Ordering Effects in Multiple-choice Exams and Interviews

Paula V. Engelhardt,

Sanjay Rebello

Kansas State University

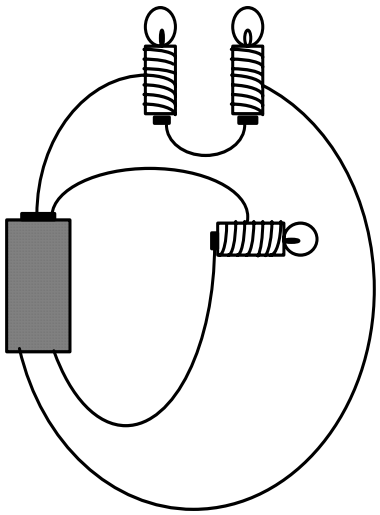
Physics Education Research Group

Supported in part by NSF Grant # REC-0133621

Research Question

- Does the order in which we ask students questions affect the information that we receive?
  - Multiple choice test
  - Interviews

Part 1 – Multiple choice test



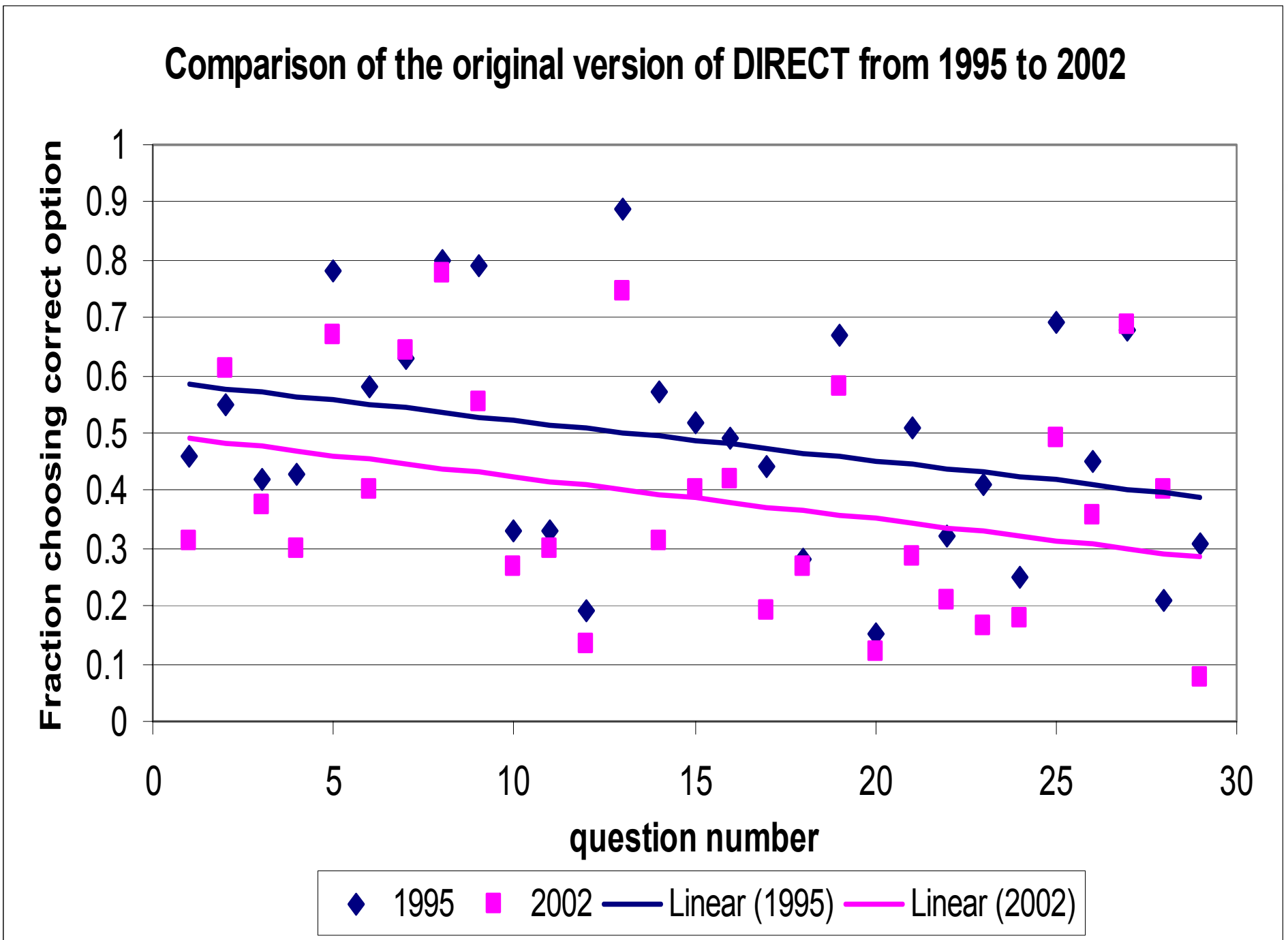
Determining and
Interpreting
Resistive
Electric Circuits
Concepts
Test **Version 1.0**

