Communicative Action in Groups and Support Networks

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Communicative Action

A joint action in which participants communicate, and in which the action is the purpose to which the communication is directed

Term is from Jürgen Habermas (1981), A Theory of Communicative Action

Two types of conflict

Beliefs

Assignments of True or False (or of probabilities) to propositions, e.g.

- "I believe it will rain tomorrow."
- "I believe that if Deborah teaches the class, students will like it."

Preferences

Assignments of relative desire to possible outcomes, e.g.

- "I prefer sunshine over rain."
- "I prefer eating indoors over a picnic in the rain."

Four Forms of Communicative Action

		Preference Conflict	
		low	*high*
Belief Conflict	*low*	coordination	negotiation
	high	argumentation	deliberation

Rosenschein, S. J., & Davies, T. (to appear). Coordination technology for active support networks: Context, needfinding, and design. AI & Society.

Usual Approaches to Preference Conflicts in Decision Theory

Preference aggregation (social choice theory)

- Voting methods (choosing, ranking, approving)
- Decision rules (majority/condorcet, plurality, borda, instant runoff)

Bargaining/negotiation

Random selection

Preference resolution can be less effective than deliberation

Example:

- Person c initially prefers action a
- Person d initially prefers action a'
- Both initially prefer outcome x over x', and do not care which action (a or a') achieves this
- But c *knows* p(x|a) =1 and p(x|a') =0
- And d *thinks* p(x|a)=.4 and p(x|a')=.6
- Both c and d are rational
- Therefore: If c and d discuss their beliefs prior to a final vote or agreement, they will converge on action a because c has better information about p(x|a) than d does.
- A focus on preferences only, without deliberation, misses this information and might lead to a worse outcome

Four Forms of Communicative Action

		Preference Conflict	
		low	*high*
Belief Conflict	*low*	coordination	negotiation
	high	argumentation	deliberation

How do these forms relate to concepts such as…?

- "collective intelligence"
- "smart cities" and "civic intelligence"
- "Global Brain" and "Mass Mind" (Bloom, 2000)

A somewhat controversial position…

"Intelligence" is a consensus concept – it applies only when (most) people agree that one solution, action, or plan is better than others.

In many social situations, especially those involving large numbers of people, there is no general agreement on what is the better or best course of action.

Therefore… a "collectively intelligent" course of action implies that the stakeholders either...

- have low interpersonal goal conflict, or
- agree that the course of action is a good way to resolve their conflicts

Let's deepen this a bit...

3 branches of decision Theory

- Expected Utility Theory (single agent in "games against nature") – Von Neumann & Morgenstern, 1944
- Game Theory (multiple agents competing for payoffs) – Nash equilibrium, 1951
- Social Choice Theory (multiple agents that must agree on a social outcome) – Arrow, 1951

Preference Profiles

5-2

	Voter 1	Voter 2	Voter 3	Voter 4	Voter 5
Ranked Alternatives	X	X	X	Y	Y
	Y	Y	Y	X	X

5-3

	Voter 1	Voter 2	Voter 3	Voter 4	Voter 5
Ranked Alternatives	Z	X	X	Y	Y
	X	Y	Y	Z	Z
	Y	Z	Z	X	X

5-3′

	Voter 1	Voter 2	Voter 3	Voter 4	Voter 5
Ranked Alternatives	X	X	X	Z	Y
	Z	Z	Y	Y	X
	Y	Y	Z	X	Z

Preference Profiles

3-2

	Voter 1	Voter 2	Voter 3
Ranked Alternatives	X	X	Y
	Y	Y	X

3-4

	Voter 1	Voter 2	Voter 3
Ranked Alternatives	X	X	Y
	Y	Y	Z
	Z	W	W
	W	Z	X

3-4′

	Voter 1	Voter 2	Voter 3
Ranked Alternatives	X	X	Z
	Z	W	Y
	W	Y	X
	Y	Z	W

Social Choice Theory

DEFINITION: **Preference relations** *R, P,* and *I* respectively exist between two outcomes whenever the outcomes can be matched with labels *x* and *y* such that:

- *x R y*, meaning *x* is preferred or indifferent to *y* (**weak preference**).
- *x P y*, meaning *x* is preferred to *y*, and holds iff not *y R x*. (**strict preference**).
- *x I y*, meaning *x* is indifferent to *y*, and holds iff *x R y* and *y R x* (**indifference**).

