Virtual Group Dynamics and Social Networks

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Collective Intelligence

Some Definitions

Collective Intelligence (1)

The working definition of collective intelligence that we're using is that *collective intelligence is groups of individuals doing things collectively that seem intelligent (Malone, 2008)*

Now, if you think about it that way, collective intelligence has existed for a very long time. Families, companies, and countries are all groups of individual people doing things that at least sometimes *seem* intelligent. Beehives and ant colonies are examples of groups of insects doing things like finding food sources that seem intelligent. And we could even view a single human brain as a collection of individual neurons or parts of the brain that collectively act intelligently. (Malone, 2008)

Malone, T. W. (2008). What is collective intelligence and what will we do about it. *Collective Intelligence: Creating a Prosperous World at Peace, Earth Intelligence Network, Oakton, Virginia*, 1-4.

Collective Intelligence

Some Definitions

Collective Intelligence (2)

Collective intelligence itself is a certain property of a group of beings which is expressed/observable and measurable. It is *not assumed* that the beings are cooperating or that they are conscious beings; nothing is assumed about the communication system; we do not even assume that these beings are alive (subsequently, a definition of *being alive* is not necessary). we can not assume willful cooperation for collective intelligence, or else the definition of cooperation would have to be very vague. (Szuba, 2001)

Szuba, T. (2001). A formal definition of the phenomenon of collective intelligence and its IQ measure. *Future Generation Computer Systems*, *17*(4), 489-500.

Collective Intelligence

Some Definitions

Collective Intelligence (3)

In recent years, the concept of collective intelligence has been widely discussed from various aspects. One series of related work is inspired by the ***"Swarm Intelligence" phenomena*** that can commonly be observed in the biological world. For example, in an ant colony, highly-intelligent collective activities of the whole colony may emerge from the local interactions between the individual ants, which embody very limited intelligence *per se.* the collective intelligence of human groups is the idea that a human group may manifest higher capabilities of information-processing and problem-solving than any individual participant of that group does (Luo, 2009)

Luo, S., Xia, H., Yoshida, T., & Wang, Z. (2009). Toward collective intelligence of online communities: A primitive conceptual model. *Journal of Systems Science and Systems Engineering*, *18*(2), 203-221.

Collective Intelligence

Some Definitions

Collective Intelligence (4)

Collective intelligence is defined as the ability of a group to solve more problems than its individual members. It is argued that the obstacles created by individual cognitive limits and the difficulty of coordination can be overcome by using a collective mental map (CMM), i.e., for istance a common culture. (Heylinghen, 1999)

Heylighen, F. (1999). Collective Intelligence and its Implementation on the Web: algorithms to develop a collective mental map. *Computational & Mathematical Organization Theory*, *5*(3), 253-280.

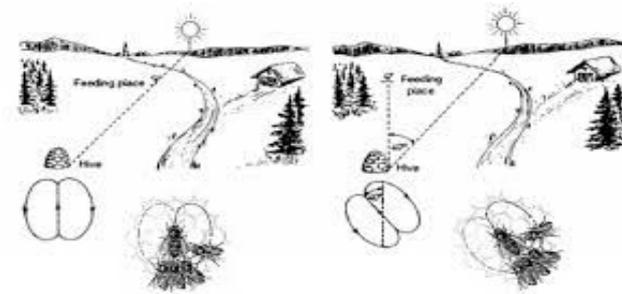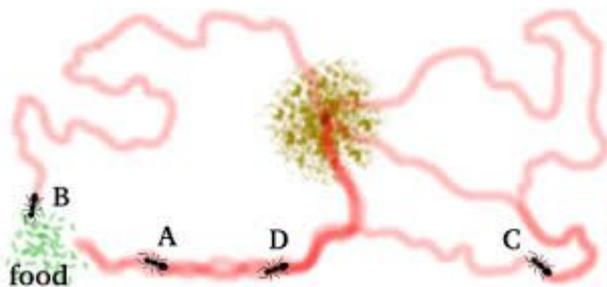# *Collective Intelligence*

Theoretical Constructs and Models

Collective Intelligence

It is a paradox that the evaluation of the collective intelligence of social structures can be easier than the evaluation of the IQ of a single being.

