Developing a Coding Scheme for Free Response Survey Questions

Application to First Year Physics Labs

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Transforming First Year Physics Labs

- In the process of transforming physics labs from a traditional recipe method to a more exploratory lab based in PER research
- Comparison of two physics labs:
  - **Physics 100:** Undergone extensive transformation (See G. Reiger's Poster)
  - **Physics 101**: Traditional recipe-like physics lab, but plan to do a similar transformation as P100
- Use P100 transformation to inform P101, so survey students to evaluate the efficacy of P100

The survey

- Developed by Jim Carolan
- 4 Likert scale-response statements (with space for comments)
- 3 open-response questions:
  1. Please write a few sentence synopsis of your experience today (what did you do, what did you learn…)
  2. Please, list a few changes (if any) that could make this lab a better learning experience
  3. Please, list the aspects of this lab that were the biggest contributor to your learning today
  - Focus of the coding scheme
- Surveys given to students in P100 first term and P101 second term

Types of Student Feedback

- From the surveys hope to learn:
  - Student's perspectives on labs
  - What students learned
  - What students think could be improved
  - What students thought was useful
  - What students liked
  - And why
- All of this is embedded in qualitative student responses to free response questions.
- Need to develop a method to translate into quantitative information

Definition: Coding Method

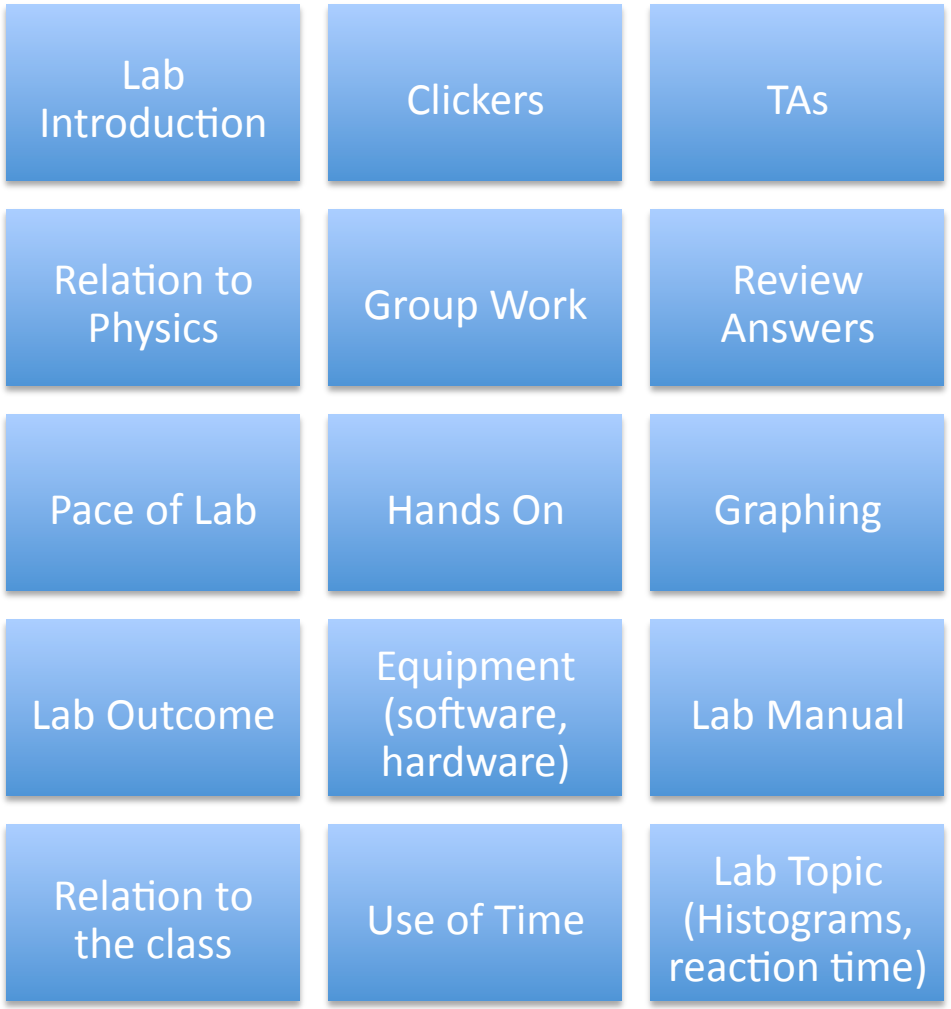
- A set of defined categories used to place open-response statements
- Consistently and reliably translates qualitative free-response survey answers to quantitative information