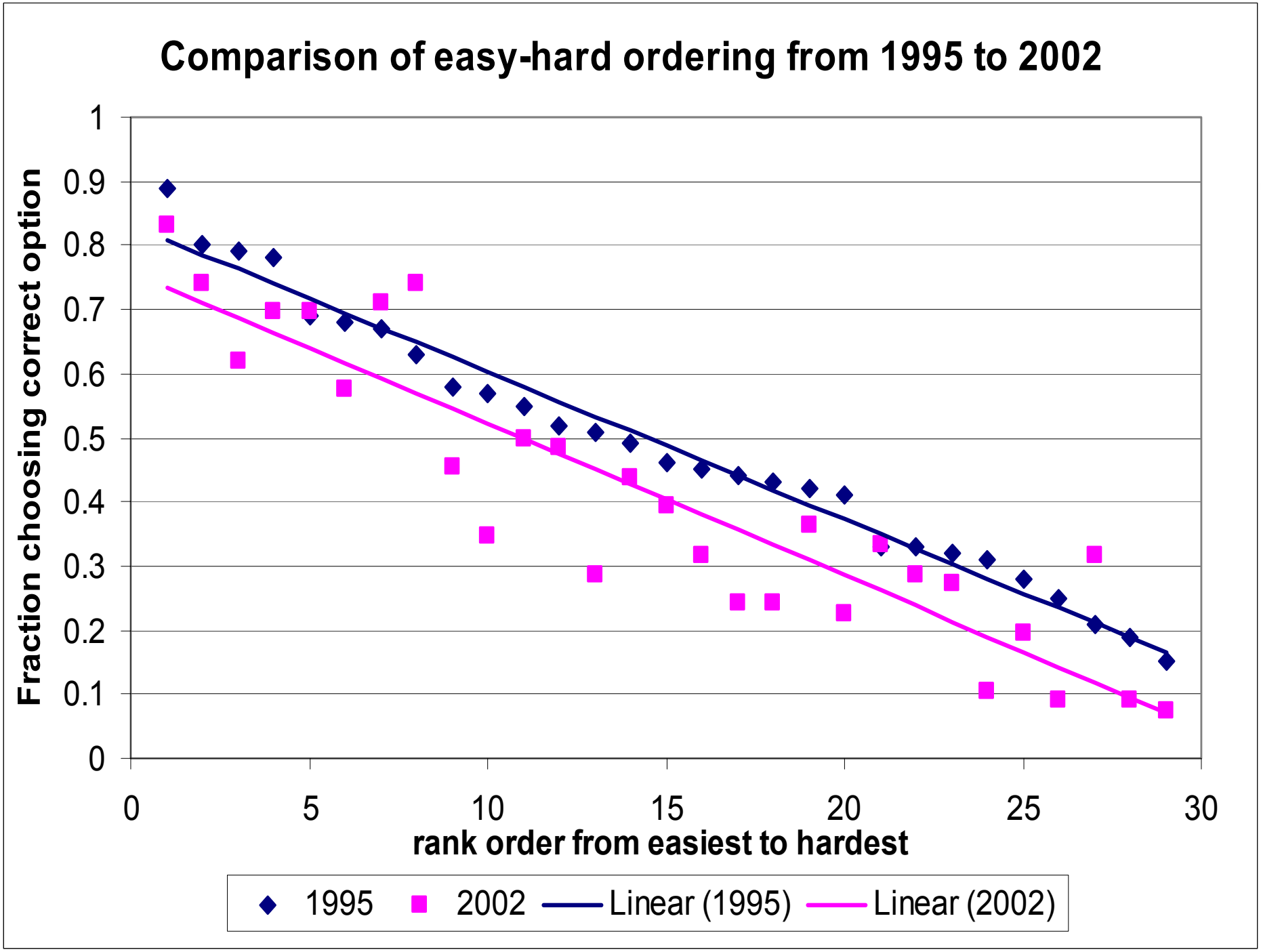
Paula V. Engelhardt and Robert J. Beichner
North Carolina State University ©1995

