Peer Tutor & Tutee Behaviors in an Online Chat Environment

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Exploring the data

- Algebra Peer Tutoring by Erin Walker
- 130 students in 8^{th} – 10^{th} grade
  - 118 came with a friend: 49 friend pairs
- Role (tutor vs. tutee) were randomly assigned between student and his/her friend
- 60 minutes problem solving over computer-mediated chat
- All students are given pretest & posttest

An excerpt

tutee	where's the im done button
tutee	what did i do wrong
tutor	im scared. J'ai trop faim. Je deteste la mathematique. Blahhh. hells if i know.
tutee	HELP ME! youre a terrible partner.
tutor	hahhaha factor out t.
tutee	youre wrong
tutor	hahahahahahhahaah. i dont know. im confused.
tutee	right?
tutor	isolate t
tutor	if this is shannon tell me something only shannon would know.

An excerpt

tutee	are you sure you wannt me to say that on here.
tutor	hahhaahaha okay, its shannon.
tutee	lol. h8u.
tutor	huh? im sorry, i dont speak stupid.
tutee	we should of made up our own language
tutee	smd.
tutee	emvolab
tutee	mmmmm yummmmmu
tutee	*yummy
tutor	hahahahha. okay. hfr equals something only me and you know. wellllll i mean a lot of people know. my parents know now too.

Data annotation

- Based on work by Lehman et. al., (2008) and Forbes-Riley and Litman (2007)
  - Tutee learning-centered traits, basic emotion, engagement level, tutor responses
- Define domain of interesting behaviors
  - **Anxiety**: currently expressing anxiety?
  - **Confusion**: confused about the material?
  - **Curiosity**: expressing a genuine interest in the material but is unsure about the next step?
  - **Hint**: contain a hint given by the tutor? (e.g. “add five”, “you need to combine like terms”)
  - **Face Threat**: being rude and attempting to threaten the other students’ self-image (this was coded during prior work on the same data set)

Data annotation Lehman et. al., (2008)

Table 1. Definitions of Affective States and Engagement Levels

State	Definition
Learning-Centered	
Confusion	poor comprehension of material, attempts to resolve erroneous belief
Frustration	difficulty with the material and an inability to fully grasp the material
Anxious	nervousness, anxiety, negative self-efficacy, embarrassment
Contempt	annoyance and/or irritation with another person
Eureka	sudden realization about the material, a ha! moment
Curiosity	desire to acquire more knowledge or learn the material more deeply
Basic-Emotions	
Anger	negative affect toward material or person to an extreme degree
Fear	feelings of panic and/or extreme feelings of worry
Sadness	feelings of melancholy, beyond negative self-efficacy
Disgust	annoyance and/or irritation with the material and/or their abilities
Surprise	genuinely does not expect an outcomes or feedback
Happiness	satisfaction with performance, feelings of pleasure about the material
Engagement Level	
Disengagement	bored, uninterested in the topic being discussed
Socially Attending	attends to conversational conventions, only acknowledges tutor speech
Actively Attending	attends to content of the conversation, content-driven responses
Full Engagement	every mental resource is invested in the current topic, in a flow state

Data annotation Forbes-Riley and Litman (2007)

- **Tutor Feedback Acts**
  - Positive Feedback (**POS**): positive feedback word/phrase present in turn
  - Negative Feedback (**NEG**): negative feedback word/phrase present in turn
- **Tutor State Acts**
  - Restatement (**RST**): repetitions and rewordings of prior student statement
  - Recap (**RCP**): summarize overall argument or earlier-established points
  - Bottom Out (**BOT**): full answer given if student answer is incorrect
  - Hint (**HINT**): partial answer given if student answer is incorrect
  - Expansion (**EXP**): novel details related to answer given without being queried
- **Tutor Question Acts**
  - Short Answer Question (**SAQ**): concerns basic quantitative relationships
  - Hard Answer Question (**HAQ**): requires definition/interpretation of concepts or reasoning about causes and/or effects

Fig. 2. Tutor Dialogue Acts

An example

tutee	where's the im done button	
tutee	what did i do wrong	Confused
tutor	im scared. J'ai trop faim. Je deteste la mathematique. Blahhh. hells if i know.	
tutee	HELP ME! youre a terrible partner.	Anxiety
tutor	hahhaha factor out t.	Hint
tutee	youre wrong	Certainty
tutor	hahahahahahhahaah. i dont know. im confused.	Confused
tutee	right?	Confused
tutor	isolate t	Hint
tutor	if this is shannon tell me something only shannon would know.	