Developing a coding scheme, step 1: Start with some ideas for categories

- We began with Georg Rieger and Cynthia Heiner's two-stage exam work (***Examinations That Support Collaborative Learning: The Students' Perspective*****,** Journal of College Science Teaching, Vol. 43, No. 4, pp. 41-47 (2014))
- Their categories included
  - Emotions/opinions/attitudes
  - Learning and feedback
  - Group dynamics
  - Grades

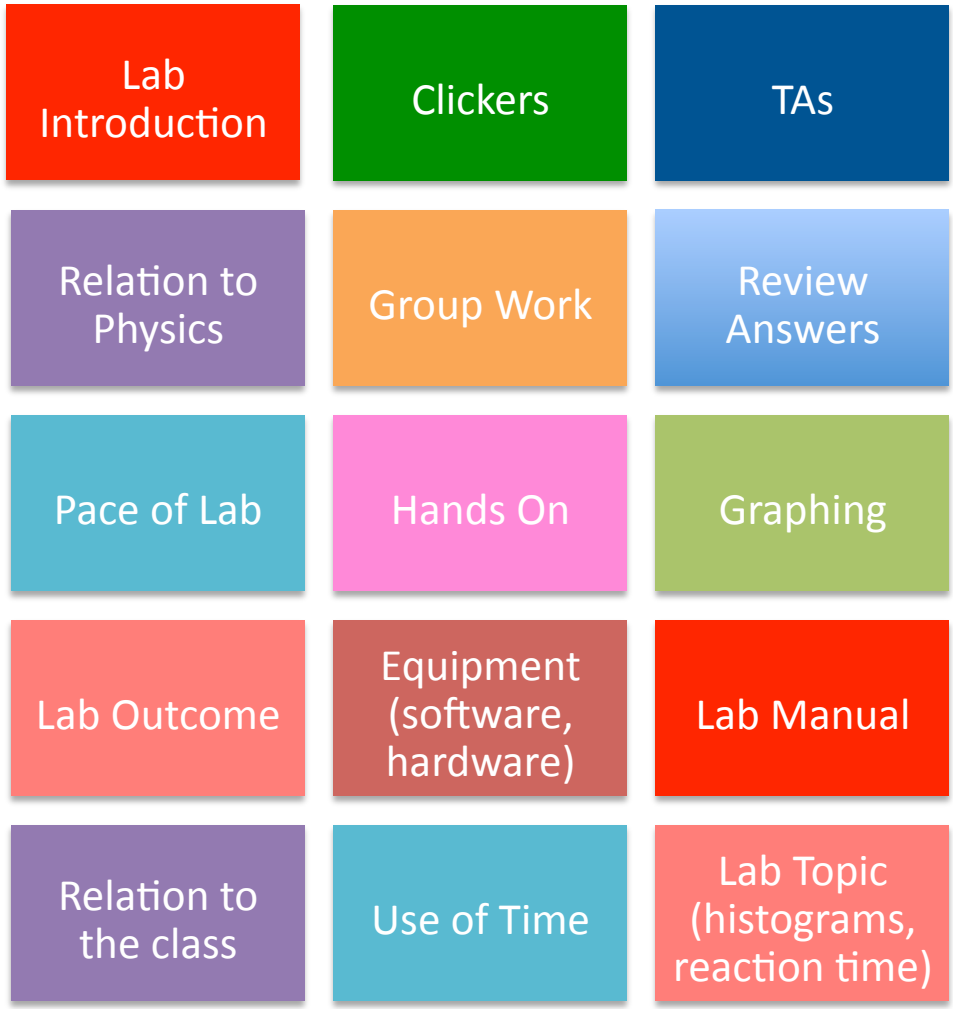
Developing a coding scheme, step 2: Skim a lot of completed surveys