- Many elements of collectively intelligent activity can be observed, measured, and evaluated in a social structure. We can easily observe displacements and actions of beings as well as exchange of information between beings (e.g. language or the ant pheromone communication system). (Szuba, 2001)

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Collective Intelligence

Theoretical Constructs and Models

The Group Mind

Many Models of computations have recently been proposed and applied to collective intelligence. Experiments with chaotic collective inferences in a social structure with use of such models, demonstrate that a group (with some restrictions) can complete an inference with an appropriate conclusion, even when facing some internal inconsistencies, i.e. it can work as a *group mind*. (Szuba, 2001)

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Collective Intelligence

Theoretical Constructs and Models

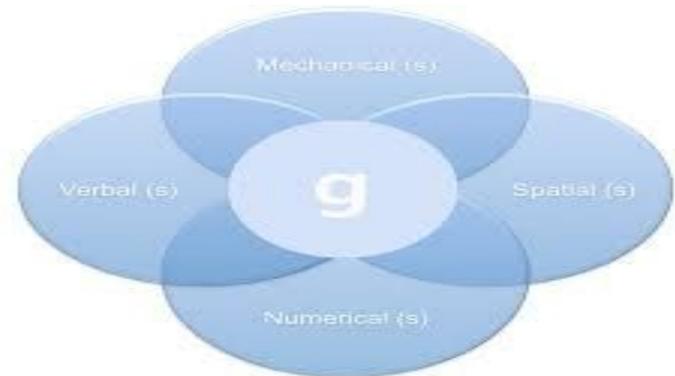## The C Factor of Collective Intelligence

The journal Science has recently published an intriguing paper by Woolley, Chabris, Pentland, Hashmi, and Malone (2010) in which evidence of a 'collective intelligence' or *'c-factor' undergirding group performance* on a variety of group tasks is presented.

● They argue that this is similar (but not strongly related) to *g* and its association with individual differences scales.

In elucidating the existence of c, individuals were randomly assigned to groups, which were then required to perform a variety of different tasks sampled from the quadrants of the McGrath Task Circumplex (a taxonomy of group tasks arranged according to their coordination process requirements; McGrath, 1984).

The tasks included

1. *brainstorming*,

2. *making collective moral judgements*,

3. *negotiation over limited resources*

4. and *solving visual puzzles amongst others*.

Luo, S., Xia, H., Yoshida, T., & Wang, Z. (2009). Toward collective intelligence of online communities: A primitive conceptual model. *Journal of Systems Science and Systems Engineering*, *18*(2), 203-221.

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Theoretical Constructs and Models

The C Factor of Collective Intelligence

- In the first study *an average correlation of r = .28 was observed between group scores on different tasks*,

- and exploratory factor analysis revealed that *the first factor accounted for over 43% of the variance.*

- Interestingly, it was also found that *the average and maximum intelligence scores of individual group members were not significantly correlated with C.*

- The second study increased the size and number of groups along with the diversity of group tasks, and substantively replicated the findings of the first study. (Luo, 2009)

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Theoretical Constructs and Models

The C Factor of Collective Intelligence

By combining the findings of both studies, the researchers found that:

- *the average intelligence of individual group members was in fact modestly correlated with C* (r=.15, p.<.05),
- as was *the intelligence of the highest-scoring team member* (r = .19, p.<.01).
- Three other unrelated factors appeared to be much more strongly correlated with **C** however:
  - average *social sensitivity of group members*, measured using the 'Reading the Mind in the Eyes Test' (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001), r=.26, p.<.01;
  - the *variance in the number of speaking turns* taken by group members, a measure of the degree to which individuals dominated conversations, (r = −.41, p.<.01);
  - *the proportion of females in the group* (r = .23, p.<.01). (Luo , 2009)

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Theoretical Constructs and Models

The Wisdom of Crowds

Surowiecki's book *The Wisdom of Crowds* (2004) vividly describes the phenomenon and highlights some of the potentially underlying mechanisms.

- *A group of average people can – under certain conditions – achieve better results than any individual of the group*. This seems to hold even if one member of the group is more intelligent than the rest of the group.

Surowiecki defines various conditions for the successful application of the "Wisdom of Crowds", such as:

- *diversity in opinions*,
- *independence*,
- and *decentrality of group members* or within a group.