Analysis

- Anxiety
- Help-seeking
- Effective response
- Face threat

- Learning gain is the central metric

Anxiety

- Based on work by Ramirez and Beilock (2011)
- Experimental group and control group
- Acknowledging and expressing anxiety prior to testing can ameliorate the anxiety
- We hypothesize similar result to our domain
  - Decrease in anxiety over time will correlate with learn gains
- Consider only tutee utterances

Anxiety score

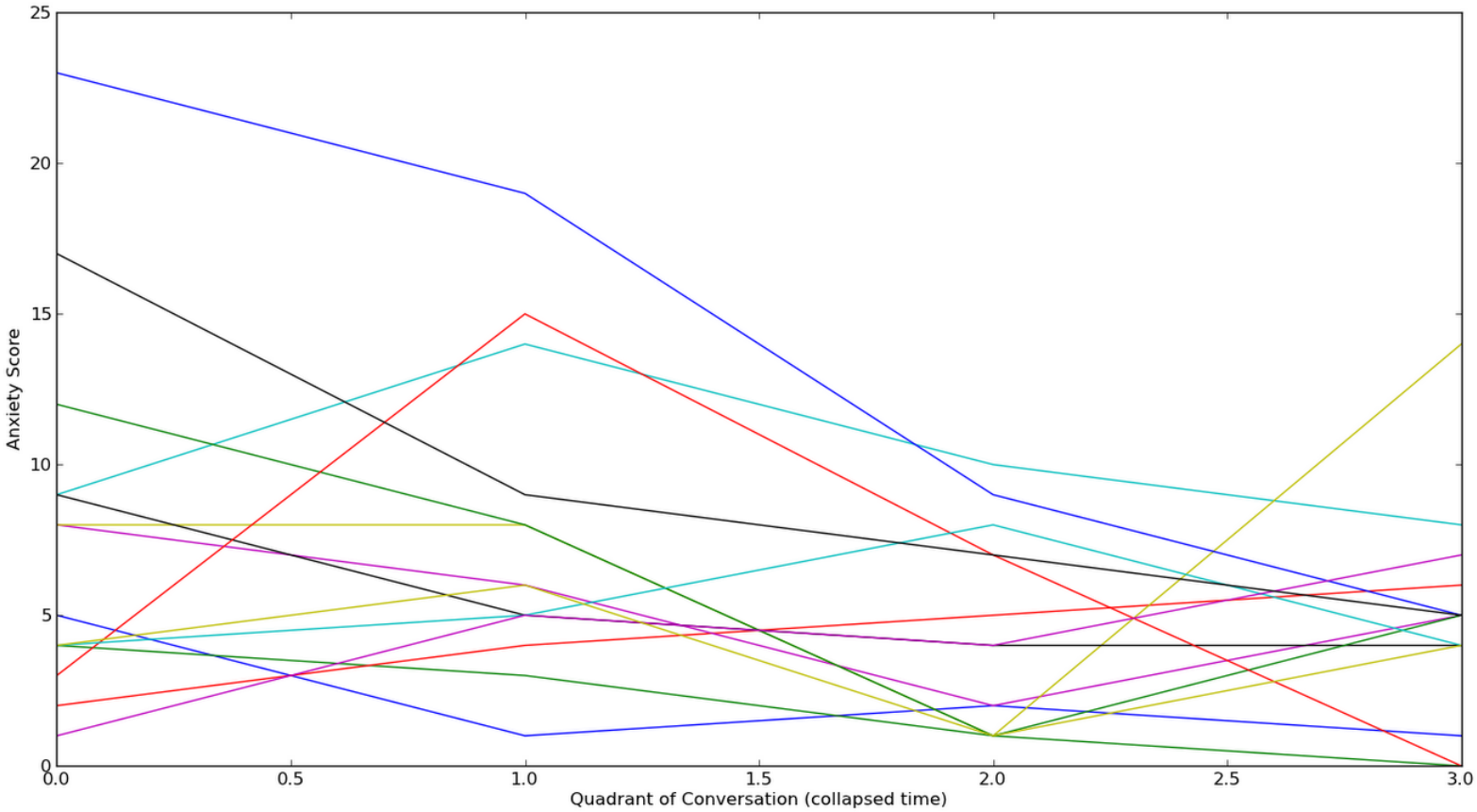
- 49 conversation, 40 tutee utterances in avg.
- Split into 4 partitions
  - Each partition, sum *anxiety score* of each utterance
- *anxiety score* = annotated features + words in LIWC
  - *anxiety* and *confusion* annotations
  - *anxiety*, *negative emotion*, and *anger* categories

