



(Toward) Inspiring Rich Clicker Question Discussions

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June 7, 2011

What do students get out of clicker discussions?

-- Guides to clicker use recommend individual vote + group discussion – but “classroom norms” of implementation vary widely.

Turpen and Finkelstein (2009) *PhysRevST-PER* 5: 020101

-- “Naïve” groups of students show improved individual performance after discussion (majors, genetics).

Smith et al. (2009) *Science* 323: 122-124
...consistent with student survey data...

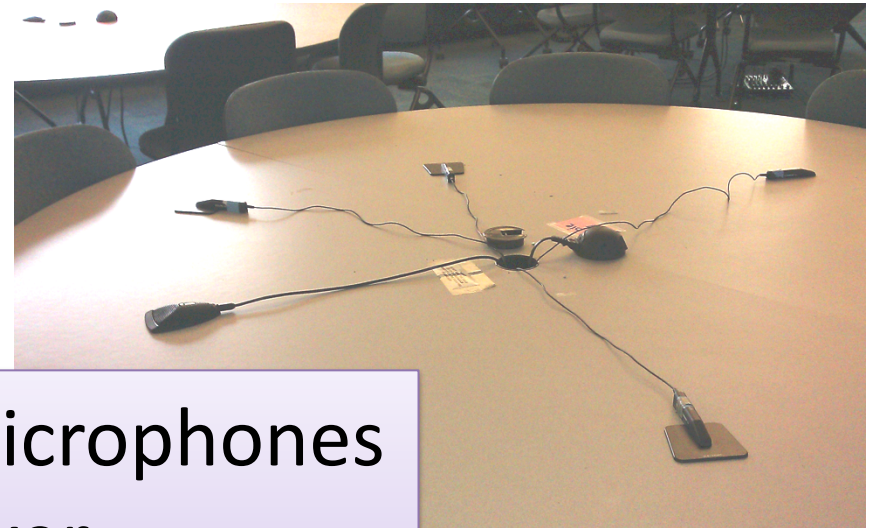
-- Many (38%) student discussions are “unproductive” (nonmajors, astronomy) – based on 10 categories.

James and Willoughby (2011) *Am. J. Phys.* 79: 123-132

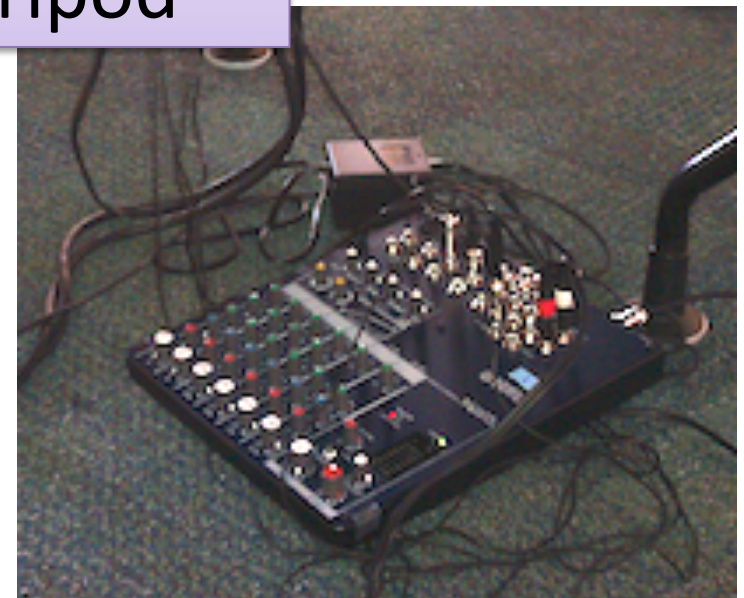
Study Goals (ongoing)

- A. Reliably measure characteristics of clicker discussions, especially those that contribute to discussion “productivity” or “richness”**
- B. Investigate factors which may influence discussion richness

Recording Setup



flat "table" microphones
6-channel mixer
video camera & tripod



Context of study:

- Instructor: Jenny Knight, MCDB
- Class: Developmental Biology, Fall 2010, n=111
- Overall style: “dialogic”
- Setup of clicker questions
 - Initial silent vote, small group discussion, re-vote, wrap-up
 - Points for participation
- Type of clicker question
 - Conceptual questions
 - Questions which “split” the class initially

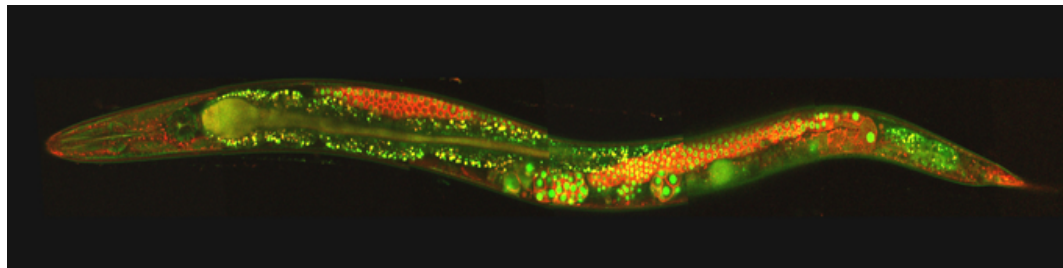
Raw data collected:

- over 9 weeks of class
- 3 groups recorded at once (4 groups total)
- 83 conversations transcribed (2-3 per period)

Let's compare 2 conversations about this clicker question (handout)

You have isolated three mutants that all have the same basic phenotype of excess cell survival (too few or no cell deaths). What are the normal functions of the corresponding gene(s)?

- a) To promote cell death.
- b) To prevent cell death.
- c) Not yet enough information to decide.



Discuss:

- Which do you think is “richer”, conversation A or B?
- Which aspects of the conversations did you use to assess “richness”?

Conversation A:

Student 1: The question asks what are normal functions of the gene. It seems that if they get apoptosis normally then they would promote cell death. So I said A.

Student 2: That's what I said, A.

Student 3: I said C, how do you know?

Student 1: I just assumed that if normally they get apoptosis and it's mutated then it must be promoting it somehow.

Student 3: What if they are preventing it and they are super turned on or something?

Student 4: They could do either, it's a trick question.

Student 1: I guess it's possible.

Student 4: I guess you don't have enough information...

Student 1: Yeah, so I guess we don't know for sure then. I've been convinced.

Time: 35 seconds



Conversation B:

Student 1: I said C

Student 2: I said C

Student 3: C? Why?

Student 2: it says...[inaudible] cell death

Student 1: Well it didn't say that on the clicker question.

Student 2: Yeah, it did.

Student 3: The mutation causes upregulation...

Student 1: Couldn't it? Couldn't it mean that it needs both to be working fully in order to have the right number of cell deaths? I don't know, either way this question is C right?

Student 3: I'll put C I guess...

Student 1: I mean hopefully someone else can explain it better, that's all I got.

Student 3: I don't know why I can't understand it.

Time: 24 seconds

Initial Turn of Speech “Coding”

- Simplified coding system for argumentation

(reviewed in Samson and Clark, 2008)

- Codes developed collaboratively, iteratively
- Reliability between 4 raters: **.74** (adequate)

Initial Turn of Speech “Coding”

General Categories:

- Setup/Background (B) – statements about question
- Claims (C) – votes
- Questions (Q)
- Extension (X) – “above and beyond” conversation

Argumentation Categories:

- Justification (J) – new idea supporting a vote
- Sense-Making (M) – any rephrased justification
- Incomplete (I) – inaudible or fragmented justification
- Recap (R) – a complete explanation combining ideas

Group A Conversation, Coded

Transcript	Code(s)
Student 1: The question asks what are normal functions of the gene. It seems that if they get apoptosis normally then they would promote cell death. So I said A.	B, J, C
Student 2: That's what I said, A.	C
Student 3: I said C, how do you know?	C, Q
Student 1: I just assumed that if normally they get apoptosis and it's mutated then it must be promoting it somehow.	M
Student 3: What if they are preventing it and they are super turned on or something?	J, Q
Student 4: They could do either, it's a trick question.	J
Student 1: I guess it's possible.	none
Student 4: I guess you don't have enough information...	C
Student 1: Yeah, so I guess we don't know for sure then. I've been convinced.	C

