

# **Theories of Collaborative Cognition: Foundations for CSCL and CSCW together**

**Gerry Stahl**

**“Computer support has focused on organizations and individuals. Groups are different. Repeated, expensive groupware failures result from not meeting the challenges in design and evaluation that arise from these differences.”**

**-- Grudin, *Eight Challenges* (1994, p.93)**

**Groups are not just sets of individuals, cognitively speaking.**

**“*Cognition*” is defined in the dictionary as the process involved in coming to know, or the act of knowing, particularly using reasoning as opposed to feeling or willing.**

**Its definition has been dramatically expanded by post-cognitive philosophy, distributed-cognition theory and AI.**

**“The group performing the cognitive task may have cognitive properties that differ from the cognitive properties of any individual”**

**-- Hutchins, *Cognition in the Wild*, p.176**

**“Small groups are the engines of knowledge building.**

**The knowing that groups build up in manifold forms is what becomes internalized by their members as individual learning and externalized in their communities as certifiable knowledge.”**

**-- Stahl, *Group Cognition*, 2006, p.16**

# Today's talk

- 1. The question of cognition in CSCL & CSCW**
- 2. History of theory: extending the cognitive unit of analysis**
- 3. Seminal theories for CSCL & CSCW**
- 4. Theories of individual, community and small-group cognition**
- 5. Findings from Virtual Math Teams research**
- 6. A multiplicity of theories**

# 1. The question for CSCL@ Work

**What is cooperation?**

**Who does it – small groups?**

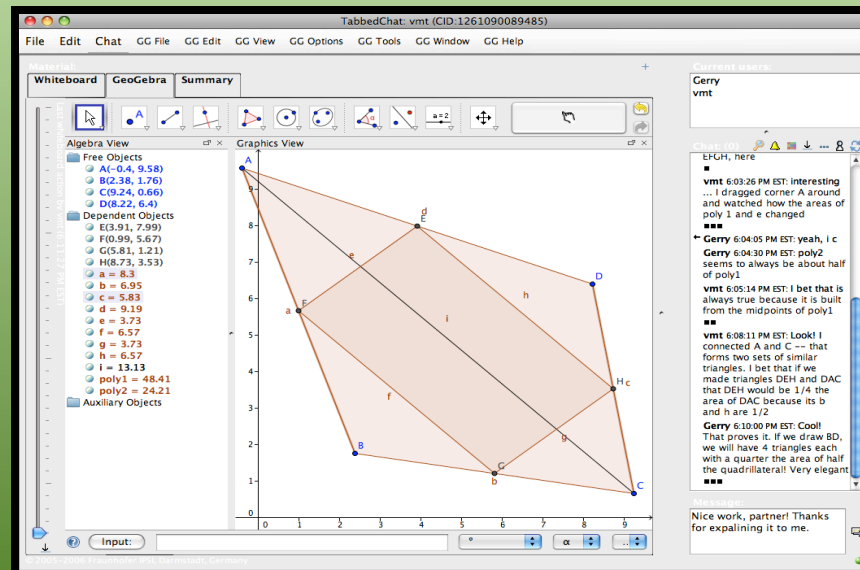
**How can we support it with networked computers?**

**Can we facilitate new forms of group cognition?**

**Do we need new theories of cognition?**

**Do we need new research methodologies?**

If CSC@W is about designing computer support for CL at work, then what new forms of cognition can we support in computer-mediated group interaction? Are new forms of group cognition possible in the age of ICT that are distinct from both individual cognition and community practices?





