

# **Group Cognition in Chat: Methods of Interaction / Methodologies of Analysis**

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Nordic Network for Analysis of Interaction and Learning**

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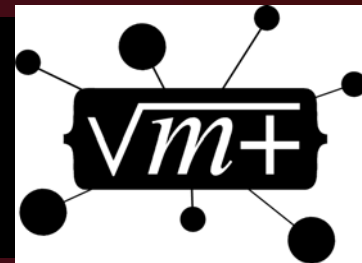
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# Research Agenda

- How do small groups of students construct their shared experience of collaborating online?
- Group interactions have structure and elements of their own that call for analytic approaches at the small-group unit of analysis

# The VMT Project



- How do teams of middle school students (age 13-15) discuss math in a chat room?
- The Virtual Math Teams project at [mathforum.org](http://mathforum.org) provides chat rooms for groups of 3-6 students to
  - Problem-solve a challenging algebra or geometry problem for about an hour
  - Explore an open-ended math world
  - Chat about their own math concerns

# Project Questions

- How to form groups of students?
- Technologies to support collaboration?
- Math pedagogy and curriculum?
- Mentoring, training, feedback, scaffolds?
- Scalability & sustainability of a service?
- Building a user community?
- Online social practices?
- Analysis of interaction?

# Conversation Analysis (CA)

## ➤ Except:

- Data: chat logs (no transcription)
- Typed, not spoken, text
- Not F2F, no gaze, no physical engagement
- Message production not visible
- Mediated by chat environment
- Messages designed for reading
- Persistence of messages
- Simultaneous, overlapping production
- Math content, not informal conversation
- Educational context, not socializing

## ➤ Better: Interaction Analysis

# Preliminary Findings

- Methods of collaborative sense making
- Expository vs. exploratory narrative
- Individual & group knowledge intertwined
- Typical math proposal/response pairs
- Referencing math objects
- Sequentiality and flow of group consciousness

# Methods

- To adapt to institutional settings
- To socialize, have fun, flirt
- To get to know each other better
- To establish interpersonal relations or roles
- To form themselves into groups
- To define a problem to work on
- To start working on a problem
- To agree on how to proceed
- To bring in math resources
- To agree on solutions
- To stop problem solving

# Research Methodology

- Data sessions among researchers
  - Shared cultural basis
- Accountability as theoretical basis from ethnomethodology
  - How are texts designed to show their meaning?
- Design-based research
  - Using CA for analysis of usage

# Expository & Exploratory Discourse

|                                 | Expository<br>narrative | Exploratory<br>inquiry |
|---------------------------------|-------------------------|------------------------|
| Problems seen<br>in advance     | X X X                   | X                      |
| Problems seen<br>simultaneously | X                       | X X X                  |

# The Group of Individuals

Three years ago, men made up two out of every three internet users in America. Today the ratio of male to female users is about 1 to 1. In that time the number of American females using the internet has grown by 30,000,000, while the number of males who use the internet has grown by 100%. By how much has the total internet-user population increased in America in the past three years?

(A) 50,000,000 (B) 60,000,000 (C) 80,000,000 (D) 100,000,000 (E) 200,000,000

| Line | Time    | Name | Message                                                | Interval |
|------|---------|------|--------------------------------------------------------|----------|
| 350  | 4:31:55 | Mic  | how do we do this..                                    |          |
| 351  | 4:31:59 | Mic  | without knowing the total number                       | 0:00:04  |
| 352  | 4:32:01 | Mic  | of internet users?                                     | 0:00:02  |
|      |         |      | ....                                                   |          |
| 357  | 4:32:23 | Dan  | it all comes from the 30000000                         |          |
| 358  | 4:32:23 | Mic  | did u get something for 10?                            | 0:00:00  |
| 359  | 4:32:26 | Dan  | we already know                                        | 0:00:03  |
| 360  | 4:32:44 | Mic  | 30000000 is the number of increase in american females | 0:00:18  |
| 361  | 4:33:00 | Mic  | and since the ratio of male to female                  | 0:00:16  |
| 362  | 4:33:02 | Mic  | is 1 to 1                                              | 0:00:02  |
| 363  | 4:33:09 | Mic  | thats all i got to give. someone finish it             | 0:00:07  |
| 364  | 4:33:10 | Mic  | haha                                                   | 0:00:01  |
| 365  | 4:33:18 | Cosi | haha you jackass                                       | 0:00:08  |
| 366  | 4:33:20 | Mic  | haha                                                   | 0:00:02  |
| 367  | 4:33:21 | Dan  | hahaha                                                 | 0:00:01  |
| 368  | 4:33:26 | Mic  | u all thought i was gonna figure it out didnt          | 0:00:05  |
| 369  | 4:33:27 | Mic  | u                                                      | 0:00:01  |
| 370  | 4:33:28 | Mic  | huh?                                                   | 0:00:01  |
| 371  | 4:33:28 | Hal  | it would be 60,000,000                                 | 0:00:00  |
| 372  | 4:33:30 | Mic  | hal                                                    | 0:00:02  |
| 373  | 4:33:31 | Mic  | its all u                                              | 0:00:01  |
| 374  | 4:33:33 | Mic  | see                                                    | 0:00:02  |