Totals:

1 Background

1 Question

6 Claims

3 Justifications

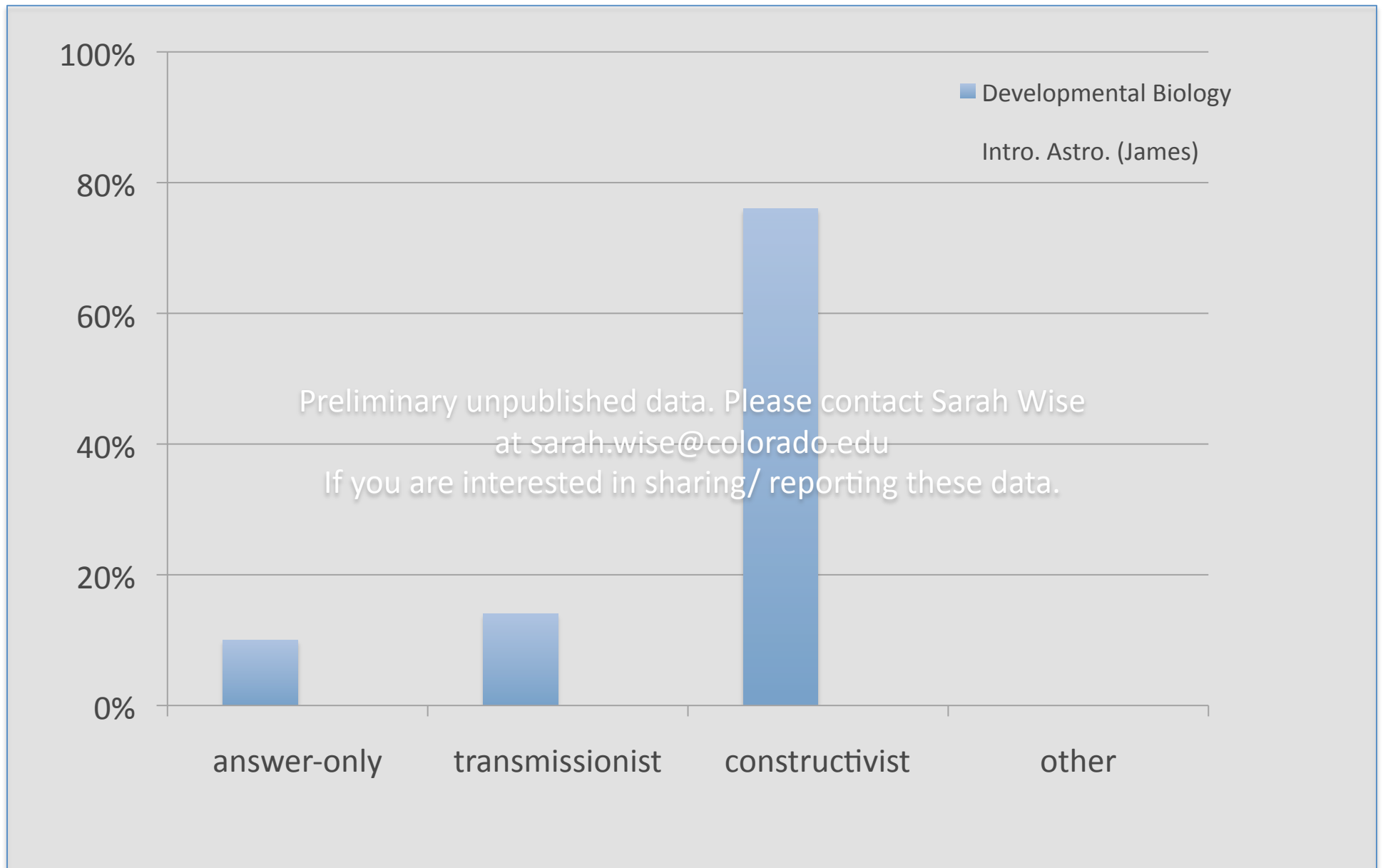
1 Sense-Making

Additional Measures of Discussion

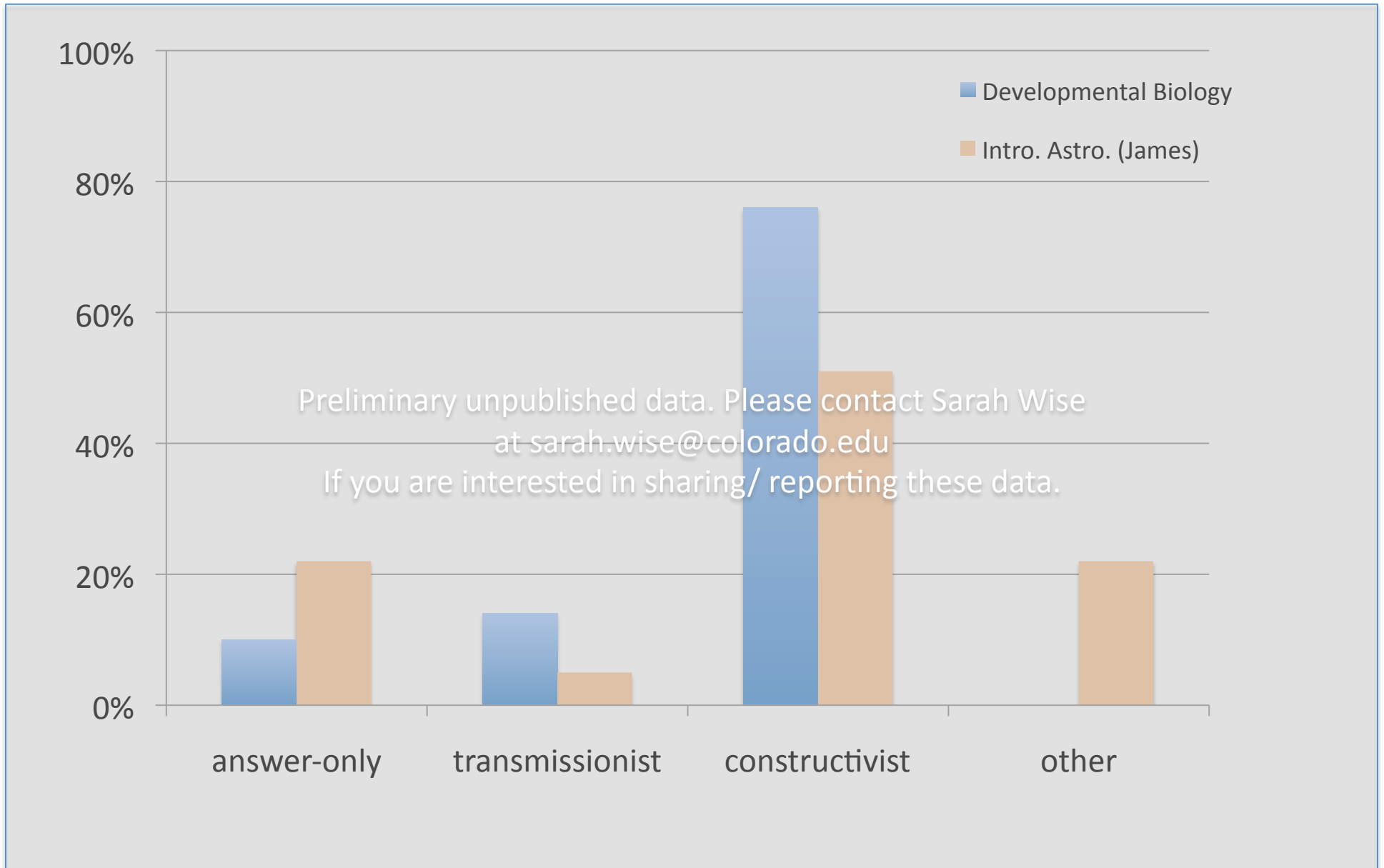
- # of turns of talk
- % of turns by most frequent speaker (dominance)
- conversation structure
(answer-only, transmissionist, or constructivist)
- % of group voting correct initially
- % of group voting correct after discussion
- normalized gain for group:

$$\frac{\% \text{ correct after} - \% \text{ correct initially}}{100 - \% \text{ correct initially}}$$