## **2. Theory: extending the unit of analysis**

**Theories of cognition began in Western philosophy**

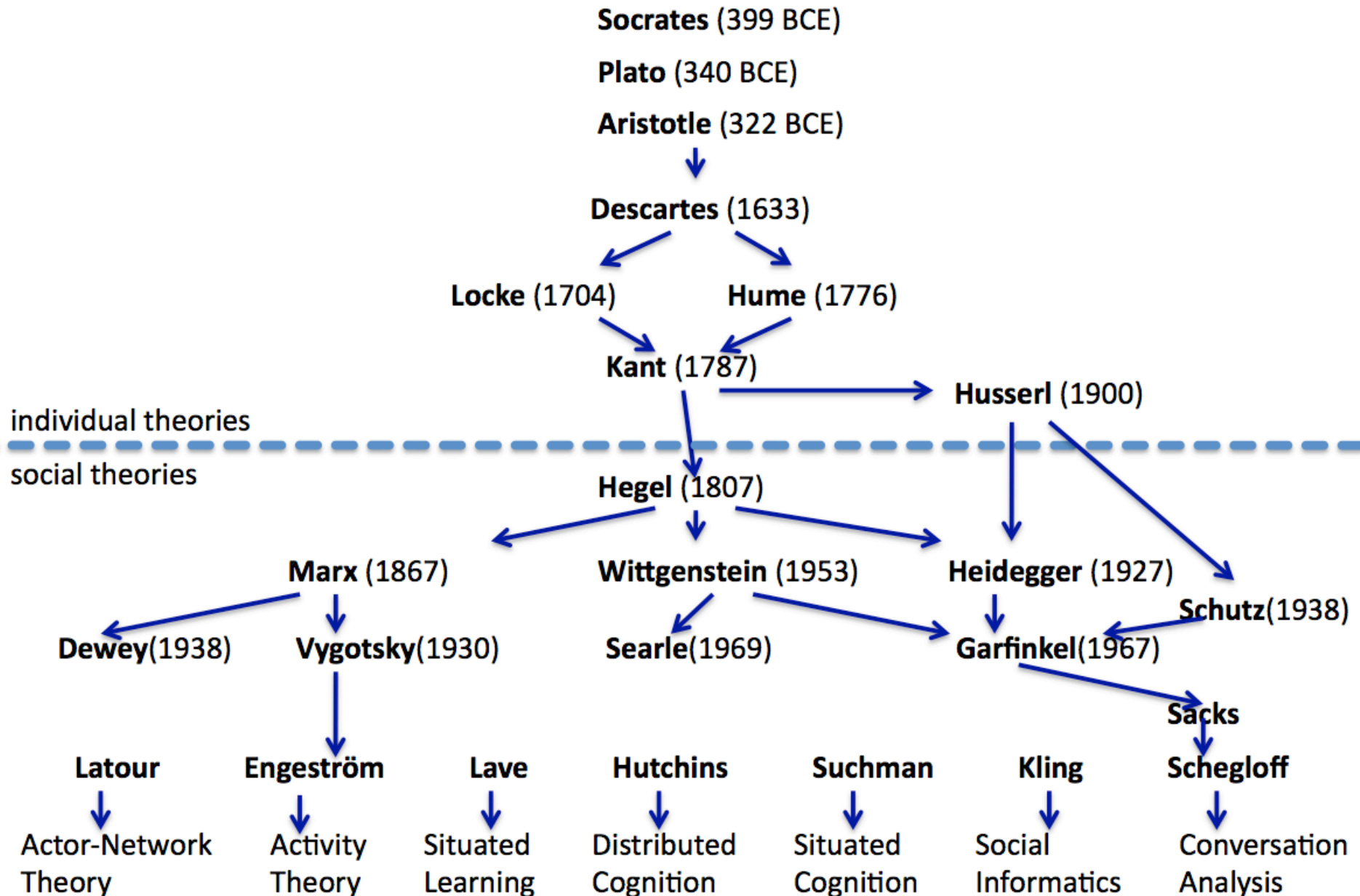
**They developed a conception of the isolated (fundamentally non-cooperative) individual mind**

**Kant's fixed mind constructed the nature of reality**

**Hegel traced the development of mind from primitive consciousness to the social Zeitgeist**

**Marx, Heidegger, Wittgenstein, etc. transformed theory into science: social, situated, linguistic**

# A brief history of theory



### 3. Seminal theories for CSCW

**Building on Marx, Heidegger, Wittgenstein:**

- ***Mind in Society* (Vygotsky, 1930/1978),**
- ***Situated Learning* (Lave & Wenger, 1991),**
- ***Lectures on Conversation* (Sacks, 1962/1995)**
- ***Understanding Computers and Cognition* (Winograd & Flores, 1986).**

# The local locus of group cognition

**While cooperative work may be coordinated across large communities of practice, the cognitive tasks are typically accomplished by small groups:**