Thus, *best collective decisions are not made by consensus building and compromises*, but through a *competition of heterogeneous independent opinions*, i.e. through the usage of collective intelligence (Surowiecki 2004).

Leimeister, J. M. (2010). Collective intelligence. *Business & Information Systems Engineering*, 2(4), 245-248.

Collective Intelligence

Theoretical Constructs and Models

The Wisdom of Crowds
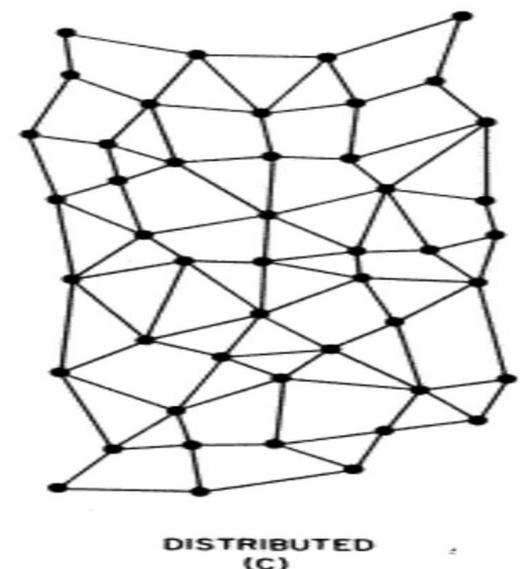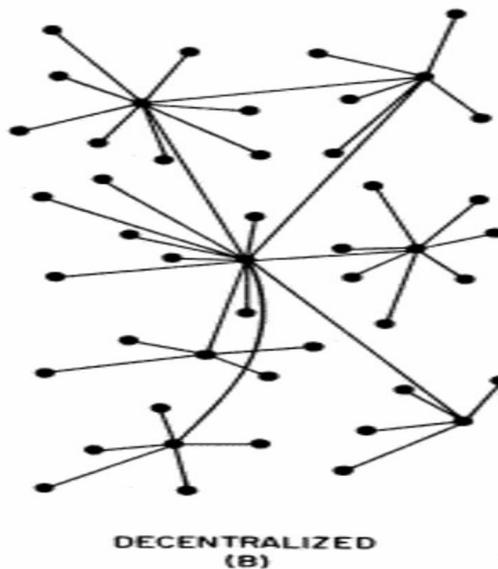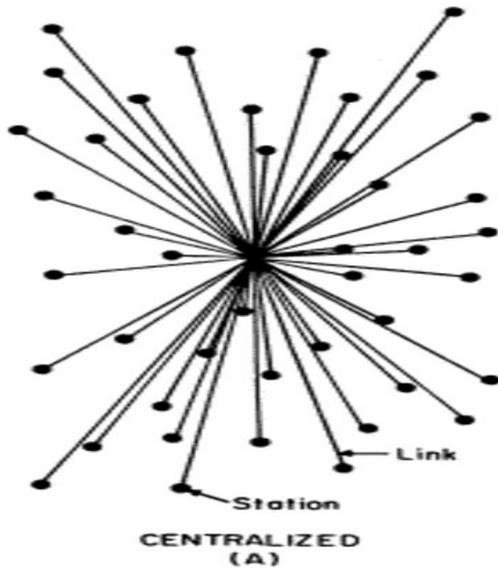

Paul Baran's Networking Diagram

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Theoretical Constructs and Models

Social Problem Solving: The Critical Thinking

To study groups dynamics of social problem solving many reaserchers employ a classification of the levels of observable intellectual behaviors based on a five-stage critical thinking and problem-solving model proposed by Garrison (1991). This particular classification system could be better understood and put into the context of analyzing individual intellectual behaviors if paralleled with earlier models developed by Bloom (1956) and Henri (1991). (Kim, 2001)

Garrison's stages	Bloom's categories	Henri's cognitive skills	Description	
Identification	Knowledge	Elementary clarification	Observe, recall and identify information	**Table I.**
Definition	Comprehension	In-depth clarification	Understand underlying meanings, values, assumptions	Comparison of the five-stage model of
Exploration	Application Analysis	Inferencing	Use of a learnt concept in a novel situation. Concepts are separated and understood by their propositional structure	critical thinking by Garrison (1991) with the cognitive learning categories of Bloom
Evaluation	Evaluation	Judgment	Decision-making, evaluation, criticism	(1956) and the cognitive
Integration	Synthesis	Application of strategies	Build from diverse elements to create a new structure	skills in problem-solving by Henri (1991)

Kim, P., Lee, D., Lee, Y., Huang, C., & Makany, T. (2011). Collective intelligence ratio: Measurement of real-time multimodal interactions in team projects. *Team Performance Management: An International Journal*, *17*(1/2), 41-62.