Usually, 2+ students offered justifications



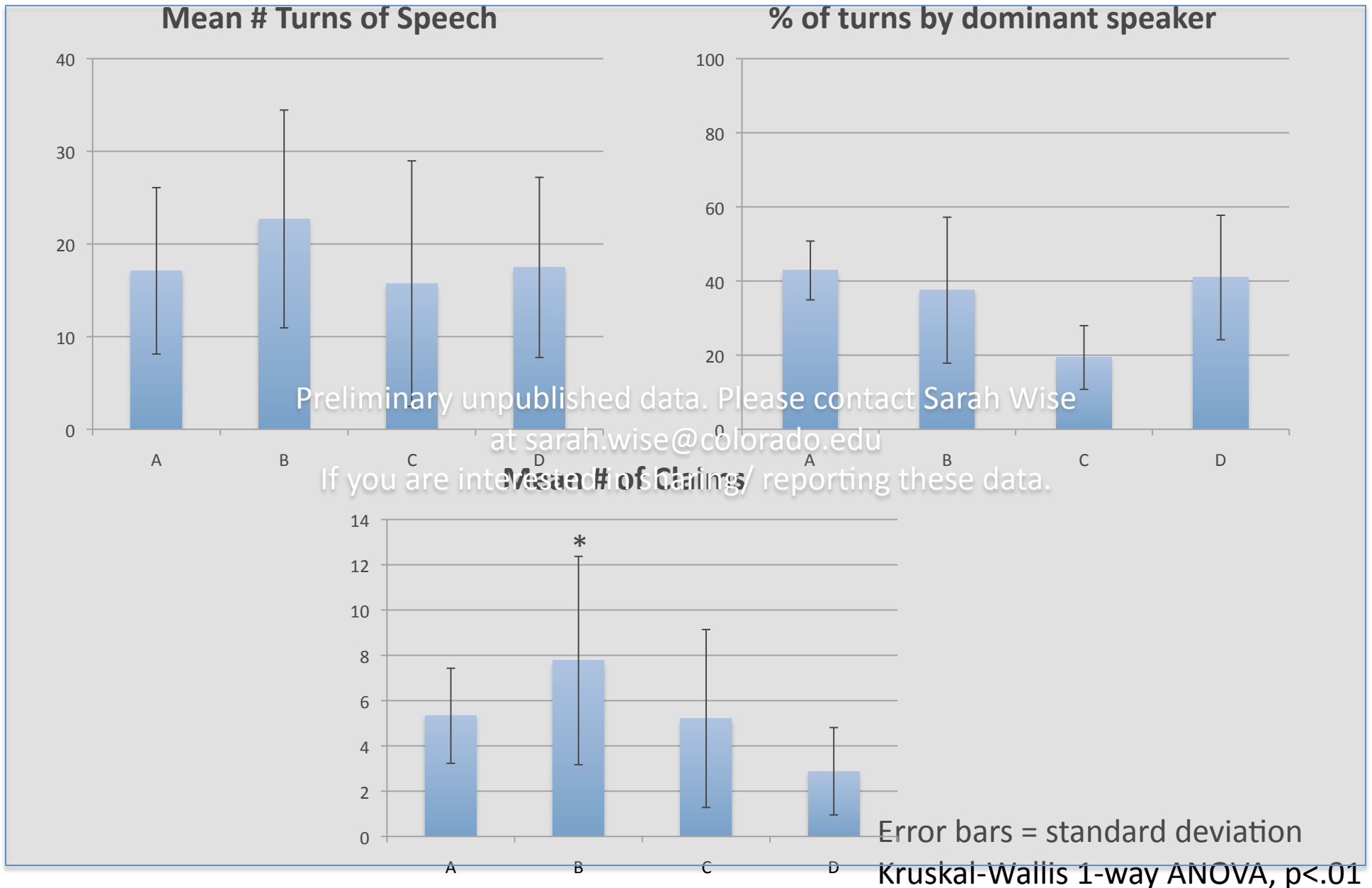
More “productive” than nonmajors’ class