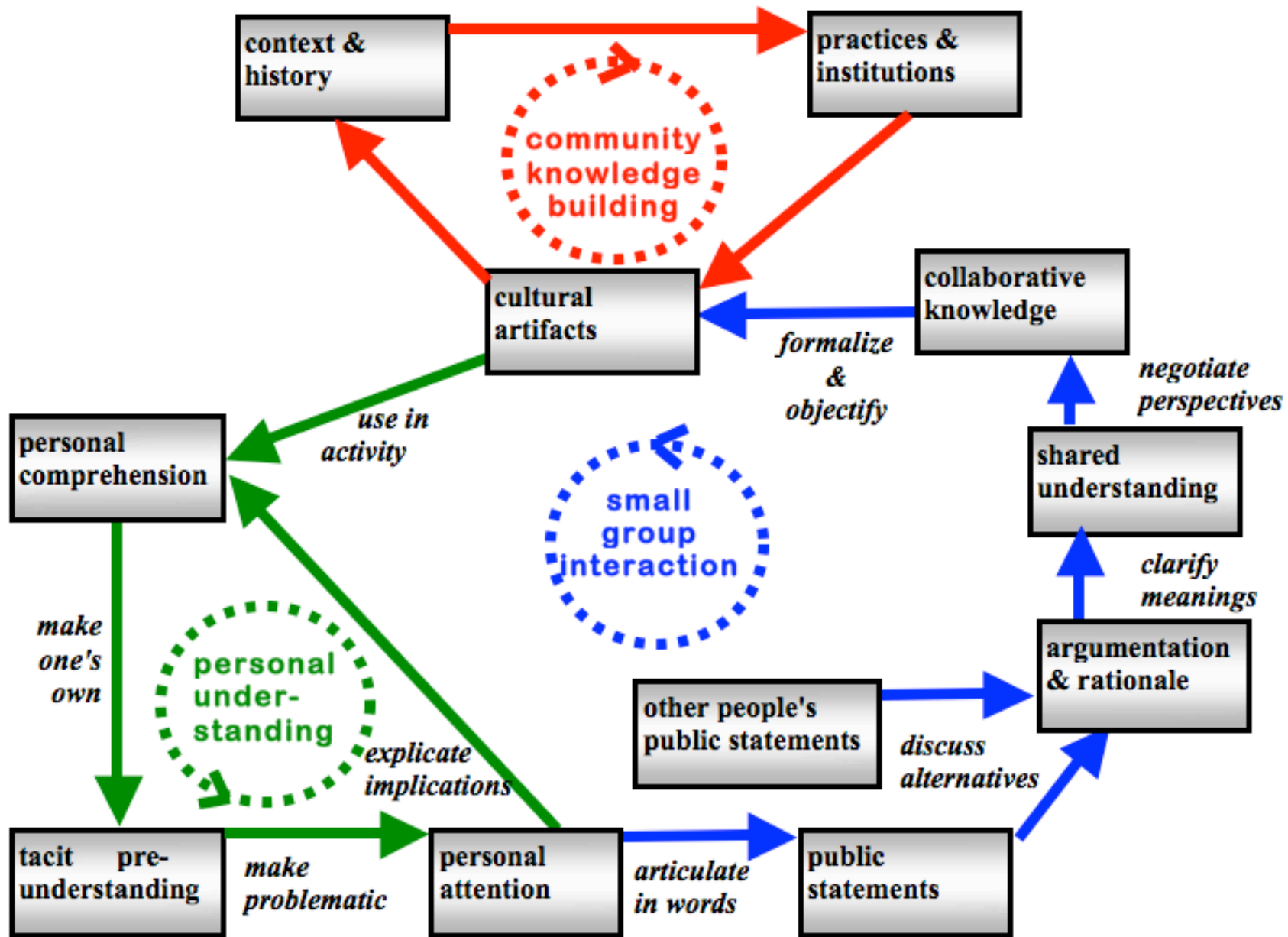
- ***Mind in Society:* family, peer dyads, mentor/student**
- ***Situated Learning:* master & apprentice or small group of apprentices**
- ***Lectures on Conversation:* Dyads or small groups talking**
- ***Understanding Computers and Cognition:* Communicator or email may link communities, but specific commitments of discussion threads involve just a couple people**