- Started with 60 surveys from Physics 100
- Skimmed surveys and noted common topics and possible responses
- Note possible codes within categories
  - Positive/helpful for learning
  - Negative/change suggested
- Build notes into draft coding scheme



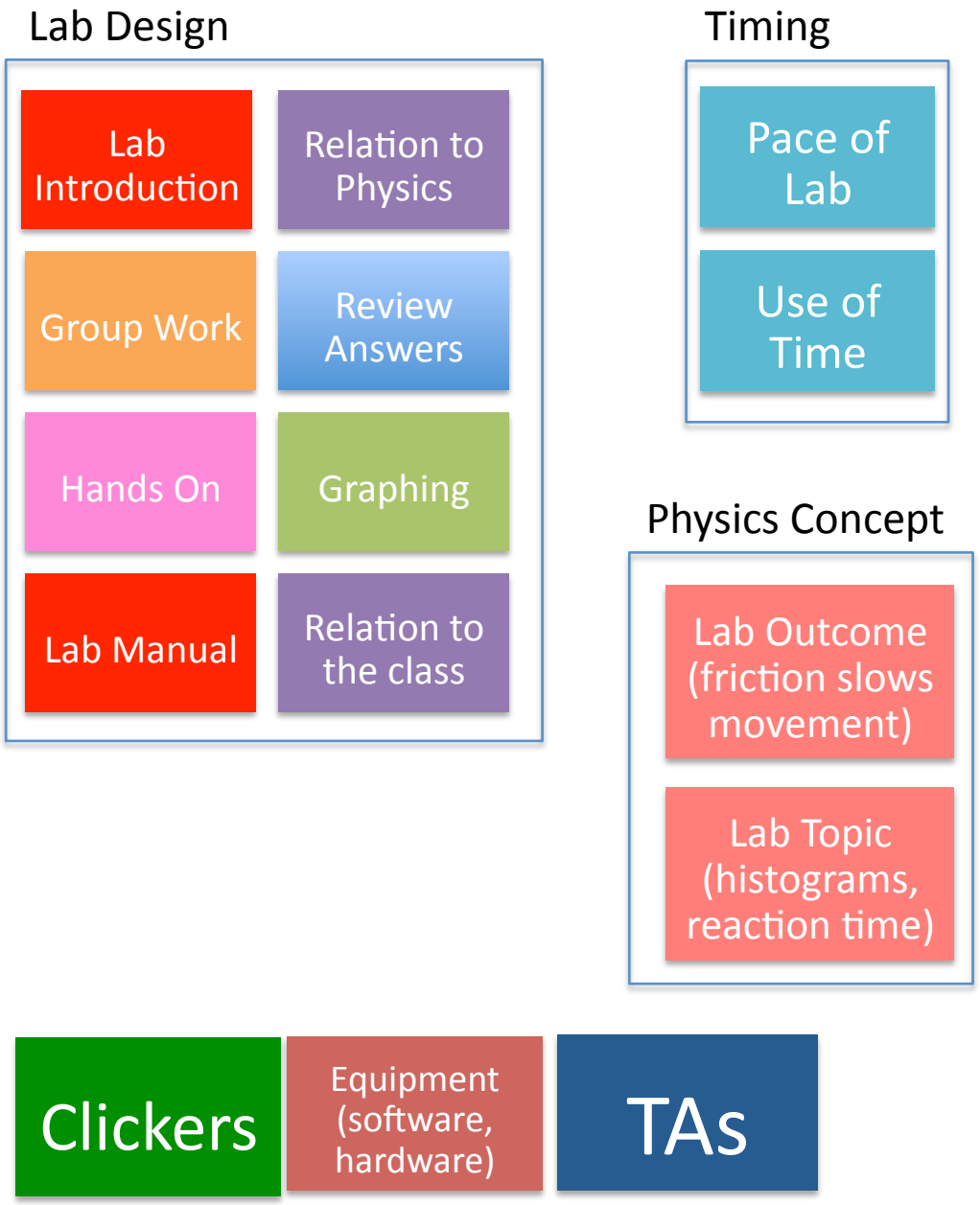
Draft Coding Scheme

- Group common topics/ responses together
- Some categories are clear:
  - Clickers
  - TAs
  - Equipment
  - Lab timing
  - Group work
- Some less easy to place:
  - Relation to physics/class
  - Hands on nature of lab
  - Mentions of activities (eg. Graphing)
  - Lab introduction and manual related to reviewing answers



Draft Coding Scheme

- Combine categories to streamline coding scheme
- 'Topic' and 'Learning outcome' combined into 'Physics concept'
- 'Worksheet' and 'Instructional Set-up' combined into 'Lab design'



Developing a coding scheme, step 3: Code, compare, refine, repeat

- We worked on this as a partnership (Sophie & Jared)
- Code the 60 surveys we skimmed with the draft coding scheme
- Think about suitability of categories and codes during, compare results after
- Combine or split categories as needed.
- Add additional codes within a category as needed
- Repeat until satisfactory coding scheme developed

Developing a coding scheme, step 4: Confirm inter-rater reliability

- Confirm reliability of coding scheme by having two people code independently
- Compare results of coding
  - (Agreed on codes) / (Average total number of codes) = interrater reliability
  - Aiming for 85 – 90% (in progress)
- Important for trusting results

General Codes

- Decided on 10 categories (eg. TAs, Lab Design, Clickers)
- Each category broken into codes
- Typical codes:
  - Positive-learning: the student found the category useful for their learning in the lab
  - Neutral: A category is mentioned without any note of positive or negative impact on student learning
  - Negative/Change: A category was not helpful to the student's learning, or should be changed in the future

Physics Concepts

- Lab topic, concepts, physics content of lab
- Relate to learning goals/lab outcomes
- Codes
  - Yes
  - No
  - Maybe

Equipment and Software

- Any comment that refers to the lab equipment or software used
- Codes
  - Positive-Learning
  - Neutral
  - Negative/change

Lab Design

- Includes:
  - lab worksheet
  - mention of the lab structure (invention, exploration, hands-on)
  - Activities (plotting data, drawing histograms)
- Codes
  - Positive-Learning
  - Neutral
  - Negative-more explanation
  - Negative- more relation to physics
  - Negative/change – other

Clickers

- Reference to the clicker questions at the end of labs
- Codes
  - Positive-Learning
  - Neutral
  - Negative/change – more
  - Negative/change - less

TAs

- Comments about TAs
- Codes
  - Positive-Learning
  - Neutral
  - Negative/change

Timing

- Amount of time allocated to the lab/tasks in the lab
- Codes
  - Negative/change – shorter
  - Negative/change - longer

Partner/Group

- Labs are done in groups of 2-3, and are the same for the whole term
- Reference to this group work
- Codes
  - Positive-Learning
  - Neutral
  - Negative/change – larger
  - Negative/change - smaller

Emotional/Opinion/Attitudes

- How a student feels about the lab
- Codes:
  - Positive-learning
  - Positive-motivational
  - Appropriate
  - Negative-struggle
  - Negative – not challenging
  - Negative – not motivating