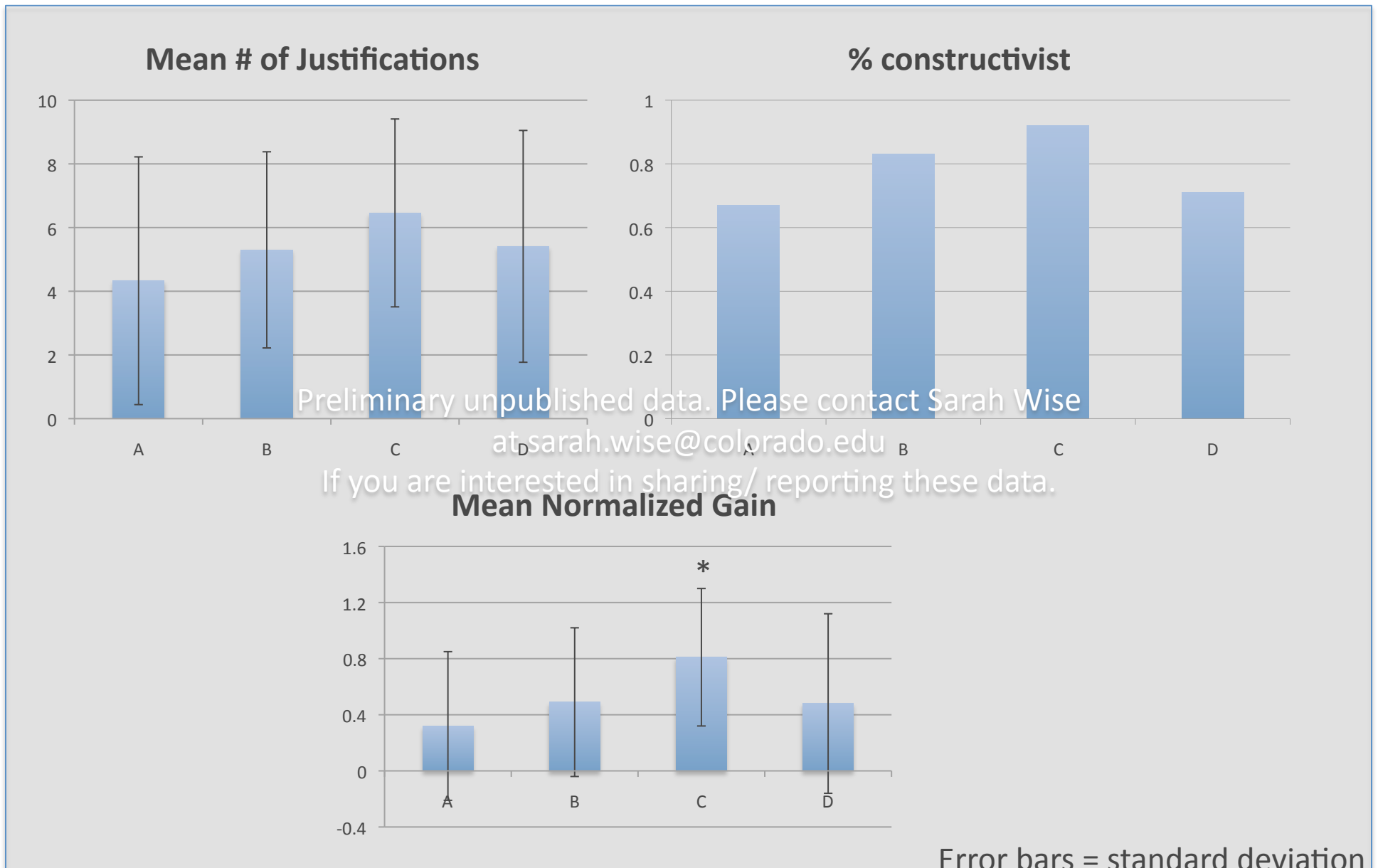
Results: impressions of groups

Group	Nickname
A	“under the radar”
B	“loudmouths”
C	“genial overachievers”
D	“last in, first out”

