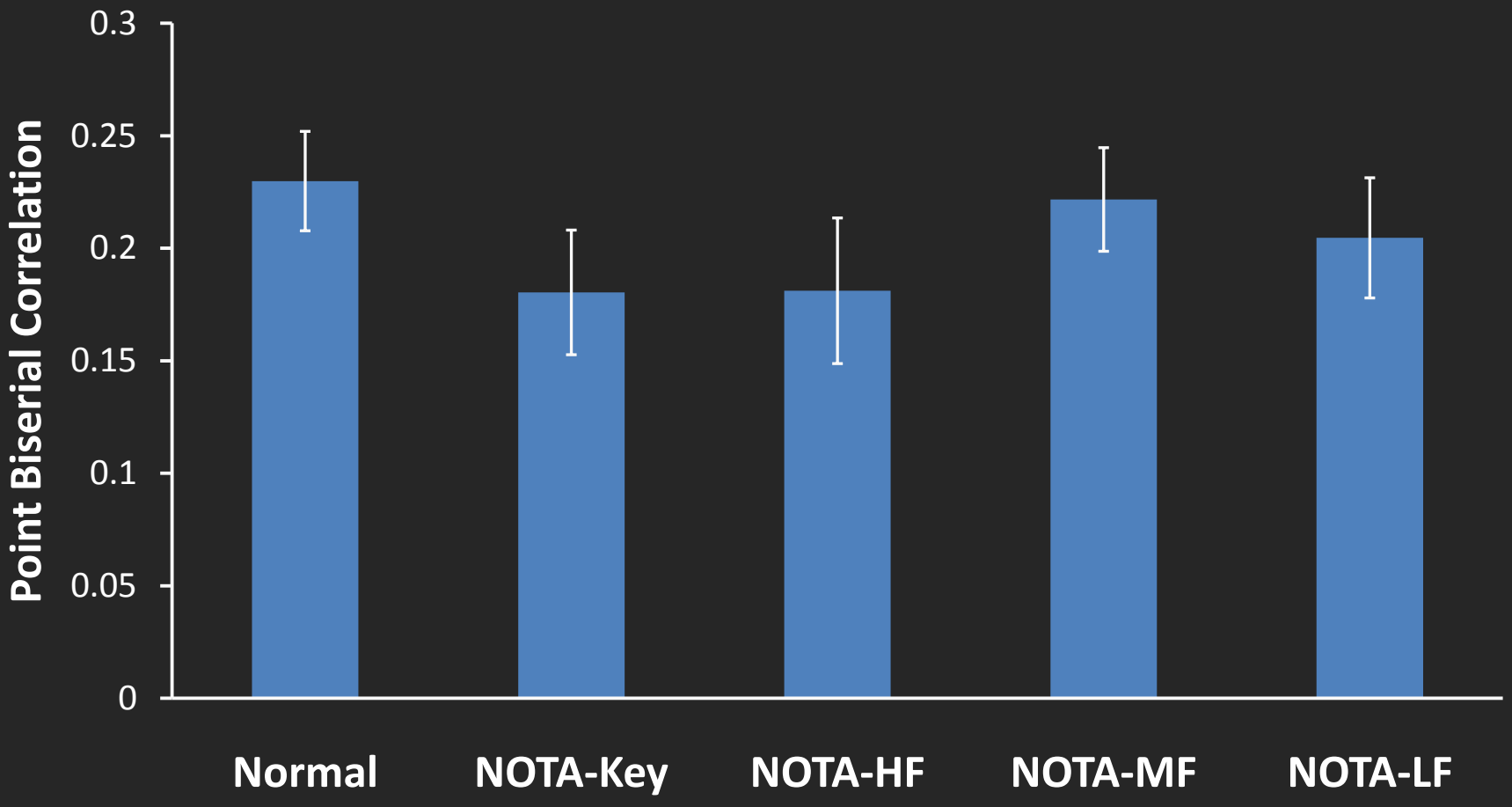
- Independent Variable: Condition
  - Normal
  - NOTA-Key
  - NOTA-HF
  - NOTA-MF
  - NOTA-LF
- Dependent Variables
  - Performance (% correct)
  - Discrimination (point-biserial correlation)

Performance



* = $p < 0.001$

Discrimination



$p > 0.05$

Implications

- What effect does NOTA have on:
  - **Assessment:**
    - **Key**: Increased difficulty
    - **Distractor:** Less effective than a good distractor
  - **Discrimination:** No effect
  - **Learning:** Negative testing effect? (Odegard and Koen, 2007)

Future Directions

- When NOTA is the correct answer, do the students selecting it know the truth?
  - Fill in the correct response for a bonus

General Conclusions

- Understanding the specific effects of writing “errors” is highly important

- Test writers should be thoughtful in question writing
  - Questions should be matched to the goals of the test

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Questions?

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