|     |         |      |                                                                          |         |
|-----|---------|------|--------------------------------------------------------------------------|---------|
| 375 | 4:33:34 | Mic  | i helped                                                                 | 0:00:01 |
| 376 | 4:33:54 | Cosi | ok, so what's 11 – just guess on 10                                      | 0:00:20 |
|     |         |      | ....                                                                     |         |
| 386 | 4:34:45 | Mic  | lets get back to 5                                                       |         |
| 387 | 4:34:47 | Cosi | i think it's more than 60,00000                                          | 0:00:02 |
| 388 | 4:34:57 | Mic  | way to complicate things                                                 | 0:00:10 |
| 389 | 4:35:03 | Cosi | haha sorry                                                               | 0:00:06 |
| 390 | 4:35:05 | Mic  | life was good until you said that                                        | 0:00:02 |
| 391 | 4:35:07 | Mic  | :(                                                                       | 0:00:02 |
| 392 | 4:35:18 | Cosi | they cant get higher equally and even out to a 1 to 1 ratio              | 0:00:11 |
| 393 | 4:35:27 | Cosi | oh, no wait, less than that                                              | 0:00:09 |
| 394 | 4:35:32 | Cosi | 50000000                                                                 | 0:00:05 |
| 395 | 4:35:34 | Cosi | yeah, it's that                                                          | 0:00:02 |
| 396 | 4:35:36 | Cosi | im pretty sure                                                           | 0:00:02 |
| 397 | 4:35:37 | Mic  | haha                                                                     | 0:00:01 |
| 398 | 4:35:38 | Mic  | how?                                                                     | 0:00:01 |
| 399 | 4:35:57 | Cosi | because the women pop had to grow more than the men in order to even out | 0:00:19 |
| 400 | 4:36:07 | Cosi | so the men cant be equal (30)                                            | 0:00:10 |
| 401 | 4:36:11 | Mic  | oh wow...                                                                | 0:00:04 |
| 402 | 4:36:16 | Mic  | i totally skipped the first sentencwe                                    | 0:00:05 |
| 403 | 4:36:16 | Cosi | therefore, the 50,000,000 is the only workable answer                    | 0:00:00 |
| 404 | 4:36:19 | Dan  | very smart                                                               | 0:00:03 |
| 405 | 4:36:21 | Cosi | Damn im good                                                             | 0:00:02 |