Groups: variable, few sig. differences



Justification patterns mirror performance



* = Krustal Wallis one-way ANOVA, $p < .01$

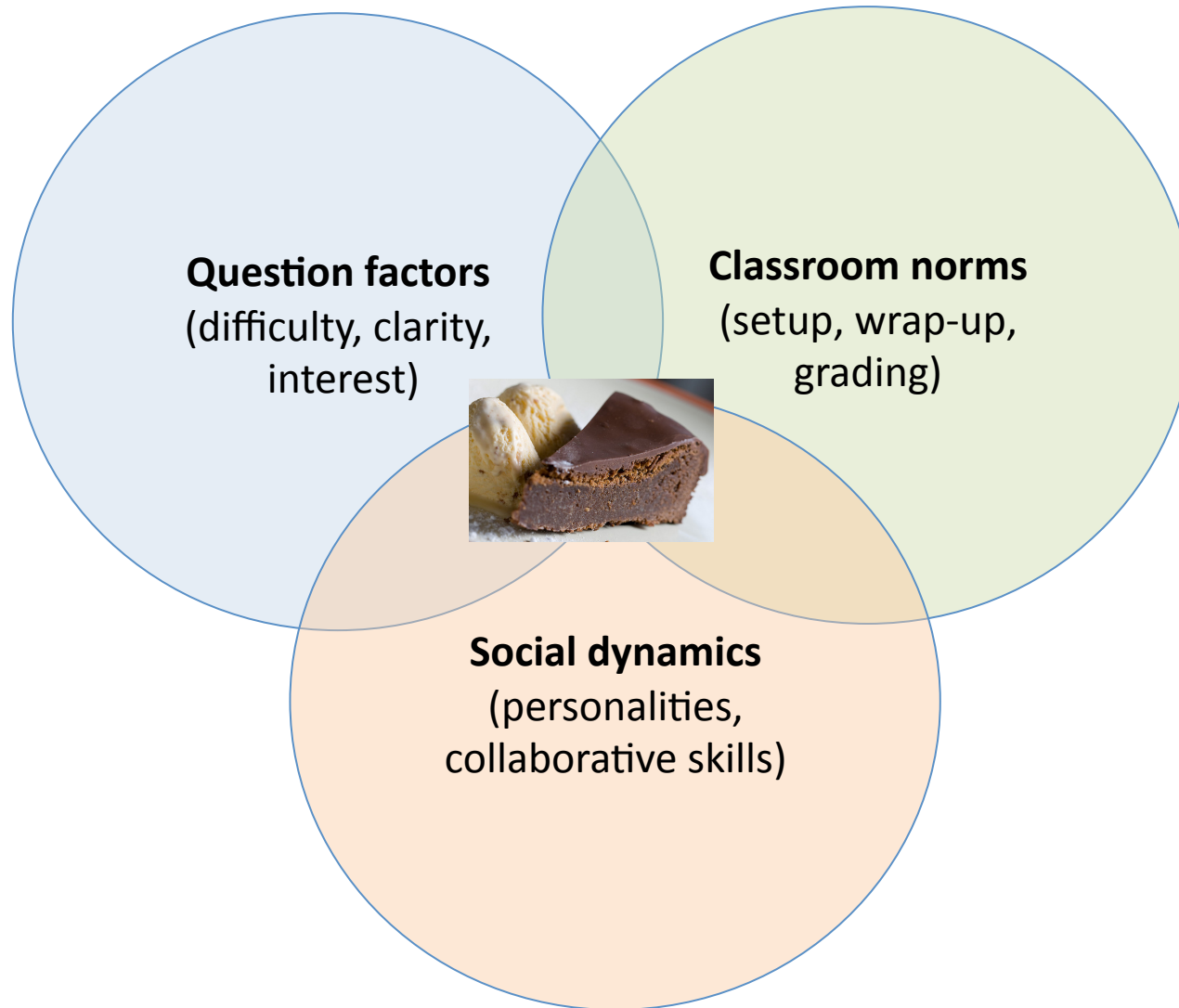
Tentative Conclusions, Goal A

- A. Reliably measure characteristics of clicker discussions, especially those that contribute to discussion “productivity” or “richness”
 - coding reliably captures productivity, style
 - groups surprisingly similar
 - multiple styles can be “productive”
 - looking forward to adding more “layers” of coding

Tentative Conclusions, Goal A

- A. Reliably measure characteristics of clicker discussions, especially those that contribute to discussion “productivity” or “richness”
- coding captures productivity and style
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 - multiple styles can be “productive”
 - looking forward to adding more “layers” of coding
- B. Investigate factors which may influence discussion richness**

Which *factors* influence the “richness” of clicker discussion?



We hypothesized...

Instructor behaviors can influence discussion richness, when they repeat to form a “classroom norm” Turpen and Finkelstein (2009) PhysRevST-PER 5: 020101

- are answers or justifications emphasized in the setup?
- is the histogram revealed before the discussion?
- does the instructor interact with groups during discussion?
- are student ideas solicited?

Can Instructor Style Influence Discussion?

**Jenny alternated two styles
in Developmental Biology, weekly:**

“Answer-oriented” style

- Voting histogram revealed, after individual vote.
- “Discuss with your table and revote, and after that I’ll explain it.”
- Tables not asked to speak after revote.

“Justification-oriented” style

- “Your votes are split between 3 choices. Go ahead and discuss, and focus on the reasons for your answers.
- Tables asked to give reasons for choice.
- Histogram revealed after discussion ends.

Reasoning Differed Slightly with Instruction

Measure	Answer-oriented (n=34)	Justification-oriented (n=49)	Stats
