

# High School Teachers' Conditional Probability Content Knowledge

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## Background

Most state governments in the USA have recently adopted the Common Core State Standards (NGA & CCSSO, 2010). The Common Core contains substantially more probability and statistics than most prior curricula. Many current math teachers have never taught the new topics and lack pedagogical knowledge. Some teachers have not seen the content since college courses years ago.

To gather information on teacher strengths and weaknesses, I conducted face-to-face interviews with practicing US high school (Grades 9 – 12) mathematics teachers. I chose questions on the relatively un-studied area of conditional probability.

During the interviews, participants worked tasks, explained their solutions, and then discussed possible student approaches and misconceptions. Interviews also explored teachers' views about probability and assistance they would like to have. Results on pedagogy and views will appear in my forthcoming dissertation.

## References & Thanks

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The College Board (2010). *AP Statistics Exam, Form B*. New York, NY: Author.  
Kahan, D. M., Peters, E., Dawson, E. C., & Slovic, P. (2013). Motivated Numeracy and Enlightened Self-government. *Yale Law School, Public Law Working Paper No. 307*.  
Mathematics Assessment Resource Service. (2012). *Modeling Conditional Probabilities 1: Lucky Dip*. Nottingham, UK: University of Nottingham & UC Berkeley.  
National Governors Association Center for Best Practices & Council of Chief State School Officers [NGA & CCSSO] (2010). *Common Core State Standards (Mathematics)*. Washington, DC: Authors.

Thanks to the interview participants, Jessica Bishop for lending the video equipment, my advisor Jennifer Kaplan, and my committee.