Anxiety score

- Look at students whose anxiety scores vary over time
  - Given scores of 4 partitions, reject conversation where MAX(score) – MIN(score) < 4
  - Obtain 31 students
- Given 49 students, compute high and low learning group based on median (0.05)
- Divide 31 into that two groups

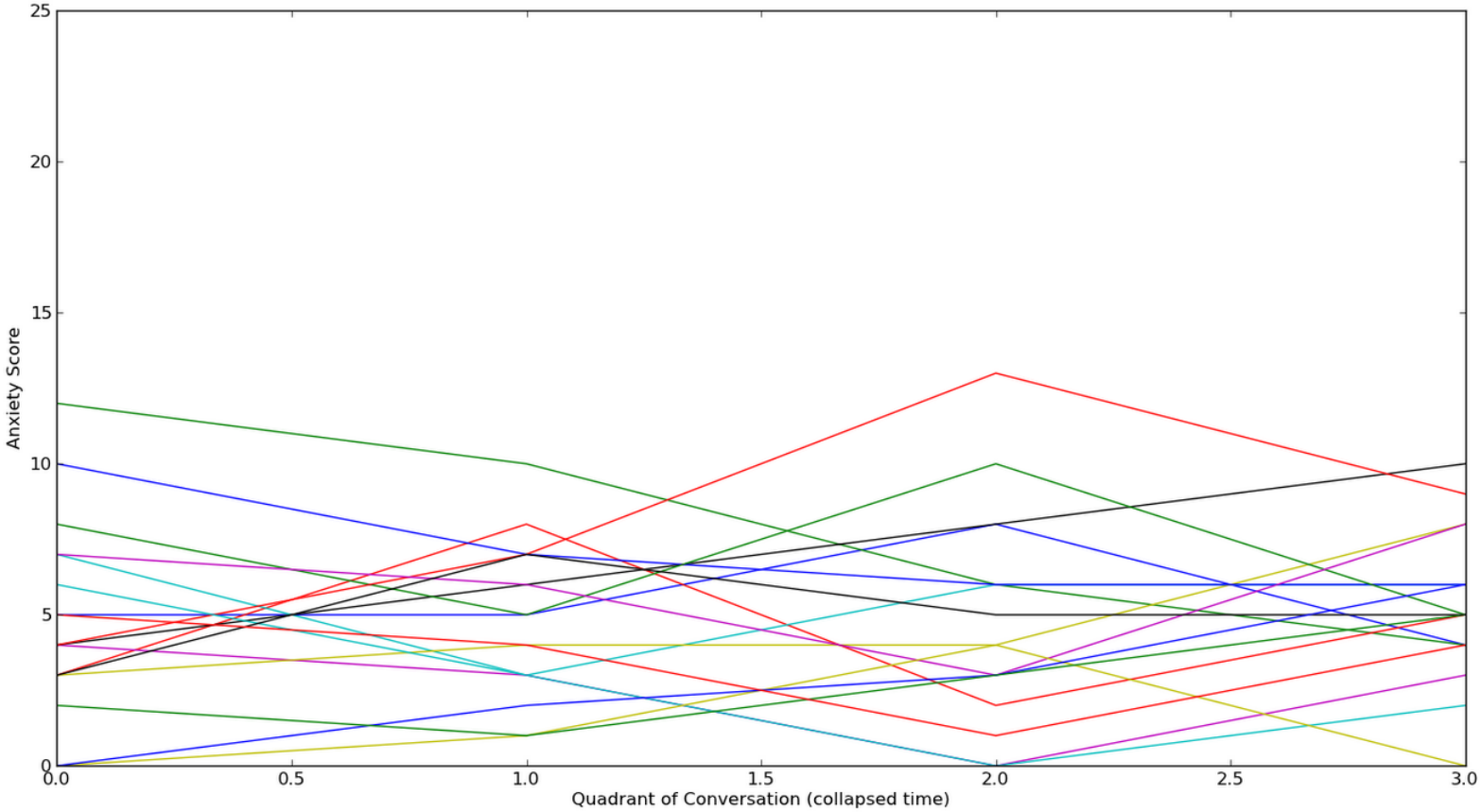