% constructivist	68%	90%	
# turns of speech	18 (8.7)	23 (13.4)	
Mean # justifications	4.8 (3.1)	6.0 (3.3)	p=.08
Mean # rephrased	1.2 (1.9)	2.9 (3.3)	p=.01
Mean # claims	5.9 (3.1)	5.5 (4.6)	p=.66
Mean normalized gain	51%	46%	

Preliminary unpublished data. Please contact Sarah Wise
 at sarah.wise@colorado.edu
 If you are interested in sharing/ reporting these data.

() = standard deviation

Interpreting Style Data...and Future Plans

- “Answer-Centered” cues *slightly* altered conversations, despite overall “Justification-Oriented” context
 - Statistical comparisons, by group
 - Would discussions differ more significantly between *sections* with different norms?
- Upper division majors may have started course with argumentation skills
 - How do Freshmen / Nonmajors argue (or fail to argue)?
 - Can Justification-oriented norms help students develop argumentation skills?
 - Could trained TAs help students develop argumentation skills?

Take home messages:

- Students do have productive conversations
- Classroom norms influence productivity
 - What instructors do, matters!
- In your classroom, try:
 - Reminding students to discuss reasons, not votes
 - Expressing interest in discussing wrong answers
 - Train TAs to prompt discussion and move around
 - Randomly choose groups to contribute to wrap-up
 - Save histogram for the end of wrap-up

Thank you:

- Jenny Knight
- Katie Southard
- Bre Pritchard
- Jia Shi



- Kathy Perkins and Chandra Turpen: study design advice
- Erin Furtak – School of Education: coding advice, equipment loan
- Ben Spike – Physics: equipment loan

Future measures of conversations

- Duration of conversation
- % of time “on-task”
- % of group providing justification (replaces 3 categories)
- Level of reasoning (Osborne, 2004)
 - 1 – no justifications made
 - 2 – one justification, no rebuttal
 - 3 – one justification, weak rebuttal
 - 4 – one justification, strong rebuttal
 - 5 – multiple justifications and rebuttals
- Content coding of justifications