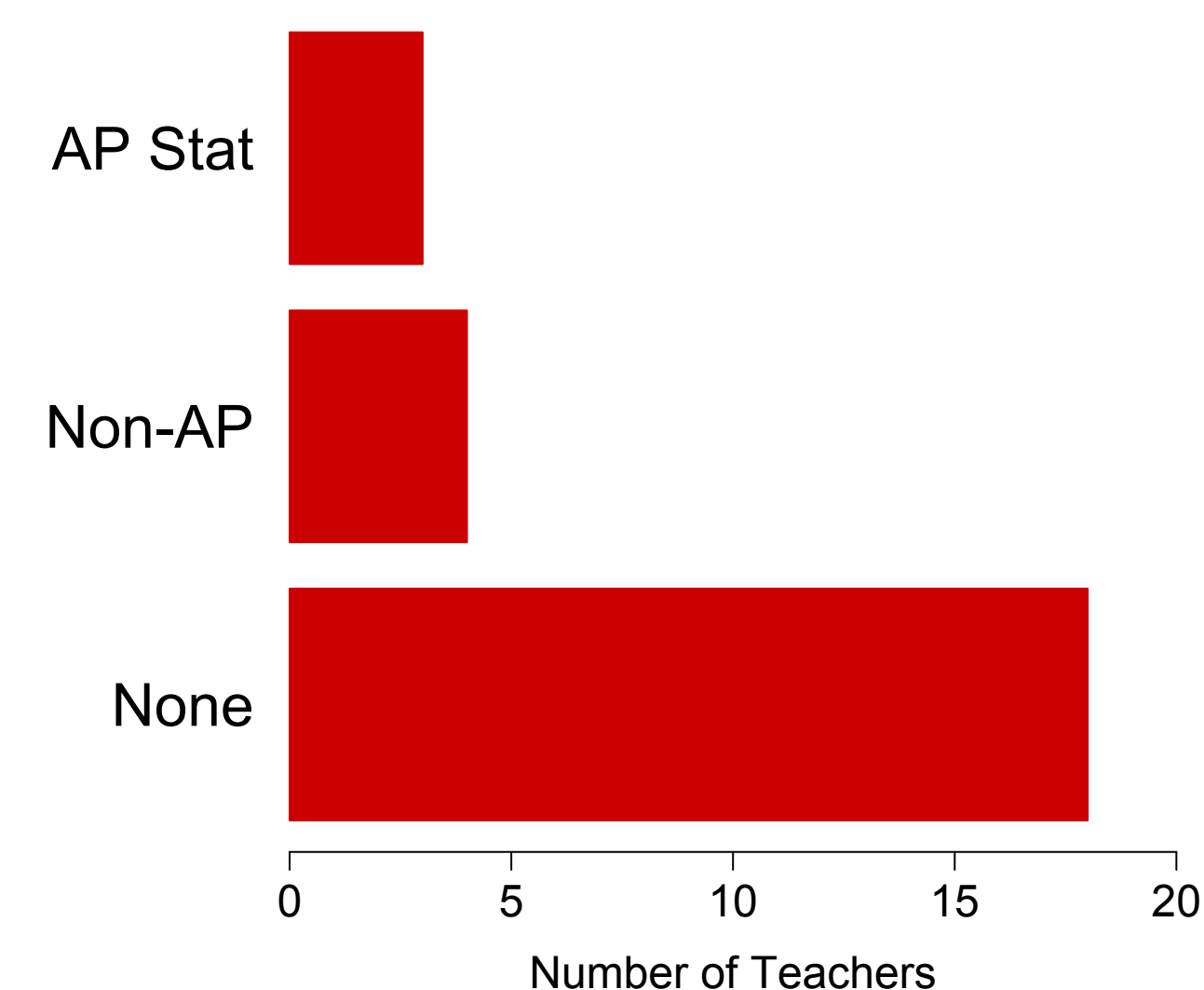
## Participants

I found participants through personal, professional, and family contacts. Though not a representative sample, interviewed teachers had diversity in age and experience. Teachers came from 3 states:

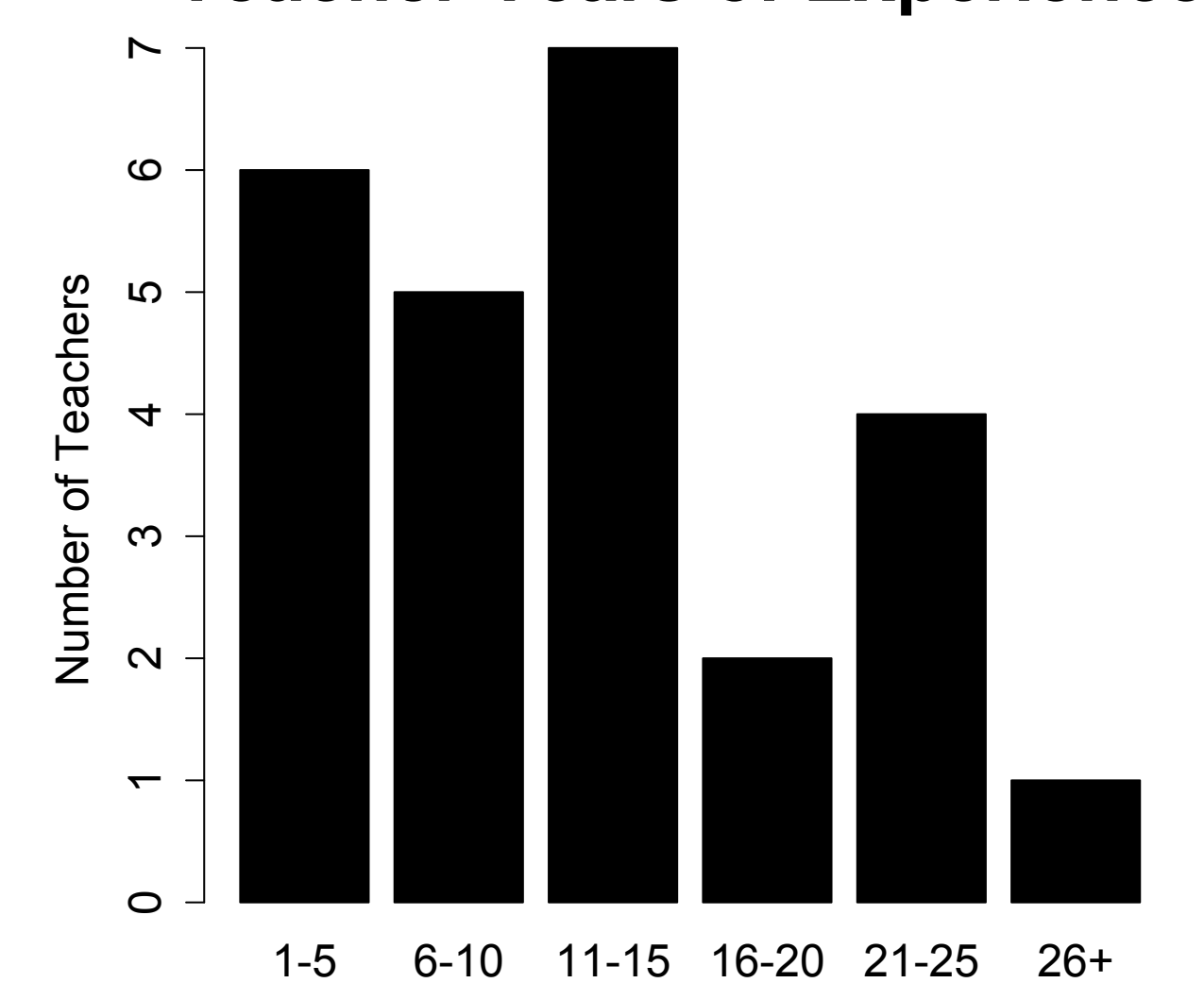
9 teachers from rural and suburban Pennsylvania  
8 teachers from suburban South Carolina  
8 teachers from urban and suburban Georgia

