

GOALS ONTOLOGY & DYNAMICS in Mind & Society. *The Agent & MAS Modeling*

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GOAL group



ISSUES

- **Beyond the Tolemaic view of Cognition**
- **“Autonomy” and Goals**
- **The “Agent” perspective**
- **Goal Ontology**
- **Goal Dynamics**
- **Goal Value**
- **Knowledge & Goals: the “Value” of Knowledge**
- **Knowledge & Goals: belief-based Goal processing**
- **Sociality & Goals: *Adoption, Delegation, Influence***
- **Sociality & Goals: Social Links & Networks**

I will put aside several promised issues

(like: *Goal-Oriented systems vs. Goal-Directed systems; Goals vs. Functions; Anticipatory Classifiers vs. True Goals; Drives and Goals; Emotions*)

and

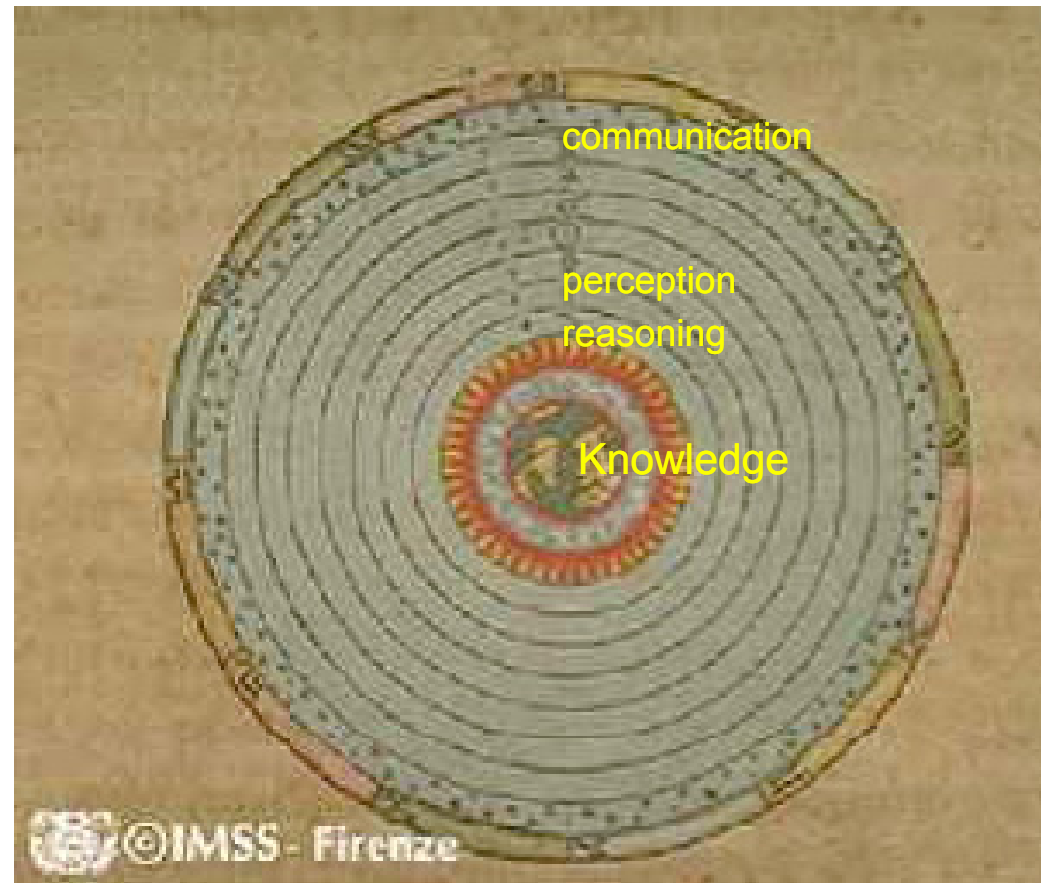
I will not discuss *important literatures* on GOALS (also Agent & MAS)

hold (like Cohen&Levesque; Allen; Rao& Georgeff; Coelho....) and recent (Dastani, Hindriks, van Riemsdijk; Lesperance; Duff et al; Braubach; Padgham, Thangaraja, et al.; Tettamanzi, Pereira; and many others ...)