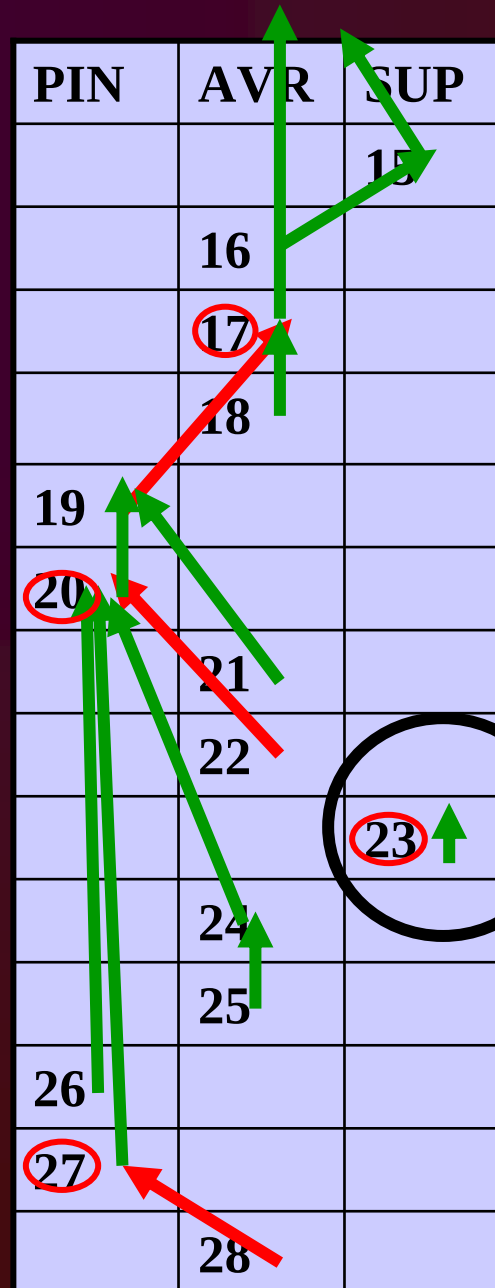
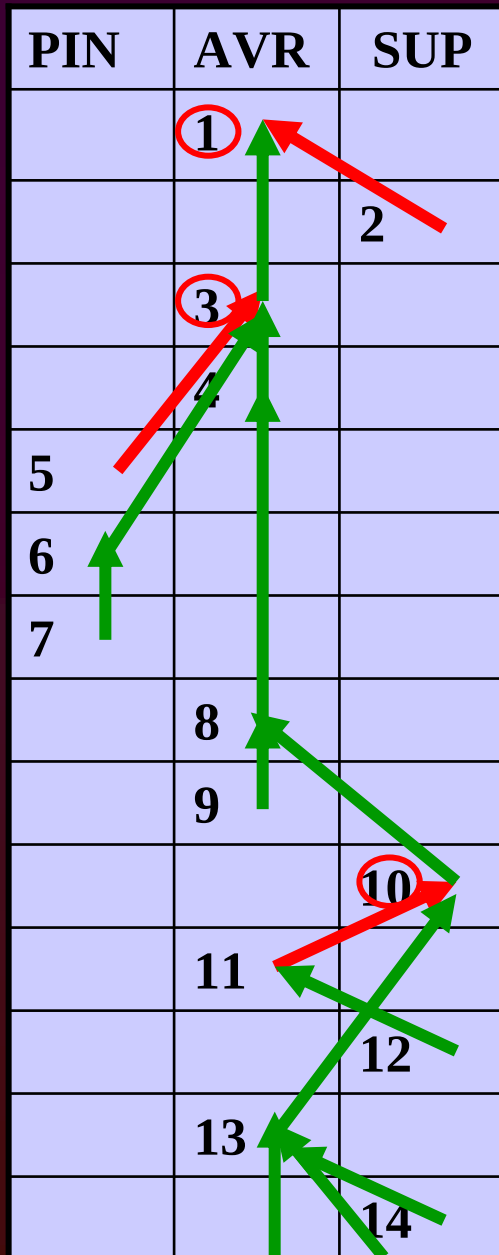
# Combined Summary

- How can I figure out the increase in users without knowing the total number of internet users? <Mic>
- It seems to all come from the 30,000,000 figure. <Dan>
- 30,000,000 is the number of increase in American females. Since the ratio of male to female is 1 to 1, <Mic>
- the total of male and female combined would be 60,000,000. <Hal>
- No, I think it must be more than 60,000,000 because the male and female user populations can't get higher at equal rates and still even out to a 1 to 1 ratio after starting uneven. No, I made a mistake, the total must be less than 60,000,000. It could be 50,000,000, which is the only multiple choice option less than 60,000,000. <Cosi>
- Very smart. <Dan>

# Math Proposal Adjacency Pairs

- 1. A bid for a proposal is made by an individual for the group to work on: “**I think we should ....**”
- 2. An acceptance, confirmation or up-take is made on behalf of the group by a second person: “**Ok,**” “**right**”
- 3. There is an elaboration of the proposal by members of the group. The proposed work is begun, often with a secondary proposal for the first sub-step.

- 1. Avr (8:21:46 PM): Okay, I think we should start with the formula for the area of a triangle
2. Sup (8:22:17 PM): ok
3. Avr (8:22:28 PM):  $A = 1/2bh$
4. Avr (8:22:31 PM): I believe
5. pin (8:22:35 PM): yes
6. pin (8:22:37 PM): i concue
7. pin (8:22:39 PM): concur\*
8. Avr (8:22:42 PM): then find the area of each triangle
9. Avr (8:22:54 PM): oh, wait
10. Sup (8:23:03 PM): the base and heigth are 9 and 12 right?
11. Avr (8:23:11 PM): no
12. Sup (8:23:16 PM): o
13. Avr (8:23:16 PM): that's two separate triangles
14. Sup (8:23:19 PM): ooo
15. Sup (8:23:20 PM): ok
16. Avr (8:23:21 PM): right
17. Avr (8:23:27 PM): i think we have to figure out the height by ourselves
18. Avr (8:23:29 PM): if possible
19. pin (8:24:05 PM): i know how
20. pin (8:24:09 PM): draw the altitude'
21. Avr (8:24:09 PM): how?
22. Avr (8:24:15 PM): right
23. Sup (8:24:19 PM): proportions?
24. Avr (8:24:19 PM): this is frustrating
25. Avr (8:24:22 PM): I don't have enough paper
26. pin (8:24:43 PM): i think i got it