Anxiety trend of high learner

14 students



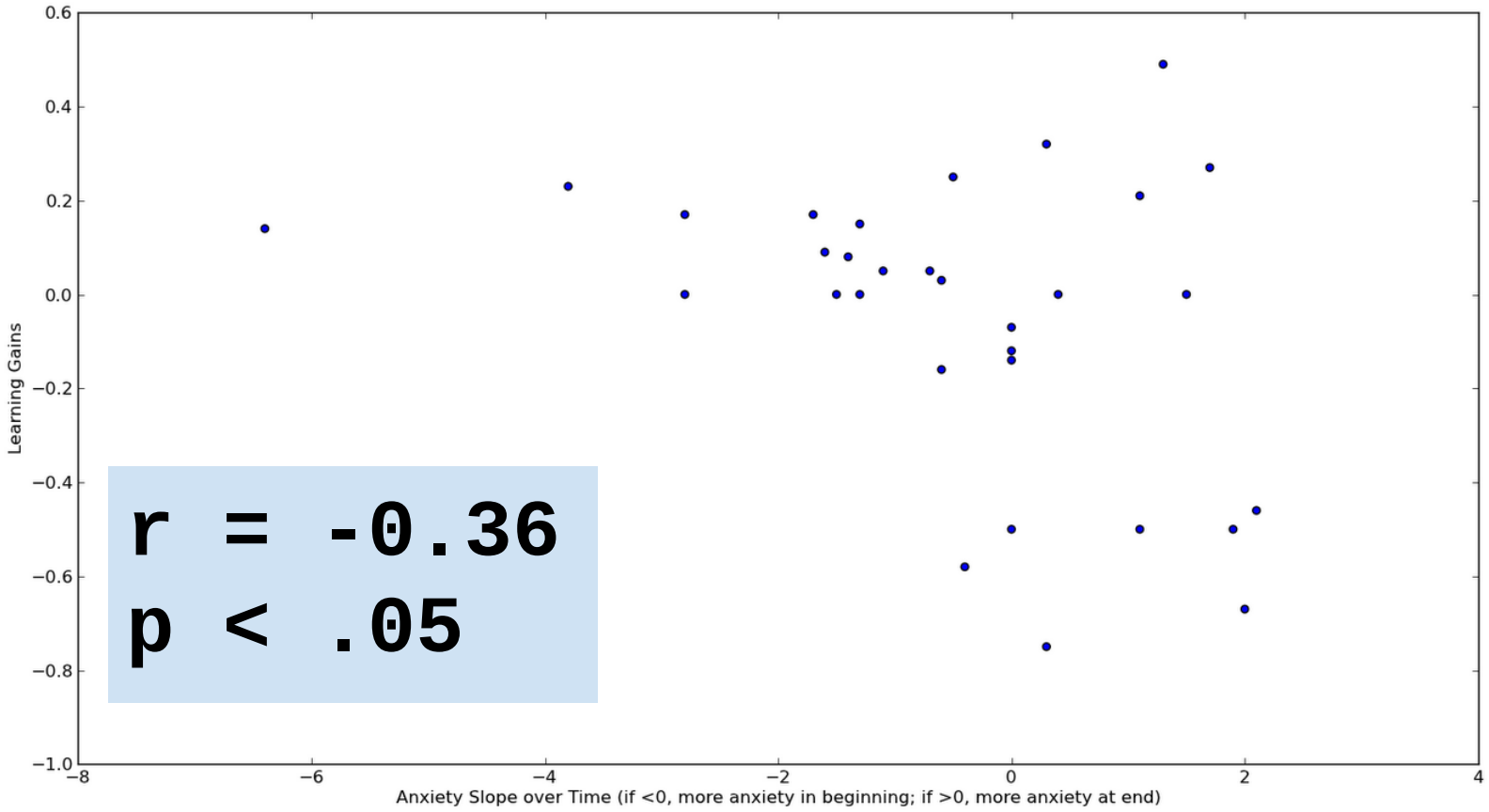
Anxiety trend of low learner

17 students



Anxiety trend and learning

Trend = linear regression line's slope over 4 scores



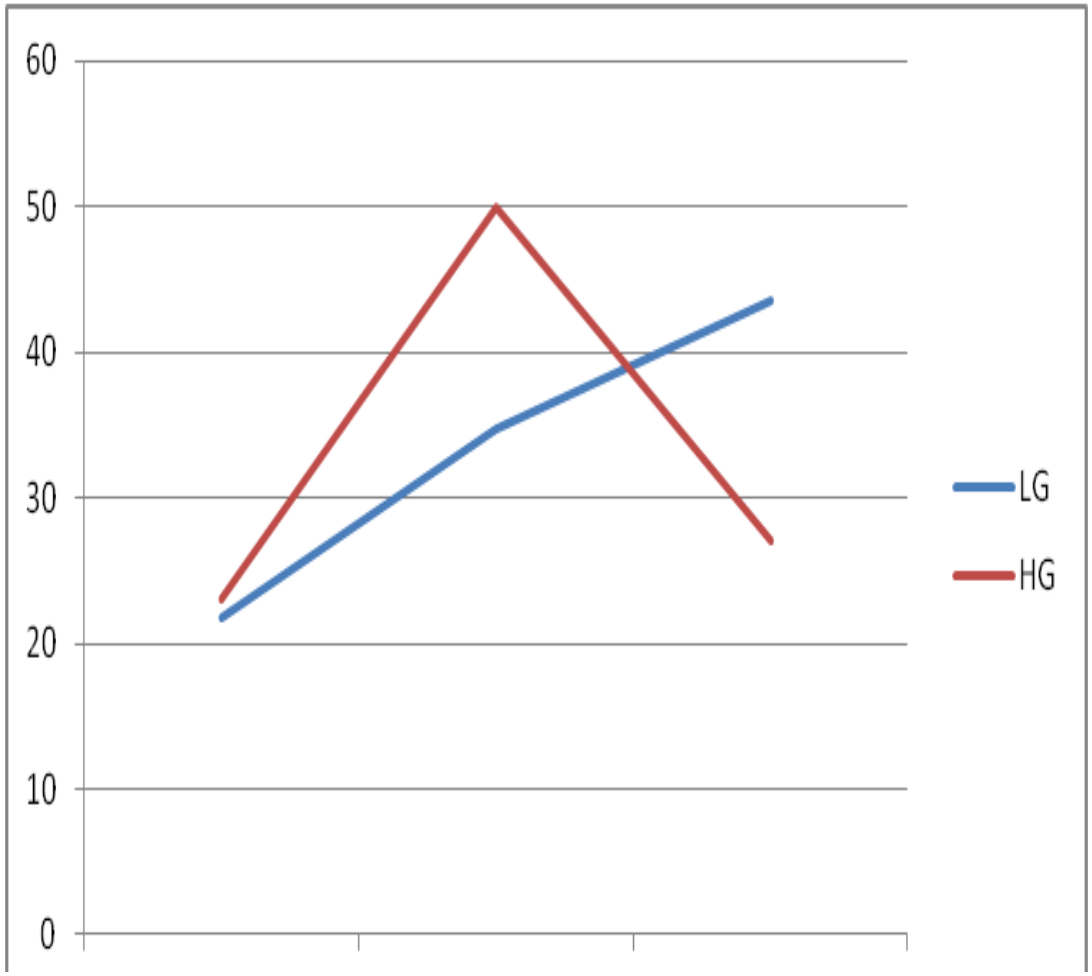
Help-Seeking Behavior

- Motivated by the paper by Puustinen (1998)
  - Development of self-regulation in school-aged children's help-seeking behavior
  - Finding: high-achievers showed a better capacity to autonomously regulate their help-seeking behavior in a problem-solving situation.
- Use tutor HINT in response to tutee CURIOSITY or CONFUSION as a proxy for help-seeking