SORRY!

The dominant TOLEMAIC view of Cognition

a **KNOWLEDGE-centered** universe



The dominant TOLEMAIC view of Cognition

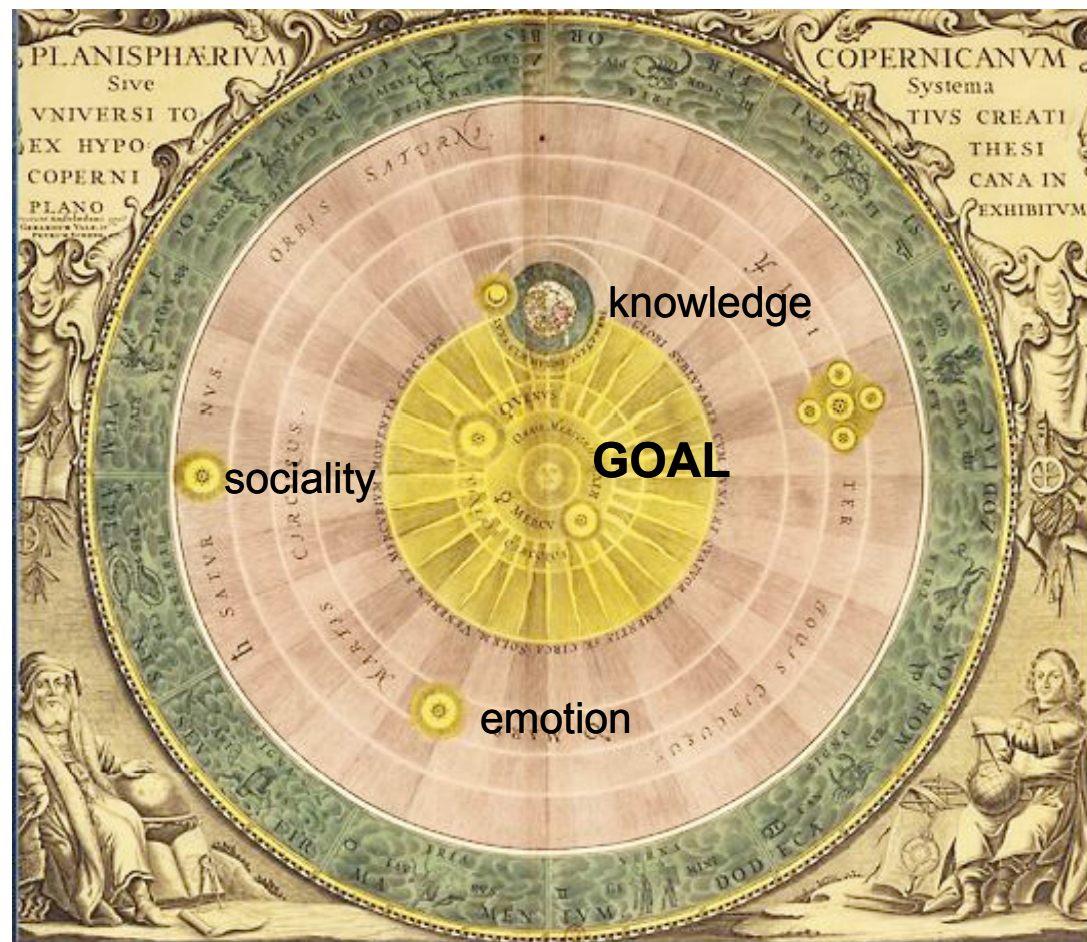
a **KNWOLEGE-centered** universe

>> “information”, “representation” = Knowledge

And what matters is *K acquisition, storage, organization, efficient search, reasoning, K provision,*

The non-dominant COPERNICAN revolution on Cognition

a **GOAL/ACTION-centered** universe



elfranchi

The non-dominant COPERNICAN revolution on Cognition

a **GOAL/ACTION-centered** universe

>> “information”, “representation” **≠** Knowledge

Also “Goals” are “representations” with a very specific use/function
(and - obviously - also the cybernetic feedback and set-point are “information processing”)

GOAL is the center of the cognitive universe; or better, the center is **“goal-directed” action**: changing, adapting the world.