Social Choice Theory (continued)

DEFINITION: A preference relation *R* is **weakly ordered** iff for all outcomes *x*, *y*, and *z*: in a set of outcomes *X*:

- *x R y* or *y R x* (**completeness**).
- *x R y* and *y R z* imply *x R z* (**transitivity**).

Social Choice Theory (continued)

DEFINITION: A **social welfare function** is a function *f* such that if

- *X* is the set of all conceivable social outcomes or states ($|X| \geq 3$),
- *N* is a set of individuals ($2 \leq \left|N\right| = n$), and
- *D* is a domain of preference profiles $\boldsymbol{R}^N = \langle R_1, R_2, \ldots R_n \rangle$, such that
- for all *i* in *N*, R_i is a weakly ordered preference relation for individual *i* over *X* (**individual rationality**),

then *f* maps *D* into a range *R* of possible social preference relations R_N on *X* for group *N*.

Social Choice Theory (continued)

DEFINITION: A social welfare function *f* is an **Arrow social welfare function** if

- the domain *D* of *f* contains all possible preference profiles $\boldsymbol{R}^N$ (**universal domain**),

and

- the range *R* of *f* is the set of weakly ordered social preference relations R_N (**collective rationality**).

Social Choice Theory (continued)

THEOREM: **Arrow's Impossibility Theorem** (Arrow, 1951/1963). There can be no Arrow social welfare function *f* satisfying all of the following:

- for all social outcomes *x* and *y* in *X*, if a preference profile $\boldsymbol{R}^N$ obeys $x\ P_i\ y$ for each individual *i* in *N*, then $f(\boldsymbol{R}^N)$ yields $x\ R_N\ y$ (**weak Pareto efficiency**);
- for all preference profiles $\boldsymbol{R}^N$ and $\boldsymbol{R}^{N\prime}$ in *D*, and all social outcomes *x* and *y* in *X*, if $\boldsymbol{R}^N$ and $\boldsymbol{R}^{N\prime}$ obey $x\ R_i\ y$ iff $x\ R_i'\ y$ for all individuals *i* in *N*, then $f(\boldsymbol{R}^N)$ and $f(\boldsymbol{R}^{N\prime})$ yield $x\ R_N\ y$ iff $x\ R_N'\ y$ (**independence of irrelevant alternatives**);

and

- there is no individual *d* in *N* such that for all preference profiles $\boldsymbol{R}^N$ in *D*, and all social outcomes *x* and *y* in *X*, if $x\ P_d\ y$ then $f(\boldsymbol{R}^N)$ yields $x\ P_N\ y$ (**non-dictatorship**).

Social Choice Theory (continued)

DEFINITION: A **social choice rule** C maps the domain D of preference profiles, together with environments $S \subseteq X$, into subsets of S.

SIDE NOTE: The above definition does not assume that C obeys an ordering. Arrow did assume this, however:

DEFINITION: A social choice rule C is an **Arrow social choice function** if it is determined by an Arrow social welfare function f and for all environments $S \subseteq X$, $C(S, f(\mathbf{R}^N)) = \{x \mid x \text{ is in } S \text{ and, for all } y \text{ in } S, f(\mathbf{R}^N) \text{ yields } x \, R_N \, y\}$.

Revealed Social Preferences (Davies & Shah 2004)

DEFINITION: Given a set X of social outcomes, a preference profile $\boldsymbol{R}^N$, and a social choice rule C, $x\ R_N^*\ y$ (meaning there is a **revealed social preference** for x in relation to y) iff there is some environment $S \subseteq X$, such that x and y are in S and x is in $C(S,\boldsymbol{R}^N)$.