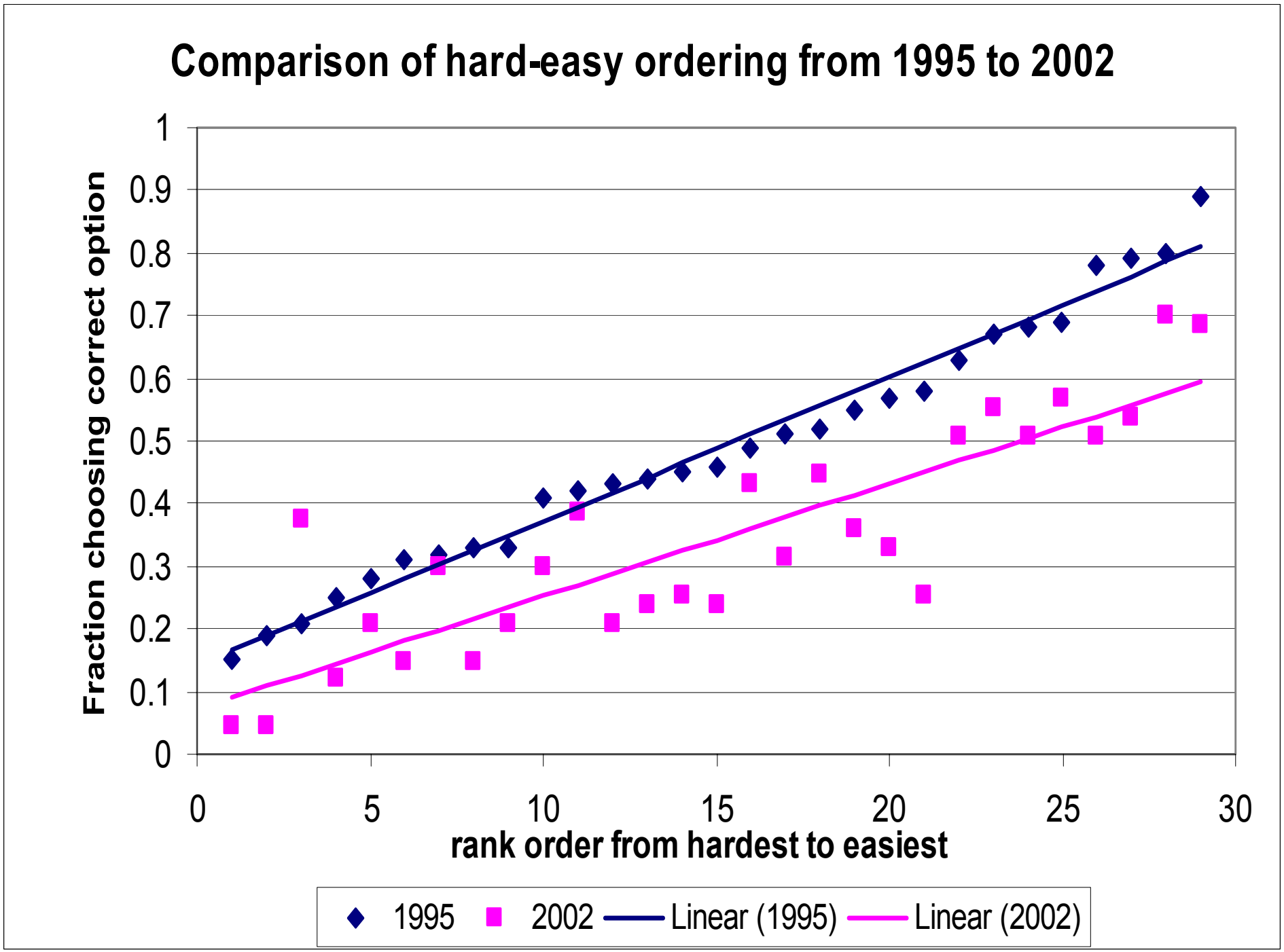
- DIRECT version 1.0
  - 29 items
  - D.C. resistive electric circuits
  - Conceptual
  - Post test
- Four versions
  - Original version (O)
  - Easy to hard (EH)
  - Hard to easy (HE)
  - Grouped by concept (C)