Males 8   17 Females

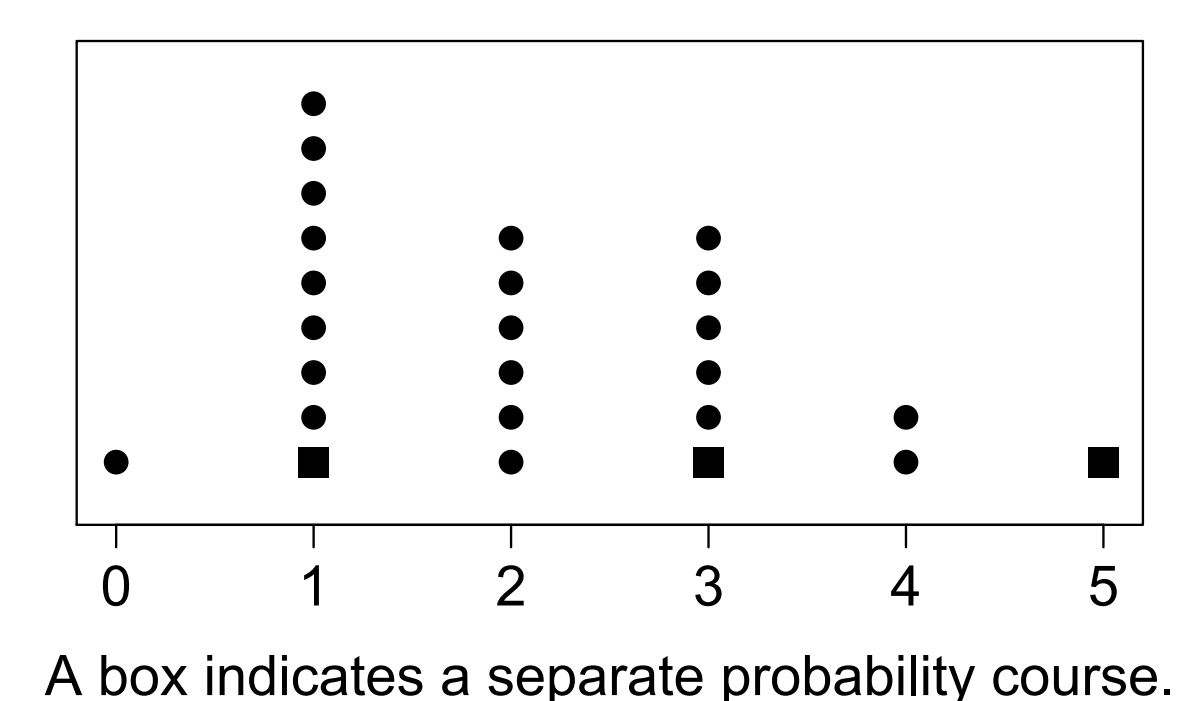
### Prob & Stat Course Teaching



### Teacher Years of Experience



### College Probability and Statistics Courses



## Task Questions

**Rash** (Kahan, Peters, Dawson, & Slovic, 2013)  
Evaluate effectiveness of a new cream for rashes based on experiment results in a 2x2 table.

**Lucky Dip** (Mathematics Assessment Resource Service, 2012)  
Determine probability of matching color of 2 balls drawn from a bag with 3 white and 3 black balls.

**Survey** (The College Board, 2010)  
Using a table with 5 rows and 3 columns,  
A) Compute a joint probability with overlap.  
B) Read table to find a conditional probability.  
C) Determine if two events are independent.

**Taxicab** (Bar-Hillel, 1980)  
Find  $P(B|A)$  via Bayes' formula or other methods, given  $P(A|B)$  and other information in a legal scenario involving a car accident.

**ELISA** (The College Board, 2009)  
Given written information about lab test results and the presence of HIV in blood samples,  
A) Read a probability from given information.  
B) Compute a conditional probability.  
C) Compute the probability of a complicated scenario involving false positives.