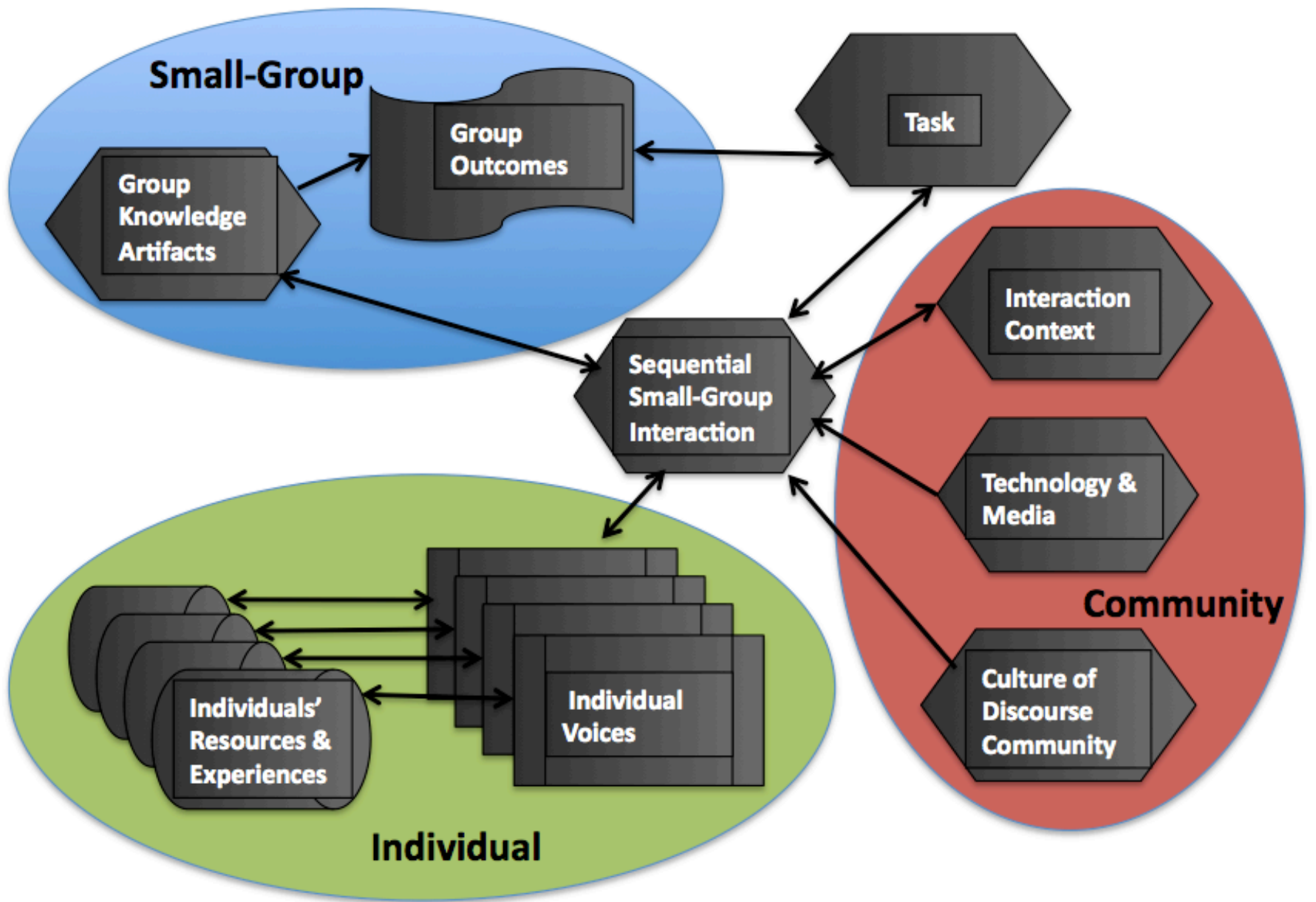
## **4. Theories of individual, community & small-group cognition in CSCW**

**Commonsensical folk theories based on classical philosophy and on the observation of the bodies of individuals and on personal introspection, conceives of cognition as an individual mental process. Cognitive science posits mental models and internal representations. Psychological research uses indirect measures to analyze hypothesized mental processes.**