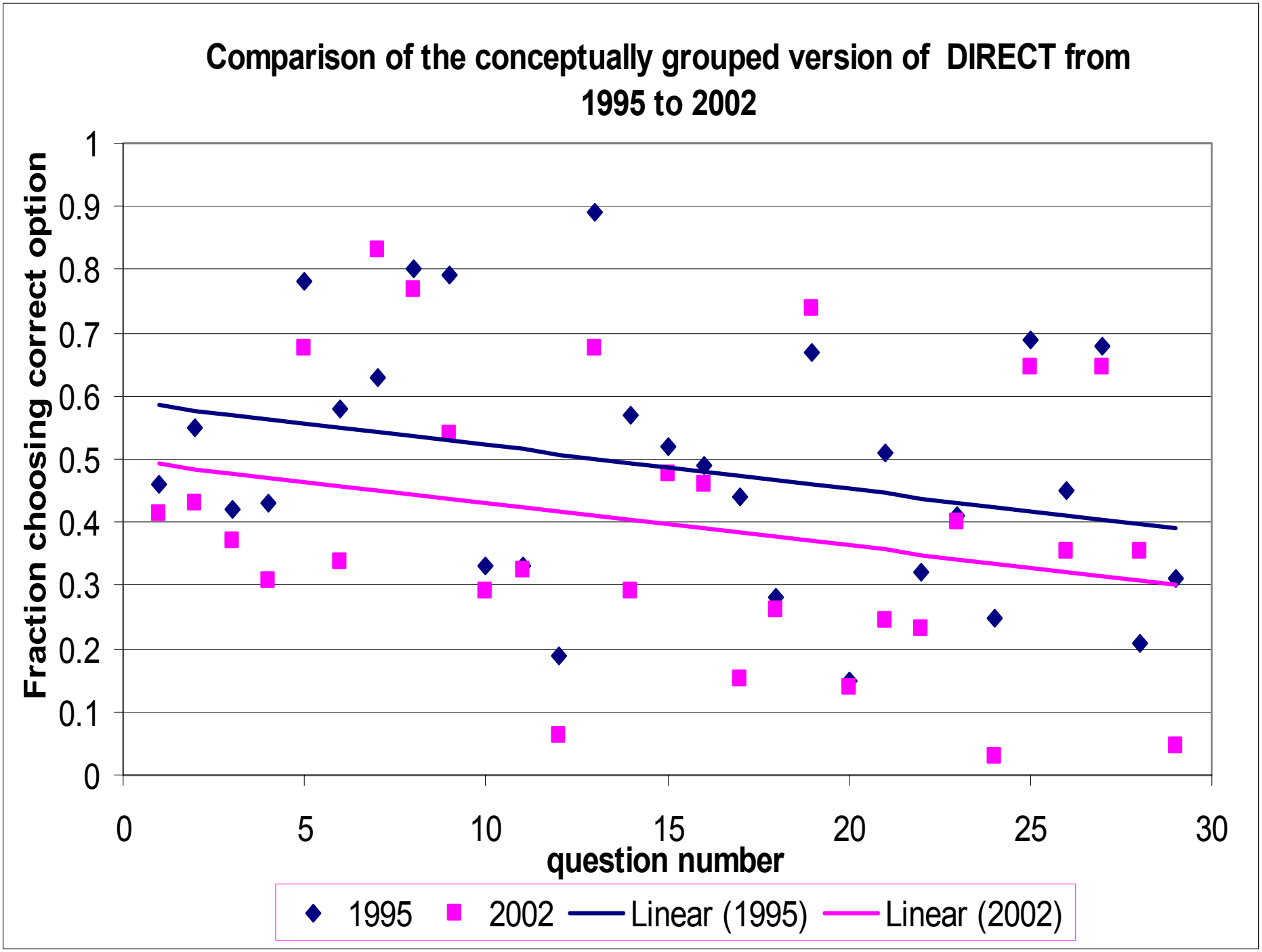
Sample

- General Physics II (N=154 pre N=147 post)
  - Algebra based
  - Given in lab
  - No compensation for taking
- Conceptual Physics (N=117 pre N=118 post)
  - Given in lecture
  - Extra credit given for taking
    - Pre-test 5 pts for having taken
    - Post-test 0.5 pts for each correct


Comparison of the original version of DIRECT from 1995 to 2002
Fraction choosing correct option
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
question number
1995
2002
Linear (1995)
Linear (2002)


Comparison of easy-hard ordering from 1995 to 2002
Fraction choosing correct option
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
rank order from easiest to hardest
1995
2002
Linear (1995)
Linear (2002)


Comparison of hard-easy ordering from 1995 to 2002
Fraction choosing correct option
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
rank order from hardest to easiest
1995
2002
Linear (1995)
Linear (2002)


Comparison of the conceptually grouped version of DIRECT from 1995 to 2002
Fraction choosing correct option
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
5
10
15
20
25
30
question number
1995
2002
Linear (1995)
Linear (2002)

Results

- ANOVA (pre)
  - p=0.011 N=270
  - Rank order from lowest to highest average
    - Version HE (hard-easy) x = 8.37
    - Version EH (easy-hard) x = 8.77
    - Version C (concept) x = 9.50
    - Version O (original) x = 10.26
- ANOVA (post)
  - p=0.011 N=264
  - Rank order from lowest to highest average
    - Version HE (x = 9.93)
    - Nearly equal on other three versions