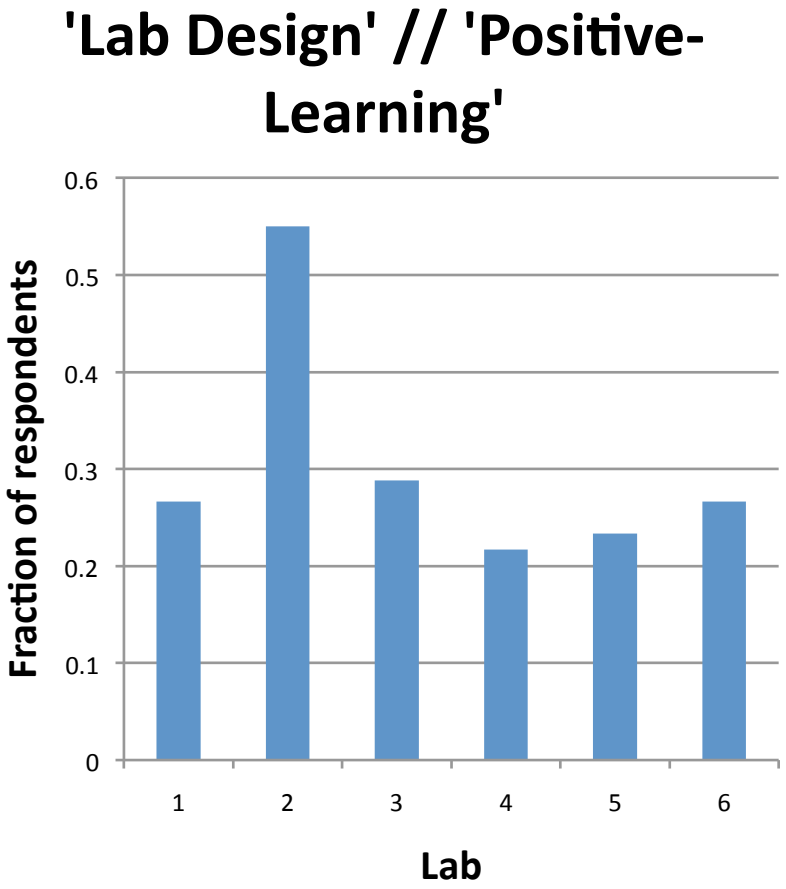
Specific Comments

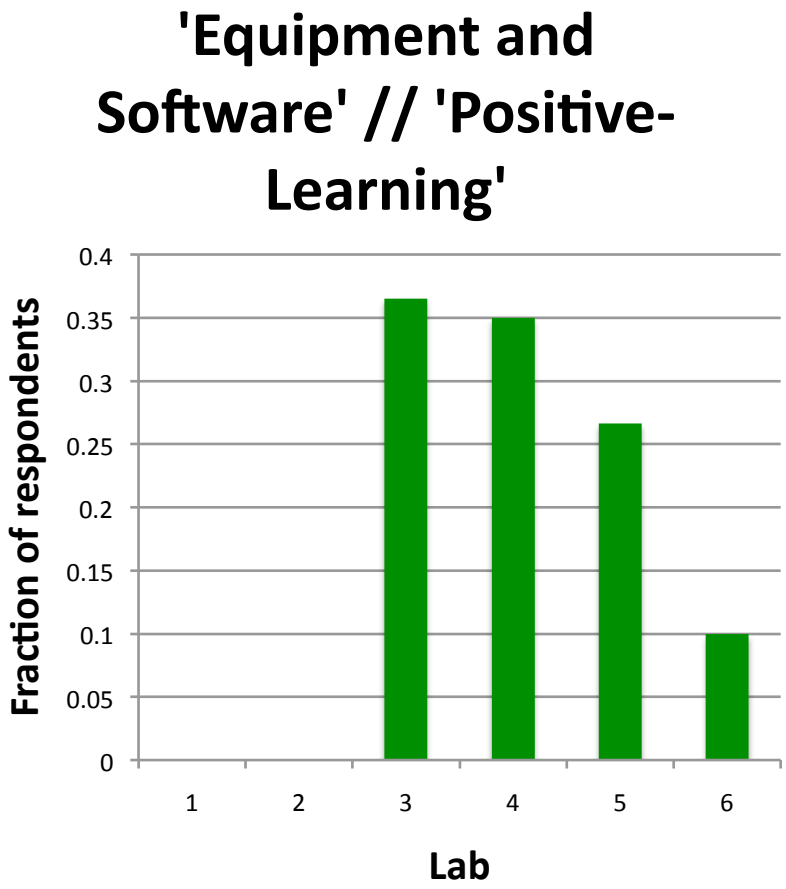
- Some comments are recorded to use in future lab development
- Lab General: Comments that refer to the lab in general
- TA Feedback: Comments that may be used to inform TA training for the course
- Miscellaneous: Anything that does not fall in the other categories