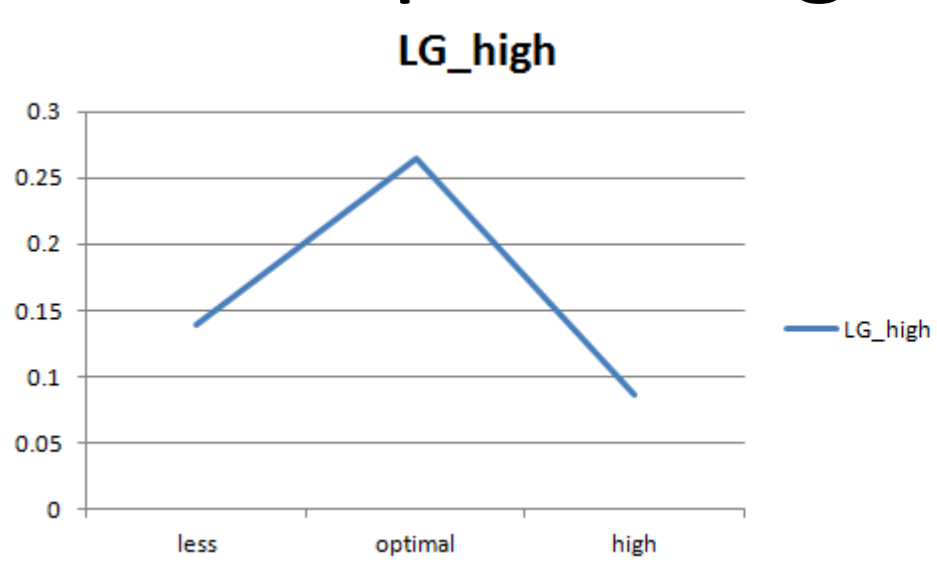
Help-seeking rate

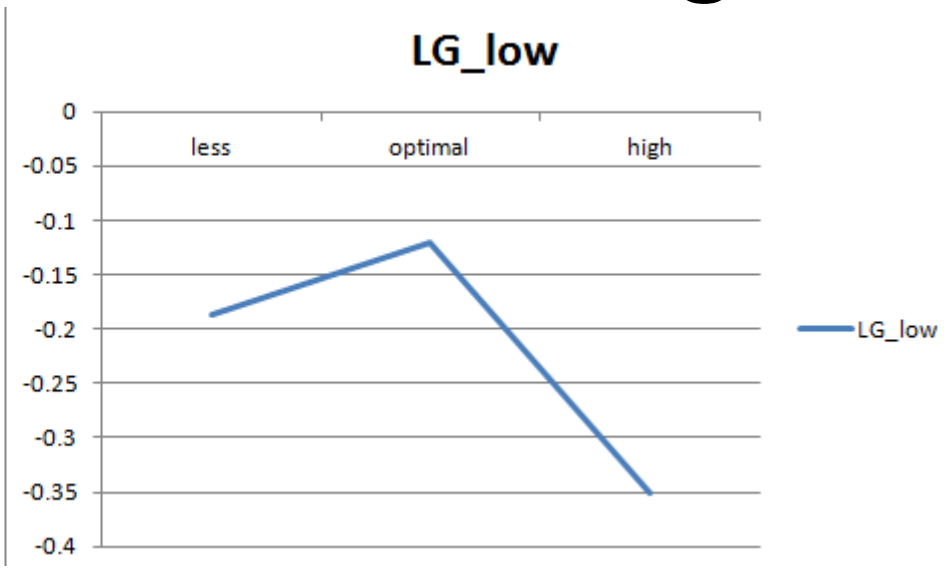
- Count tutor HINT driven by tutee CURIOSITY or CONFUSION
- Normalize by number of turns
- Help-seeking rate vary from 0.01 to 0.45
  - Less frequent: [0.01, 0.15]
  - Moderate: (0.15, 0.3]
  - More frequent: (0.3, 0.45]
- Compute mean rate of each segment