## Discussion

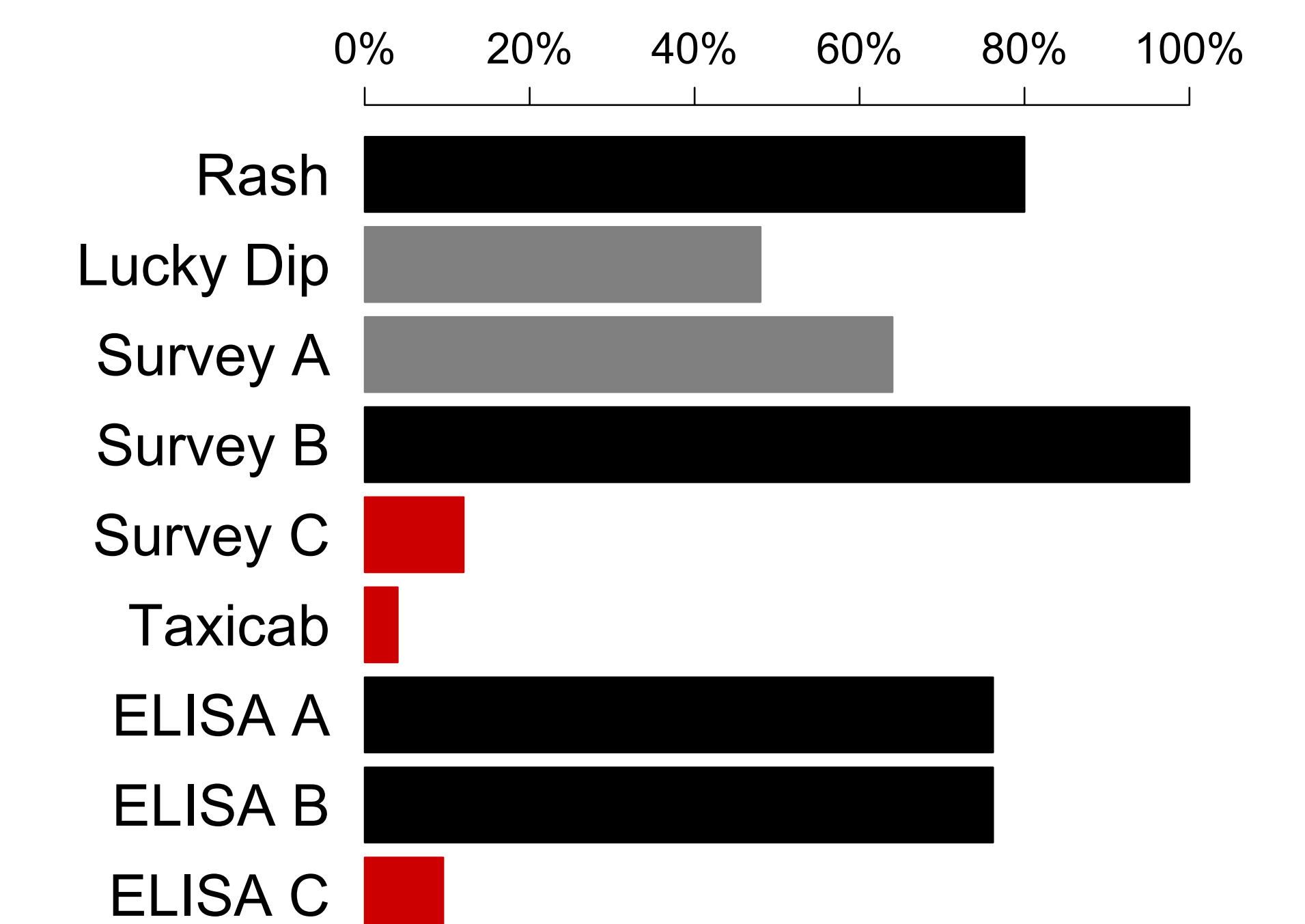
Although the scores appear low, we should NOT use these results to criticize teacher ability. Participants did not prepare beforehand, and most teachers do not currently teach probability. It is a little worrisome that probability and statistics teachers did not do substantially better.

Teachers did well on problems that involved reading tables and text, direct questions like many standardized tests. Poor performance is not surprising on Taxicab and ELISA C, complex questions designed for Advanced Placement and college courses, not the general high school curriculum.

## Correct Responses

Overall 52% Course Teachers 59%

No teacher answered all 9 questions correctly; one answered 8 and two answered 7.



We should consider ways to support the learning and teaching of conditional probability. Many teachers desired prepared tasks for classroom use.

Researchers should investigate how teachers and students understand the word "independence", a key term in probability and statistics. Only 3 participants did a proper test in Survey C. 3 used an incorrect formula; 10 mentioned overlap (not mutually exclusive); 8 said the events were independent because people did one but not the other (not a subset); and 1 gave another incorrect definition.