Example responses

- Q1: Please write a few sentence synopsis of your experience today (what did you do, what did you learn…):
  - "did an experiment to calculate average speed" (coded as 'Physics Concepts' // 'Maybe')
  - "Did experiment on average speed accounting uncertainties in the experiment" ('Physics Concepts' // 'Yes')
- Q6: Please, list a few changes (if any) that could make this lab a better learning experience:
  - "include actual physical lab work" ('Lab Design' // 'more relation to physics')
  - "Maybe a small lecture on SD (standard dev.) before doing questions" ('Lab Design' // 'more explanation')
  - "Nothing" ('Emotional/Opinion/Attitudes' // 'Appropriate')
- Q7: Please, list the aspects of this lab that were the biggest contributor to your learning today:
  - "Letting us experiment on our own rather than just having us told what to do" ('Lab Design' // 'Positive-Learning')
  - "T.A.'s" ('TAs' // 'Positive-Learning')
  - "explaining the iClicker questions" ('Clickers' // 'Positive-Learning')

Preliminary results





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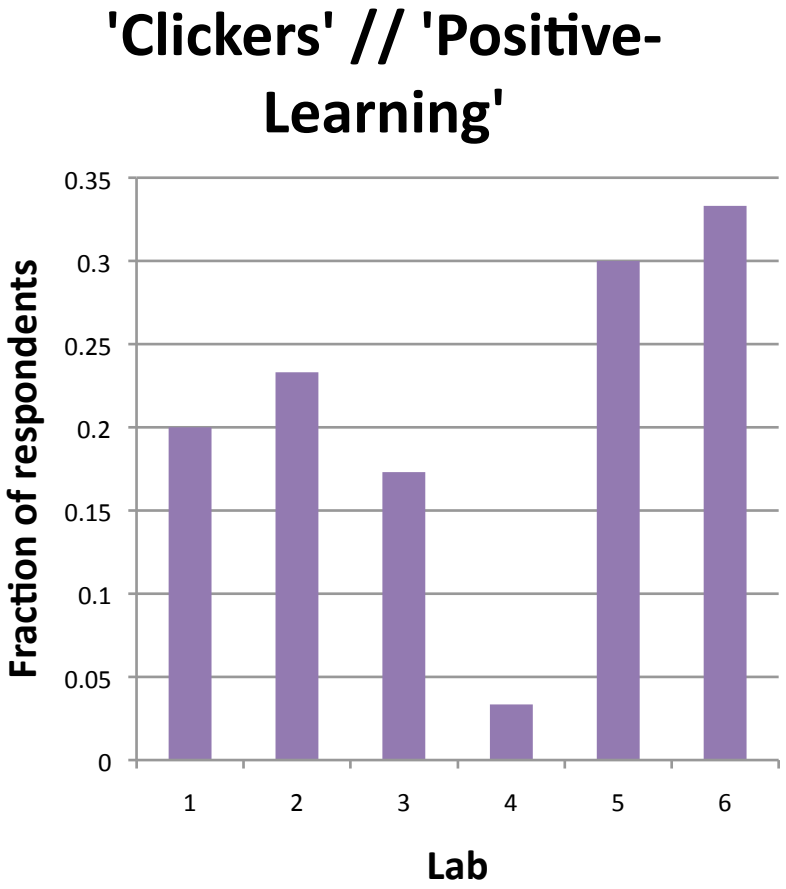