adjacency pair



other uptake



intersubjective  
small-group  
meaning  
making

co-construction  
of sequentiality  
in doing math

# A Failed Proposal

- 1. No semantic or syntactic structure
- 2. Poor timing in sequence of messages
- 3. Interruption of on-going work
- 4. No elicitation of a response
- 5. No proposal of work to be done
- 6. No history of helpful contributions

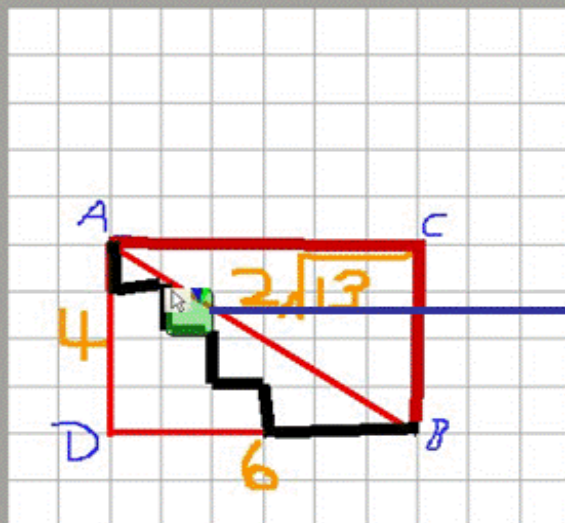
# Comparing Proposals

- 17, 18. Avr (8:23: 29 PM): **i think we have to figure out the height by ourselves ... if possible**
- 19. pin (8:24:05 PM): i know how
- 21. Avr (8:24:09 PM): how?
- 20. pin (8:24:09 PM): **draw the altitude'**
- 22. Avr (8:24:15 PM): right
- 24. Avr (8:24:19 PM): this is frustrating [...]
- 23. Sup (8:24:19 PM): **proportions?**
- 25. Avr (8:24:22 PM): [...] I don't have enough paper

# References & Threading

- Importance of deictic referencing & indexicality
- VMT-Chat allows explicit, graphically represented references:
  - (a) between chat messages
  - (b) from a message to drawings
- Students often combine textual & graphical referencing

## Whiteboard:



1. What is the shortest path along the grid between the two points?
2. How many possible routes are there from point A to point B?
3. What is the maximum distance from point A to B if you can only travel on each POINT once?
4. How many ways are there to get from A to B in rectangle ABCD?
5. Make a right triangle with AB as the hypotenuse. What is the area of the circumscribed circle?
6. Can you go off the edge and come back somewhere else?

## Extras

7. What is the shortest path along the grid between any two points  $A(x_1, y_1)$ ,  $B(x_2, y_2)$ ?
8. How many shortest paths are there from A to B and how does this vary with changes in the positioning of A relative to B?
9. Suppose the right and left edges of the grid are connected. How does that change the distances between points?

## Current users:

## Chat: (207)

OK

← ImHere (May 12, 2005 8:42 PM):  
what is the area of this shape?

Jason (May 12, 2005 8:42 PM):  
which shape?

ImHere (May 12, 2005 8:43 PM):  
woops

ImHere (May 12, 2005 8:43 PM):  
ahhl

← Jason (May 12, 2005 8:42 PM):  
kinda like this one?

Jason (May 12, 2005 8:42 PM):  
the one highlighted in black and dark red?

ImHere (May 12, 2005 8:43 PM):  
between th stairs and the hypotenuse

Jason (May 12, 2005 8:43 PM):  
oh

Jason (May 12, 2005 8:43 PM):  
that would be a tricky problem, each little "sector" is different

← Jason (May 12, 2005 8:43 PM):  
this section...

ImHere (May 12, 2005 8:44 PM):  
perimeter is  $12\sqrt{13}$

← Jason (May 12, 2005 8:43 PM):  
is smaller than this section

ImHere (May 12, 2005 8:44 PM):  
assume those lines are on the blocks

Jason (May 12, 2005 8:44 PM):  
the staircase lines?