      - Version EH (x = 11.70)
      - Version C (x = 11.50)
      - Version O (x = 11.24)

Conclusions

- Students appear to perform differently depending on the arrangement of questions
- When ordered from hard to easy, students do not perform as well
- When using a test bank, need to be careful how the items are ordered

Research Question

- Does the order in which we ask students questions affect the information that we receive?
  - Multiple choice test
  - Interviews

Part 2 - Interviews

- DC resistive circuits concepts
- Semi-structured demonstration
  - Pre-instruction
    - Determine initial knowledge base
  - Post-instruction
    - Determine how knowledge was applied to real world contexts

Sample

- Conceptual Physics students
  - N=10 pre-instruction
  - N=8 post-instruction
  - Students same pre to post
- Given extra credit for participating

Protocol

Scenarios	Examples	
	Real World	Contrived
1	1.5 V D Cell	Lemon battery
2	Make a flashlight light given top of flashlight, 2 batteries and 2 wires	Make a Christmas tree bulb light given the bulb, a large socket connected to a battery
3	3 flashlights – 1 working and 2 not – problem solve	3 circuits consisting of a bulb and battery – 1 working and 2 not – problem solve
4	Bulb connected to a household dimmer switch	Bulb connected to a rheostat and 6V battery

Tentative conclusion

- Examples with components that were in clear view to the students seem to cue more ideas resulting in a more descriptive discussion of the phenomena

For further information

E-mail: engelhar@phys.ksu.edu

http://www.phys.ksu.edu