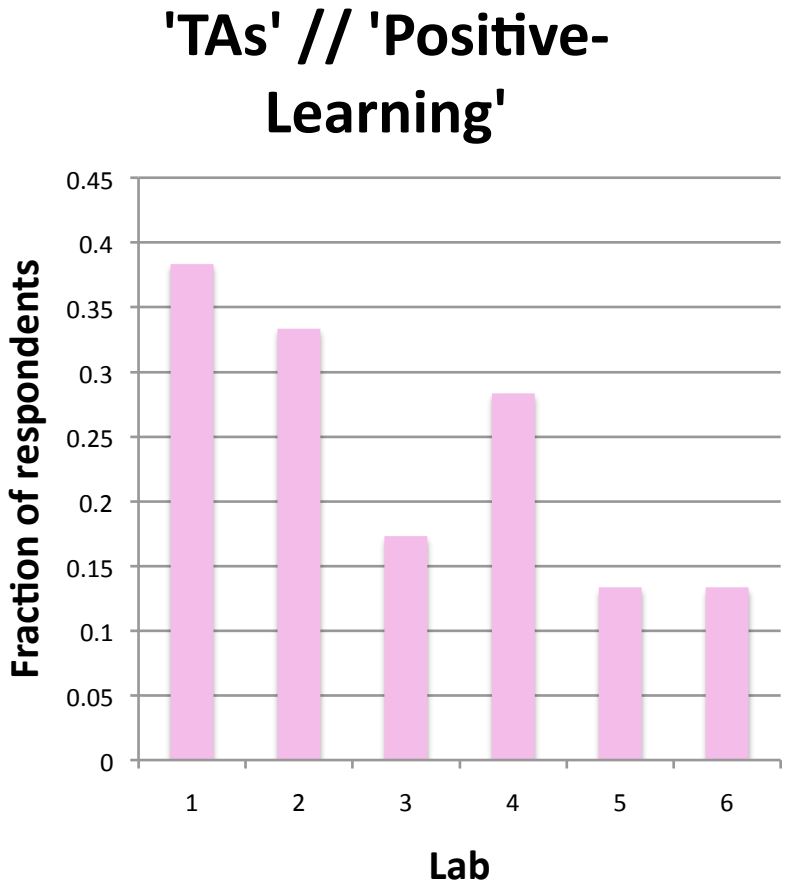

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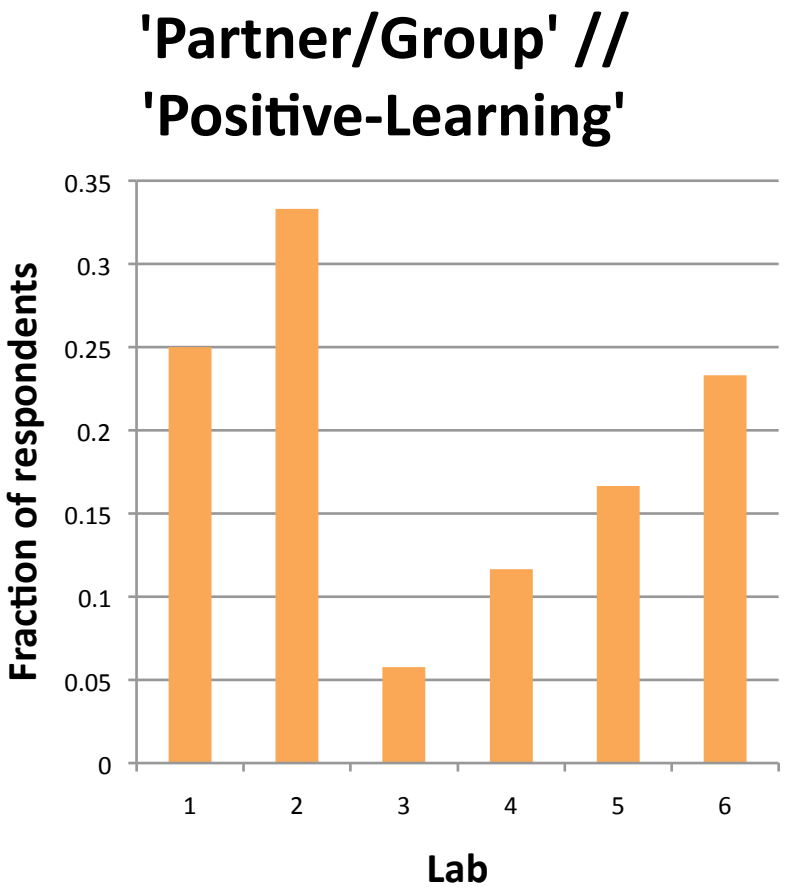

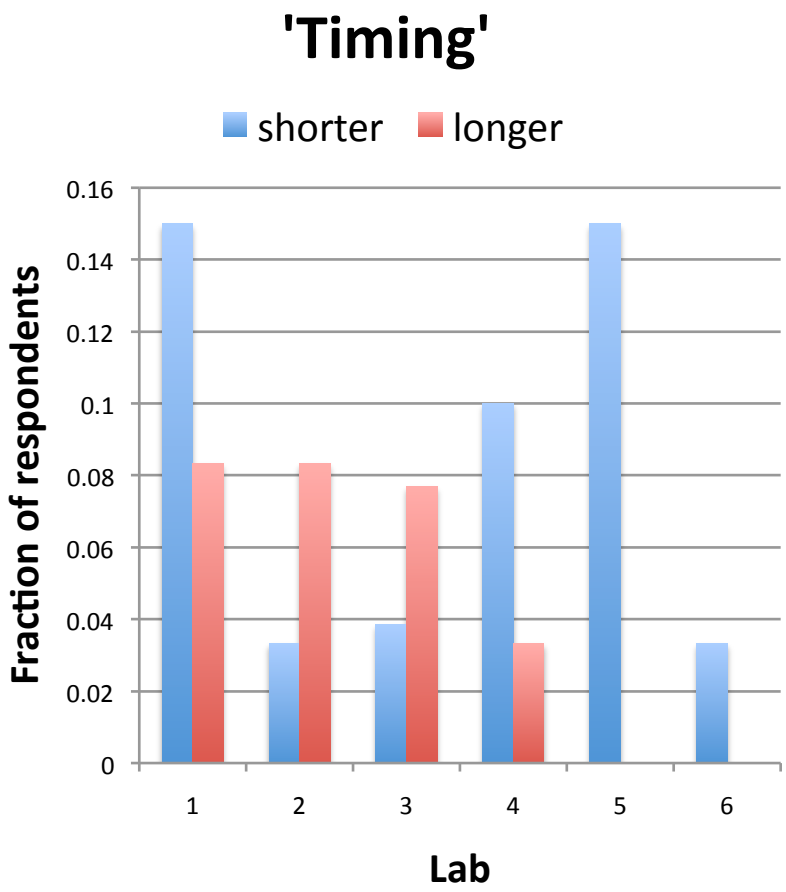

Conclusions

- Open-response-type surveys can offer a variety of interesting data
- A reliable coding scheme makes it possible to draw quantitative conclusions based on this data