**Small-group interaction makes thinking visible to enable shared understanding – and help researchers.**

**Community artifacts, practices and institutions preserve and disseminate cognitive accomplishments.**





## 5. Findings from Virtual Math Teams research

**The Virtual Math Teams Project (VMT) explores how small groups of people build knowledge collaboratively**

**In the learning process, one can observe the genesis of group cognition**

**The structure of the problem solving is made visible in the logs of interaction, where group cognition emerges**

**A recent case study illustrates some features of group cognition**





# Building Knowledge Together

137 5/16/06 7:23:17 PM EDT: It equals  $1+3+\dots+(n+n-1)$  because of the "rows"?

qwertyuiop 5/16/06 7:24:00 PM EDT: yes- 1st row is 1, 2nd row is 3...

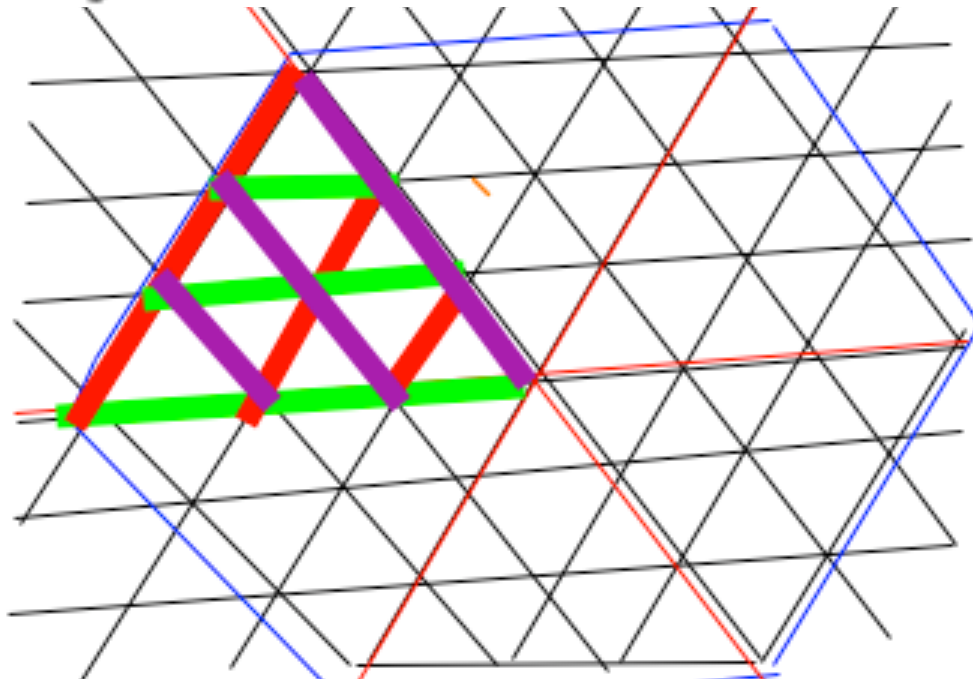
137 5/16/06 7:24:49 PM EDT: And there are  $n$  terms so...  $n(2n/2)$