Revealed Social Preferences (Davies & Shah 2004, continued)

DEFINITION: **Weak axiom of revealed social preference**. Given a set X of social outcomes, a preference profile $\boldsymbol{R}^N$, and a social choice rule C, a social preference relation R_N satisfies **inter-menu consistency** (**IMC**)* iff it is a revealed social preference relation under C for all pairs of social outcomes in X, and the following condition holds: For all environments $S \subseteq X$, if x and y are in S and x is in $C(S,\boldsymbol{R}^N)$, then for all environments $S' \subseteq X$ such that x and y are in S', if y is in $C(S',\boldsymbol{R}^N)$, then x is in $C(S',\boldsymbol{R}^N)$.

* This term is from Sen (1993).

Revealed Social Preferences (Davies & Shah 2004, continued)

THEOREM: If R_N^* is a revealed social preference relation associated with a set X of social outcomes, a preference profile $\boldsymbol{R}^N$, and a social choice rule C, and R_N^* violates inter-menu consistency, then it violates collective rationality.

TDavies, T. & Shah, R (2004). Intuitive preference aggregation: Tests of independence and consistency. http://papers.ssrn.com/abstract=2213600

Intuitive Preference Aggregation (5 voters)

5-2

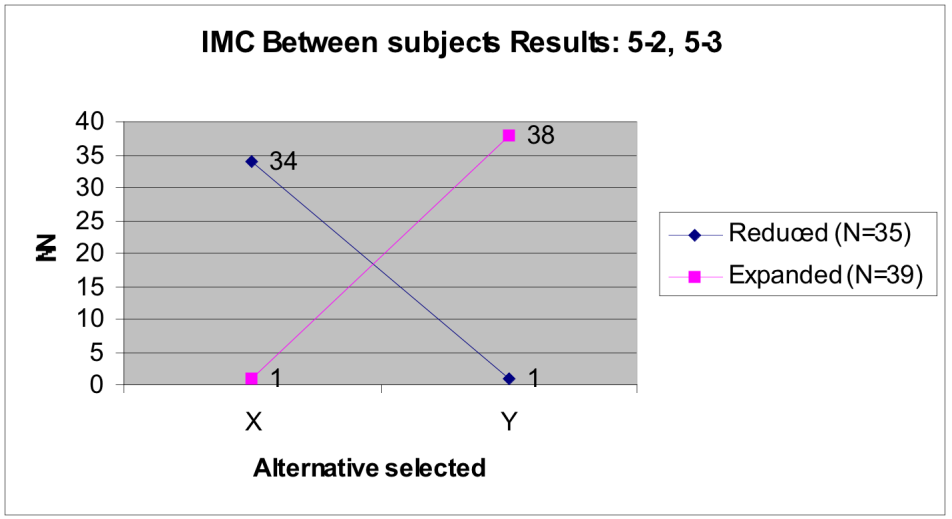
	Voter 1	Voter 2	Voter 3	Voter 4	Voter 5
Ranked Alternatives	X	X	X	Y	Y
	Y	Y	Y	X	X