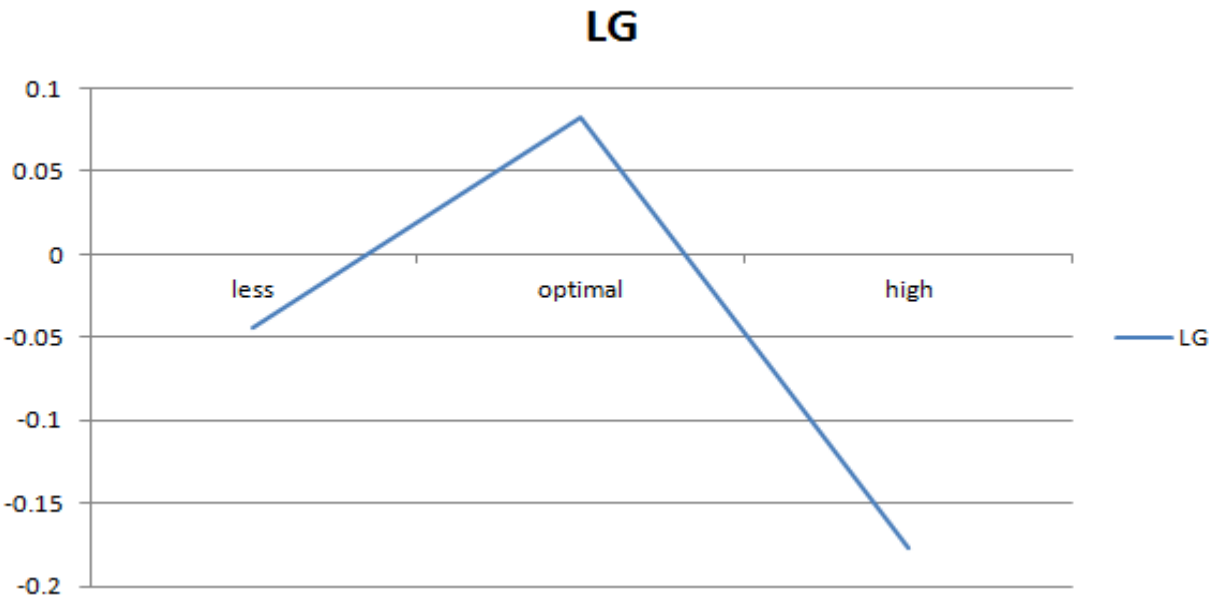
Help-seeking rate histogram



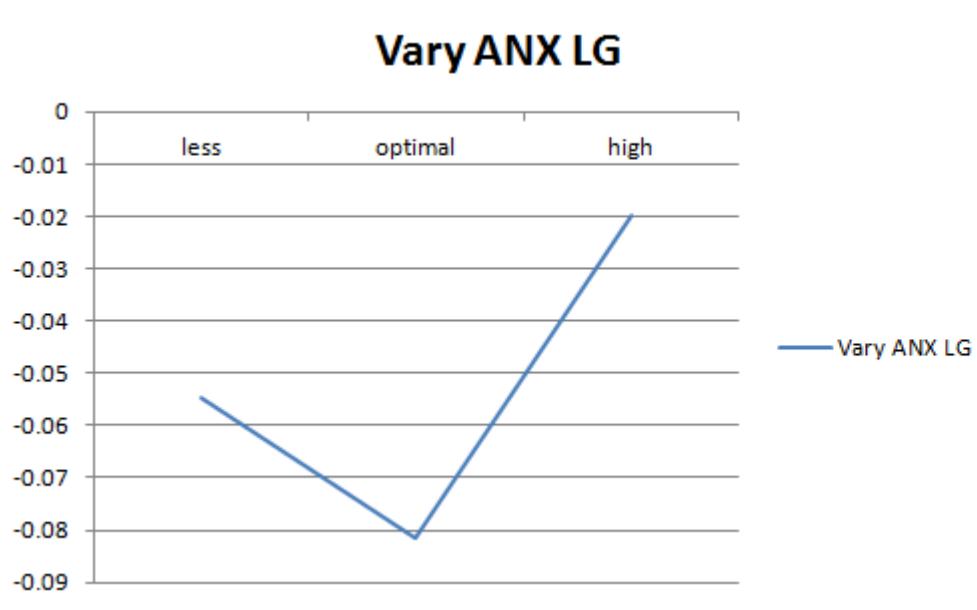
Help-seeking rate and learning

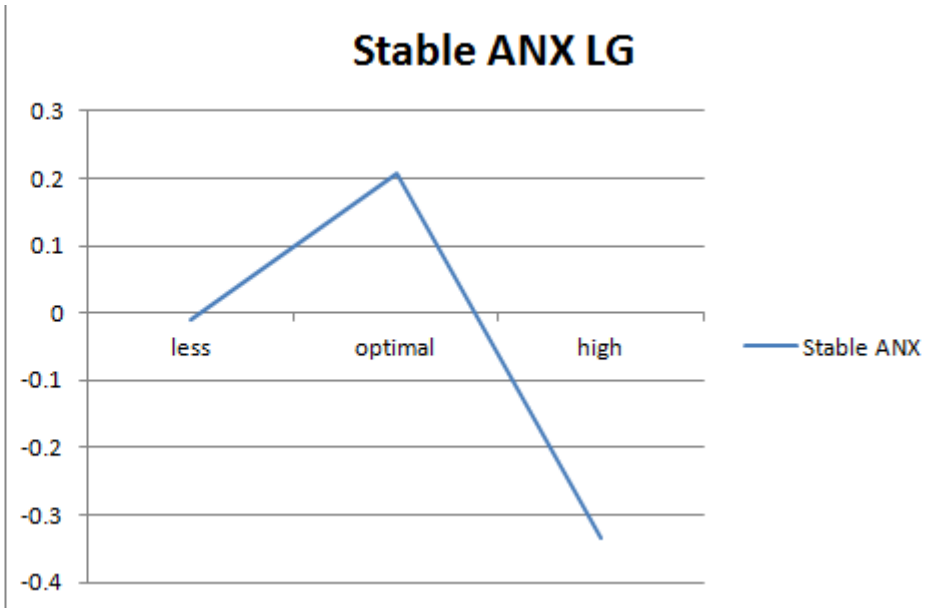






Help-seeking and anxiety





Dialog Cohesion and Learning

- Tutorial effectiveness is often dependent on the preparedness level of student
- Inspired by work by Ward and Litman (2006)
  - Cohesion in tutorial dialogs help to predict learning for below-mean, but not above-mean pre-testers
- Question: whether the same results are found in our data?