↑ 137 5/16/06 7:25:07 PM EDT: or  $n^2$

Jason 5/16/06 7:25:17 PM EDT: yeah

Jason 5/16/06 7:25:21 PM EDT: then multiply by 6

↑ 137 5/16/06 7:25:31 PM EDT: To get  $6n^2$



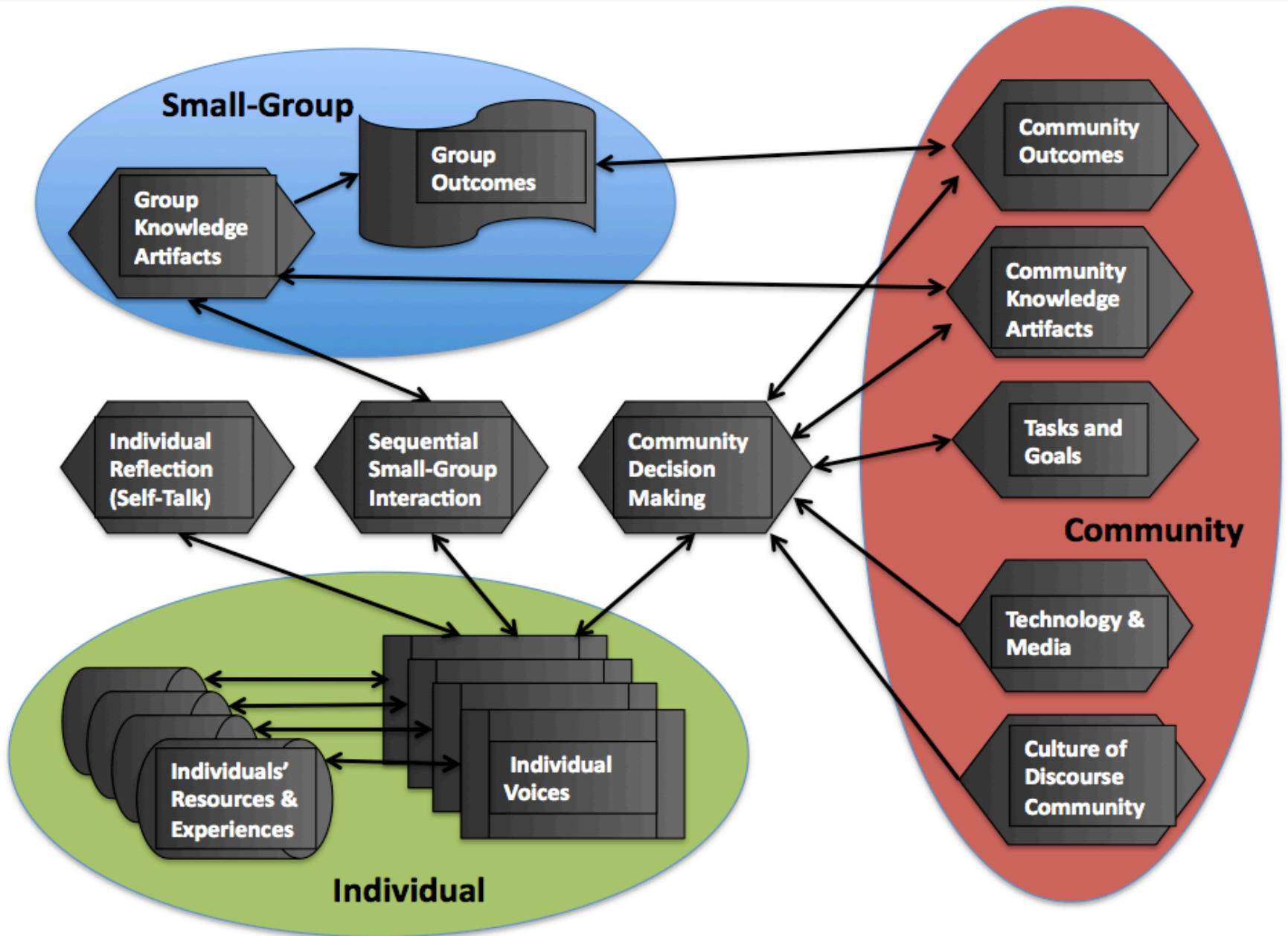
# The mediation of group cognition through digital interaction in VMT

- 1. Open a digital world with interaction through text, graphics, external representations**
- 2. Co-construct, maintain, repair a joint problem space by building on each other's proposals & questions**
- 3. Share the world and co-attend to objects in it by dialog, pointing, questioning, visually sharing**
- 4. Accomplish multi-step problem solving at the group unit of analysis (interaction among group members)**

## 6. A multiplicity of theories in CSCW

- **The idea of a universal science is outdated**
- **We need different theories, methods, sciences, discourses for different levels of description, time periods, research questions**
- **Even for a specific object, we need multi-vocal approaches and analytic perspectives**
- **We need to also recognize commonalities across levels and domains – e.g., common group phenomena in CSCW and CSCL**