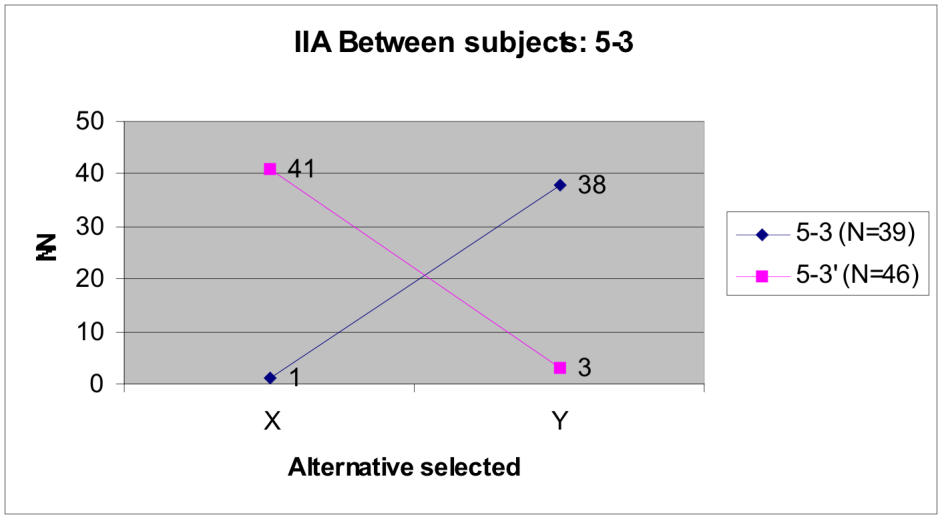
5-3

	Voter 1	Voter 2	Voter 3	Voter 4	Voter 5
Ranked Alternatives	Z	X	X	Y	Y
	X	Y	Y	Z	Z
	Y	Z	Z	X	X

5-3′

	Voter 1	Voter 2	Voter 3	Voter 4	Voter 5
Ranked Alternatives	X	X	X	Z	Y
	Z	Z	Y	Y	X
	Y	Y	Z	X	Z





Intuitive Preference Aggregation (3 voters)

3-2

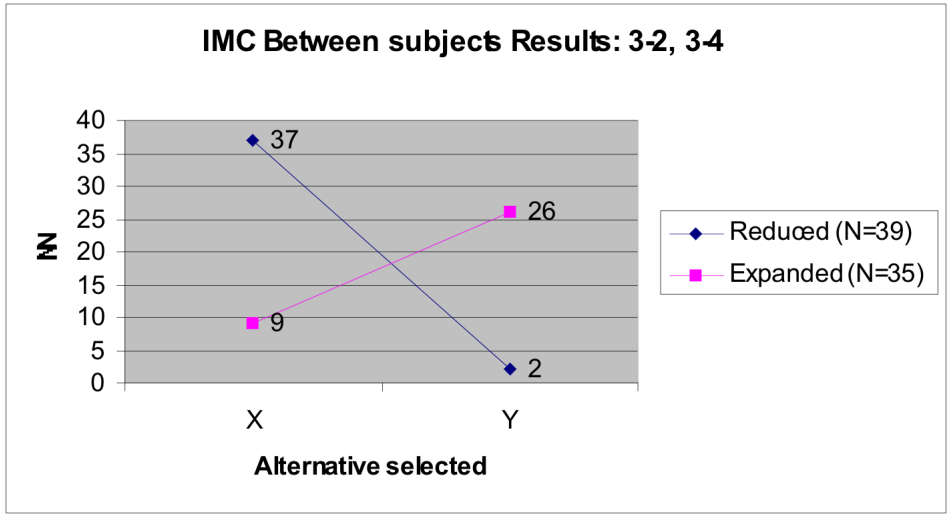
	Voter 1	Voter 2	Voter 3
Ranked Alternatives	X	X	Y
	Y	Y	X