Tutorial dialog cohesion

- Two kinds of cohesive ties
  - Token: count the same word form in two consecutive turns
  - Stem: count the same word stem
- Normalize by number of turns in dialog
- Split students into low and high pre-testers
  - 25 low and 24 high

Cohesion score

- No difference on cohesion score between low and high group

	Low mean	High mean	p-value
Token	0.11	0.12	0.66
Stem	0.11	0.11	0.82

- No significant correlation found with learning

	All students	High group	Low group
Token	0.13	0.14	0.18
Stem	0.13	0.1	0.14

Effective response and learning

- Effectiveness can be identified be exploiting code labeled to each turn
  - Students' learning traits and tutors' responses
- Based on idea of dialog transactivity of Amzitia and Montgomery
  - Tutor's response must really help student solving problem and/or challenge student's thinking

Effective responses

12 effective pairs

- Define pairs of on-task student's query – tutor's response

Anxiety f.b. Hint	Anxiety f.b. NEG.Feedback	Anxiety f.b. POS.Feedback
Confusion f.b. Hint	Confusion f.b. NEG.F	Confusion f.b. POS.F
Curiosity f.b. Hint	Curiosity f.b. NEG.F	Curiosity f.b. POS.F
Frustration f.b. Hint	Frustration f.b. NEG.F	Frustration f.b. POS.F

- Count number of effective pairs
- Normalize by number of turns

An example

tutee	im soo sorrry idk how to do this :(	Confusion
tutor	okay you have to add bg to both sides	Hint
tutee	alrightt now?	Confusion
tutor	you have to factor out w	Hint
tutee	okk i did that now what?	Curiosity
tutor	you have to divide both sides by -y+r to get w by itself	Hint
tutee	is that it?	Confusion
tutor	yeah i think so	POS.Feedback

Effectiveness score

- No significant difference between low and high pre-testers groups

	Low mean	High mean	P-value
# turns	94	93	0.92
# E. responses	11.1	13.6	0.23
Effectiveness	0.12	0.15	0.09

- Effectiveness and learning correlates in low pre-testers

All students (49)	R = 0.14
High group (24)	R = -0.06
Low group (25)	**R = 0.41 ***

Effective response and anxiety

Only varied anxiety (31)	Correlation with anxiety
Low pre-test score (14)	**r = -0.53 ***
High pre-test score (17)	r = -0.21
All	**r = -0.38 ***

Only varied anxiety (31)	Correlation with Learning gain
Low pre-test score (14)	**r = 0.62 ***
High pre-test score (17)	r = -0.24
All	r = 0.24

Face-threat

- Politeness theory and learning by Brown and Levinson, 1978
- Work by Ogan et. al. on the same data as ours indicated that:
  - Face threat is a positive predictor of learning gains
  - No correlation between positivity and learning gains
- Face Threats => Politeness => Learning
  - It goes against rapport building in this age group under study

Face Threats in Different Groups

- Face Threats ~~Politeness~~ → Learning gain

Group	%users use Direct Insults
High Pre-test	24%
Low Pre-test	45%

Group	%users use Direct Insults
Positive Learning Gain	72%
Negative Learning Gain	28%

When is a direct insult used

Reason\Group	Positive Gain, High Pretest	Positive Gain, Low Pretest	Negative Gain, High Pretest	Negative Gain, Low Pretest
Greeting	1	4	1	4
Bully	1	12	2	2
Responding to offensive statements	6	3	2	3
In correct response / out of focus	10	12	3	2
others	1	3	0	1

Example

- Incorrect responses:

Tutor: we screwed up exit outta all the red 1s
Tutee:there r no red ones dumbass lol

Tutee: now what?
Tutor: now how do you think you can get rt and vt by themselves?
Tutor: don't factor out yet, you have to get it by themself dummy.

- When the partner goes out of focus:

Tutee: OOhhhh i thought it wanted "y“
Tutor: see because your mind is never focused

Face-threat and effectiveness

- No correlation in general
- When conditioning on anxiety
  - Sub-population whose anxiety vary
  - Negative correlation: $r = -0.51$, $p < 0.05$

Face-threat and effectiveness

tutee	how do i do this?
tutor	you have to add vt to both sides to get the t terms together

tutee	yhue aint no help !
tutor	i knoe do what i said !
tutor	your no teven tryin like
tutee	okay idont get what your saying give me a hint on how to do that
tutee	who's the dum one now craig ? ahaa mmburr !
tutor	shut yur face nd do the problem !

Conclusion

- Anxiety and effectiveness are found correlated with learning and highly correlate to each other
- Students with high learning gains can regulate their help (or hint) seeking behavior
- Face threats (in certain circumstances) could a good indicator of learning in peer tutoring environment

Thank you!