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Theoretical Constructs and Models

Collective Intelligence

Smith (1994) stated the reasons that people normally form collaborative groups – *the task is too large to be completed by an individual* within limited time and no one possesses all of the skills and knowledge required.

- Through collective intelligence, groups of individuals often *work collectively so as to acquire new knowledge on a just-in-time basis* (Jenkins, 2009).
- Levy (2000) described the potential of "collective intelligence" as *"everyone knows something, nobody knows everything and what any one person knows can be tapped by the group as a whole."*
- In regards to the motivation of collaborative behaviors, Brown and Lauder (2001) defined *collective intelligence as* a basis for an empowerment opportunity: "*pooling of team intelligence to attain common goals or resolve common problems*"

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Theoretical Constructs and Models

Collective Intelligence

- ***Teams often create novel and unexpected combinations of knowledge*** in ways that individuals could not (Hargadon, 1999).

Such ***opportunistic team cognition becomes more possible when there is a collective critical thinking process***. In other words, outcomes (e.g. ***augmented intelligence, new knowledge, innovative solution***) led by ***iterative team reflections and cognitions*** qualify to be the result of collective intelligence because such critical thinking processes involve the analysis of premises, arguments, and evidence arising from team interactions (Kamin et al., 2001).

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Collective Intelligence
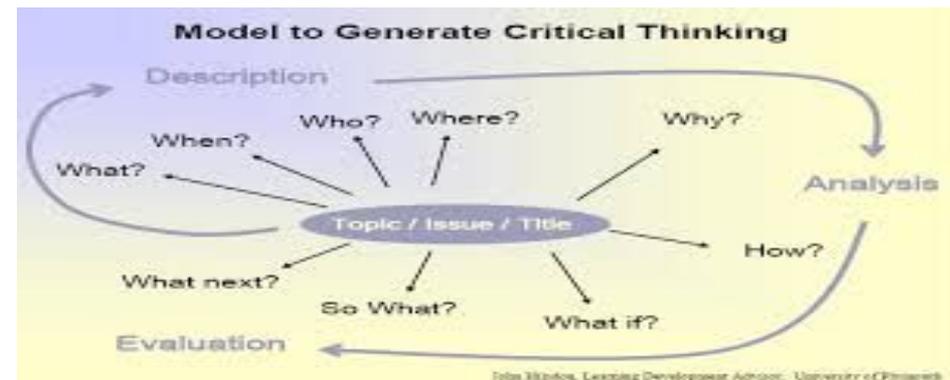
Theoretical Constructs and Models

Critical Thinking: The model of Norris & Ennis

A widely used definition of critical thinking is proposed by Norris and Ennis (1989) who asserted that critical thinking is reflective thinking that is focused on deciding what to believe or do.

Accordingly, four categories of critical thinking skills were identified by Ennis (1987) and Norris and Ennis (1989). In their definition and model of critical thinking, they addressed intellectual behaviors such as:

1. *clarifying information*,

2. *assessing evidence*,

3. *judging inferences*, and

4. *applying appropriate strategies and tactics*.

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Theoretical Constructs and Models

Critical Thinking: From the model of Bloom to hyphothesys of Newman

A more historical source of critical thinking can be found in Bloom's cognitive taxonomy of educational objectives (Bloom, 1956).

The top three of Bloom's categories:
1.   *analysis*,
2.   *synthesis*
3.   and *evaluation*

are comparable to the definitions of critical thinking by Kennedy et al. (1991).

Analysis of requirements and possibilities

Evaluation

Synthesis and proposal

Note for the future
Newman et al. (1997) concluded that ***computer-mediated conferencing facilitates higher levels of critical thinking while face-to-face interactions encourage more creative and higher volumes of interaction.*** For this regard, Newman et al. (1997) also provided discrete evidence for each phase of Garrison's (1991) critical thinking model and a specific scenario in which teams tackled explicit problem-solving tasks.

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