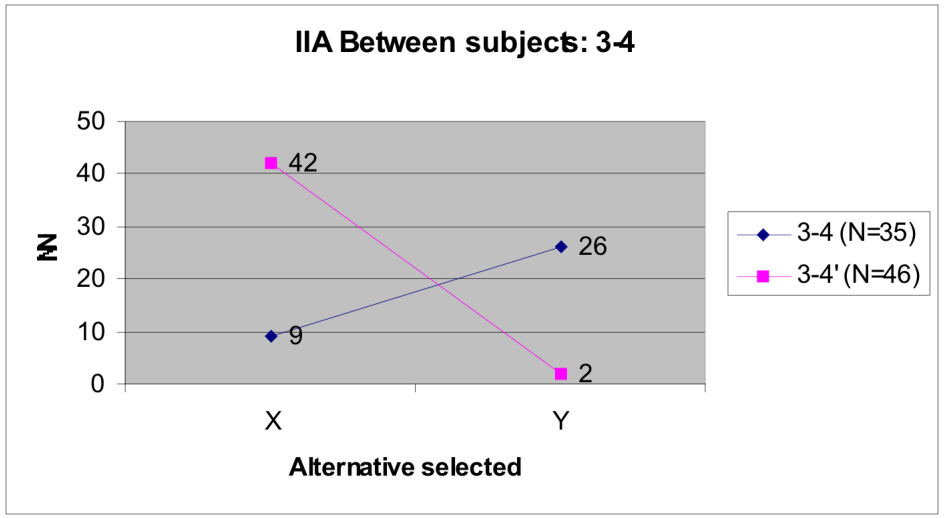
3-4

	Voter 1	Voter 2	Voter 3
Ranked Alternatives	X	X	Y
	Y	Y	Z
	Z	W	W
	W	Z	X

3-4′

	Voter 1	Voter 2	Voter 3
Ranked Alternatives	X	X	Z
	Z	W	Y
	W	Y	X
	Y	Z	W





Preference Aggregation: Conclusions

Arrow's Theorem shows that in the general case of a collection of agents, there is no way to aggregate their preferences that leads to "consistent" choices across different preference profiles

Single-agent decision theory (i.e. Expected Utility Theory) assumes consistent choices across varying menus *are* possible for individuals, at least in theory

Therefore… Arrow's theorem provides an argument that collective decision making cannot be rational in the same sense as individual decision making.

Human intuitions about fair preference aggregation robustly violate Arrow's conditions.

But humans do not agree on what is the fairest social choice rule.

So what does this mean for "collective intelligence"?

An important question facing humanity…

If we assume that a "collectively intelligent" solution to a social problem or issue is one that most people would agree is better than other solutions…

Are the social problems or issues we face susceptible to collectively intelligent solutions?

Examples of research: Coordination (Rosenschein & Davies, to appear)

Coordination levels and sublevels:

- *Individuals* engage in behavior that requires coordination between tasks, even if the individual is viewed as
  - *isolated* from others, and that requires coordination with others when that individual is
  - *connected* to them;
- ***Networks* of individuals**, who are connected to each other but who retain autonomy to decide on their own actions, may coordinate for
  - *information-sharing*, e.g. in communities of practice (Wenger, 1998), or to provide more
  - **direct *support*** for each other; and
- *Teams*, whose members are consciously working together to achieve the same goal(s), and must typically coordinate with each other whether they come together on an
  - *ad-hoc* basis or as members of an
  - *organization*.

Examples of research: Coordination

Four application areas for improving coordination in active support networks:

(i) academic coaching,

(ii) vocational training,

(iii) early learning intervention, and

(iv) volunteer coordination

Examples of research: Coordination

We argue that the tools needed to support coordination in active support networks are different from those that work best in teams, because those in a support network are

- less obligated to do needed tasks
- more likely to be focused on other tasks and jobs as primary (more distractable)
- more likely to engage intermittently or only when they have extra time

Rosenschein, S. J., & Davies, T. (to appear). Coordination technology for active support networks: Context, needfinding, and design. AI & Society.

Examples of research: Deliberation

Community planning processes often leave out key stakeholders because they rely on face to face meetings that not everyone can make – need online tools for joining the deliberation.

> Davies, T., Sywulka, B., Saffold, R., & Jhaveri, R. (2002). Community democracy online: A preliminary report from East Palo Alto.

Different main deliberation methods all lead to substantial changes in knowledge and/or attitudes over and above background information

> Carman, K. L., et al. (2015). Effectiveness of public deliberation methods for gathering input on issues in healthcare: Results from a randomized trial. Social Science & Medicine, 133, 11-20..

Online deliberation methods do not appear to negatively affect equality of participation relative to face to face methods, except for a small effect on racial disparity (African-American versus White).

> Showers, E., Tindall, N., & Davies, T. (2015, August). Equality of Participation Online Versus Face to Face: Condensed Analysis of the Community Forum Deliberative Methods Demonstration. In *International Conference on Electronic Participation* (pp. 53-67). Springer International Publishing.