ImHere (May 12, 2005 8:45 PM):  
yeah

Jason (May 12, 2005 8:44 PM):  
they already are on the blocks

## Message:

- 1 ImH: what is the area of this shape? [REF TO WB]
- 2 Jas: which shape?
- 3 ImH: woops
- 4 Imh: ahh!
- 5 Jas: kinda like this one? [REF TO WB]
- 6 Jas: the one highlighted in black and dark red?
- 7 ImH: between th stairs and the hypotenuse
- 8 Jas: oh
- 9 Jas: that would be a tricky problem, each little “sector”  
is different
- 10 Jas: this section [REF TO WB]
- 11 ImH: perimeter is  $12\sqrt{3}$
- 12 Jas: is smaller than this section [REF TO WB]
- 13 ImH: assume those lines are on the blocks
- 14 Jas: the staircase lines?
- 15 ImH: yea
- 16 Jas: they already are on the blocks

# The Collaborative Experience

- How is the group experience structured as interpersonal interactions?
- How is the group constituted as an interactive unit?

# Replies, Up-Take, Pairs, Triplets

- In CA, turn taking structures the sequentiality & social order
- In chat about math, bids & up-takes like “math proposal adjacency pairs” structure the flow of interaction
- Meaning is created by these interactions among multiple people – it is not simply transferred between individuals and agreed upon

# Longer Sequences

- Adjacency pairs or bid/up-take
- Longer sequences that do some work
- Episodes of interaction
- Topics of dialog
- Online sessions
- Interruptions & returns
- Initiation & transition
- ... various layers & time scales

# Constructing Proofs

- Problem-solving sequences of math work are analogous to proof. Proofs include:
  - The problem statement/situation
  - Exploratory search for a solution
  - Reduction to elegant proof
  - Formal proof statement
  - Lived experience of following the proof (see Livingston)

# Stream of Group Consciousness

- Narrative flow of group interaction: introduction, character development, problem phase, resolution, temporal sequencing

# Group Cognition in Chat

- In chat, small groups construct shared meaning, solve problems, formulate proofs, conduct inquiry.
- Through interplay of interpretive perspectives, questioning, checking, etc., group cognition can exceed individual cognition
- Small groups constitute themselves and form larger communities

# How Groups Construct their Experience

- Designers can provide environment, affordance, infrastructure, opportunities
- But the users enact their experience, establish methods of interaction, & construct shared meaning within and about their situation

# How does one transform recordings of interaction into analytic accounts?

- Design-based research as tool-design, interaction usage analysis, re-design
- Member methods as analytic structures
  - Found everywhere
  - Understood by community participants
  - Facile adaptation by students

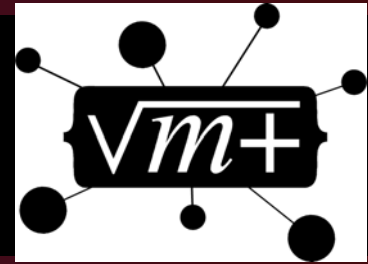
# What is the relation between studies of interaction & theories of learning?

- Learning takes place through establishment of shared meaning, created in interaction (via instruction, books, guided discovery, cooperative explanation, collaborative exploration, interaction)

# How does one make the analysis relevant for curricular design?

- Design opens a world of opportunities & removes barriers
- Interaction analysis shows what members can do there and what barriers remain

# The VMT Team



- Principal Investigators: Gerry Stahl, Stephen Weimar, Wesley Shumar
- Math Forum staff: Stephen Weimar, Annie Fetter, Ian Underwood
- Research Assistants: Murat Cakir, Johann Sarmiento, Ramon Toledo, Nan Zhou
- Post-docs: Alan Zemel, Elizabeth Charles
- Visiting researchers: Jan-Willem Strijbos (Netherlands), Fatos Xhafa (Spain), Stefan Trausan-Matu (Romania), Martin Wessner (Germany)
- The VMT-Chat software was developed at the Fraunhofer Institute IPSI in Darmstadt, Germany, by Martin Wessner, Martin Mühlpfordt and colleagues based on their ConcertChat
- The VMT project is supported by the US National Science Foundation

## ***“Group Cognition”***

**(the book)**

**MIT Press in the Spring  
prepublication version  
available now:**

**[www.cis.drexel.edu/faculty/gerry/mit](http://www.cis.drexel.edu/faculty/gerry/mit)**

**Journal of CSCL:**

**[ijCSCL.org](http://ijCSCL.org)**

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