<i>Level of description</i>	<b>Individual</b>	<b>Small group</b>	<b>Community</b>
<i>Role</i>	<b>Person / student</b>	<b>Group participant</b>	<b>Community member</b>
<i>Adjective</i>	<b>Personal</b>	<b>Collaborative</b>	<b>Social</b>
<i>Object of analysis</i>	<b>Mind</b>	<b>Discourse</b>	<b>Culture</b>
<i>Unit of analysis</i>	<b>Mental representation</b>	<b>Utterance response pair</b>	<b>Socio-technical activity system, mediating artifacts</b>
<i>Form of knowledge</i>	<b>Subjective</b>	<b>Intersubjective</b>	<b>Cultural</b>
<i>Form of meaning</i>	<b>Interpretation</b>	<b>Shared understanding, joint meaning making, common ground</b>	<b>Domain vocabulary, artifacts, institutions, norms, rules</b>
<i>Learning activity</i>	<b>Learn</b>	<b>Build knowledge</b>	<b>Science</b>
<i>Ways to accomplish cognitive tasks</i>	<b>Skill, behavior</b>	<b>Discourse, group methods, long sequences</b>	<b>Member methods, social practices</b>
<i>Communication</i>	<b>Thought</b>	<b>Interaction</b>	<b>Membership</b>
<i>Mode of construction</i>	<b>Constructed</b>	<b>Co-constructed</b>	<b>Socially constructed</b>
<i>Context of cognitive task</i>	<b>Personal problem</b>	<b>Joint problem space</b>	<b>Problem domain</b>
<i>Context of activity</i>	<b>Environment</b>	<b>Shared space</b>	<b>Society</b>
<i>Mode of Presence</i>	<b>Embodiment</b>	<b>Co-presence</b>	<b>Contemporary</b>
<i>Referential system</i>	<b>Associations</b>	<b>Indexical field</b>	<b>Cultural world</b>
<i>Form of existence (Heidegger)</i>	<b>Being-there (<i>Dasein</i>)</b>	<b>Being-with (<i>Mitsein</i>), Being-there-together at the shared object</b>	<b>Participation in communities of practice (<i>Volk</i>)</b>
<i>Temporal structure</i>	<b>Subjective experiential internal time</b>	<b>Co-constructed shared temporality</b>	<b>Measurable objective time</b>
<i>Theory of cognition</i>	<b>Constructivist</b>	<b>Post-cognitive</b>	<b>Socio-cultural</b>
<i>Science</i>	<b>Cognitive and educational psychology</b>	<b>Group cognition theory</b>	<b>Sociology, anthropology, linguistics</b>
<i>Tacit knowledge</i>	<b>Background knowledge</b>	<b>Common ground</b>	<b>Culture</b>
<i>Thought</i>	<b>Cognition</b>	<b>Group cognition</b>	<b>Practices</b>
<i>Action</i>	<b>Action</b>	<b>Inter-Action</b>	<b>Social praxis</b>



# Recommendations

**Many attempts to support groups in CSCW have assumed that group cognition is reducible to individual cognitions:**

- **E.g., theories of group psychology or common ground reduced analysis to individual beliefs**
- **E.g., systems for Group Decision-Support Systems supported exchange of ideas and voting on opinions, not building joint knowledge**
- **But group cognition has its own characteristics, group practices, potential achievements**

**Many theories claim universality, but we may need multiple theories for different levels of description, units of analysis, time periods, research questions**

**Many methods claim universality, but we may need multiple research methods for different objects**



**There may be many possible levels to distinguish in CSCW studies, but 3 seem natural and important: individual, small group and community**

- **The quantitative research paradigm of social psychology focuses on individual cognition**
- **The qualitative research paradigm of social sciences focus on social practices and cultural artifacts**
- **We need theories and methods appropriate to analyzing group cognition, such as interaction analysis as part of design-based research**

## **Group cognition is the future**

- **Small groups are the engines of knowledge building**
- **The potential of group cognition awaits our innovative CSCW & CSCL systems of support**

*For Further Information:*

- **“*Group Cognition*” (2006, MIT Press)**
- **“*Studying Virtual Math Teams*” (2009, Springer)**
- ***Gerry Stahl’s e-Library* (collections of papers free for iPad, Kindle, PDF or low-cost print-on-demand): [GerryStahl.net/elibrary](http://GerryStahl.net/elibrary)**
  
- **This paper: <http://GerryStahl.net/pub/group2012.pdf>**
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