The non-dominant COPERNICAN revolution on Cognition

a **GOAL/ACTION-centered** universe

- *Action* is for Goals (and Goals are for potential Actions)

- *Knowledge* is for Goals

- *Intelligence* is for Goals

(solving problems via mental representations)

- *Sociality* is for Goals and Goal-based

1. AUTONOMY & Goals

The centrality of Goals

for Agency

for Autonomy

=====

Few words on Agents & MAS paradigm

Agents & MAS paradigm

Just a Technology?

I stress those aspects still needing a theory (that we cannot just buy and import from the cognitive and social sciences) also because it is important not reducing “Agents” (and MAS) to a technology. This is not only an impoverishing move but even a risky move (remember the serious mistake that AI did with the “expert systems”).

“Agents” are an intellectual (and formal-computational) framework; *a way of thinking and of analyzing dynamic and complex phenomena that involve active, partially independent, distributed but interfering and interactive entities, producing common (either planned or unplanned) collective results, for individual or collective advantages.*

Agents & MAS paradigm

Just a Technology?

“Agents” are a fundamental *scientific frame*, which deals with complex and layered (micro-macro) phenomena by providing two related **levels of modeling**:

- **the “architecture”** of the agent and the mechanisms behind its behavior,
- and **the interaction** or communication channels, and the **emergent networks**, and the collective outcome, and its feedback on and within the agents.

“GOALS” at both levels:

- Internal, “psychological” GOALS (set-points)
- External, emerging “functions” of behaviors (“goal-oriented” but not “goal-directed”)

1. AUTONOMY & Goals

The centrality of GOALS for AGENCY and AUTONOMY

Not really interesting “agency” in efficient cause “agents” (like rain or cold), or in S-R “agents” (goal-oriented, functional but not “goal-directed/driven”: no internal/cognitive representation of the Goal)

Real “Agents”: *internally regulated by their Goal*: true “**action**” not just “behavior”.

Real “autonomy” from the environment and the stimulus: in a sense the stimulus for the action is “internal”: what does it *means* this *Stimulus* from the environment?

- *That the Goal is satisfied? => inaction;*
- *That the Goal is not satisfied? => Action!*

Autonomous from the environment because the behavior depends on the internal state and representation/interpretation; but also because **it is regulated by “unreality” representation**, what is not-there: the anticipation of the future, of possible outcomes of the actions (“mind”).

1. AUTONOMY & Goals

(i) “AUTONOMY” is a RELATIONAL notion.

X is autonomous FROM Y (but not - for example - from Z) (be Y the “environment with its effective causes and stimuli; or being another Agent: Social Autonomy

(ii) “AUTONOMY” is a CONTEXT-DEPENDENT notion

X is autonomous FROM Y in a given context C but not in another context.

(iii) “AUTONOMY” is a GOAL- CENTERED notion:

First: X is AUTONOMOUS from Y AS FOR REALIZING A GIVEN GOAL
/performing a given action (but not for another one)

Second:

the complete/deep/true form of Autonomy is “goal-Autonomy”: *X has its own goals:*

Motivational Autonomy, not just “executive” autonomy

12. AUTONOMY & Goals

Where do goals come from??

Different origins:

➤ **INBORN/GIVEN:**

- due to evolution/selection
- designed (a fix set of predefined/engineered “motives”)
- imposed/written from outside (no real choice, no “adoption”)

➤ **LEARNED:**

- for INSTRUMENTAL: imitation; accidental effects and new “action repertoire”
- for new TERMINAL Goals (motives): various mechanisms from means to end; pleasure & pain; ..

➤ **“ADOPTED”:**

- orders; norms (possibility to violate. Choice. X has to have some “motive” for doing)
- free help; exchange; cooperation;

➤ **DISCOVERED by reasoning:**

- for INSTRUMENTAL goals: planning, problem-solving: creating “means”

Goals **ONTOLOGY**

2. Goal **Ontology**

The general and basic notions.

(i) Goals: basic misunderstandings

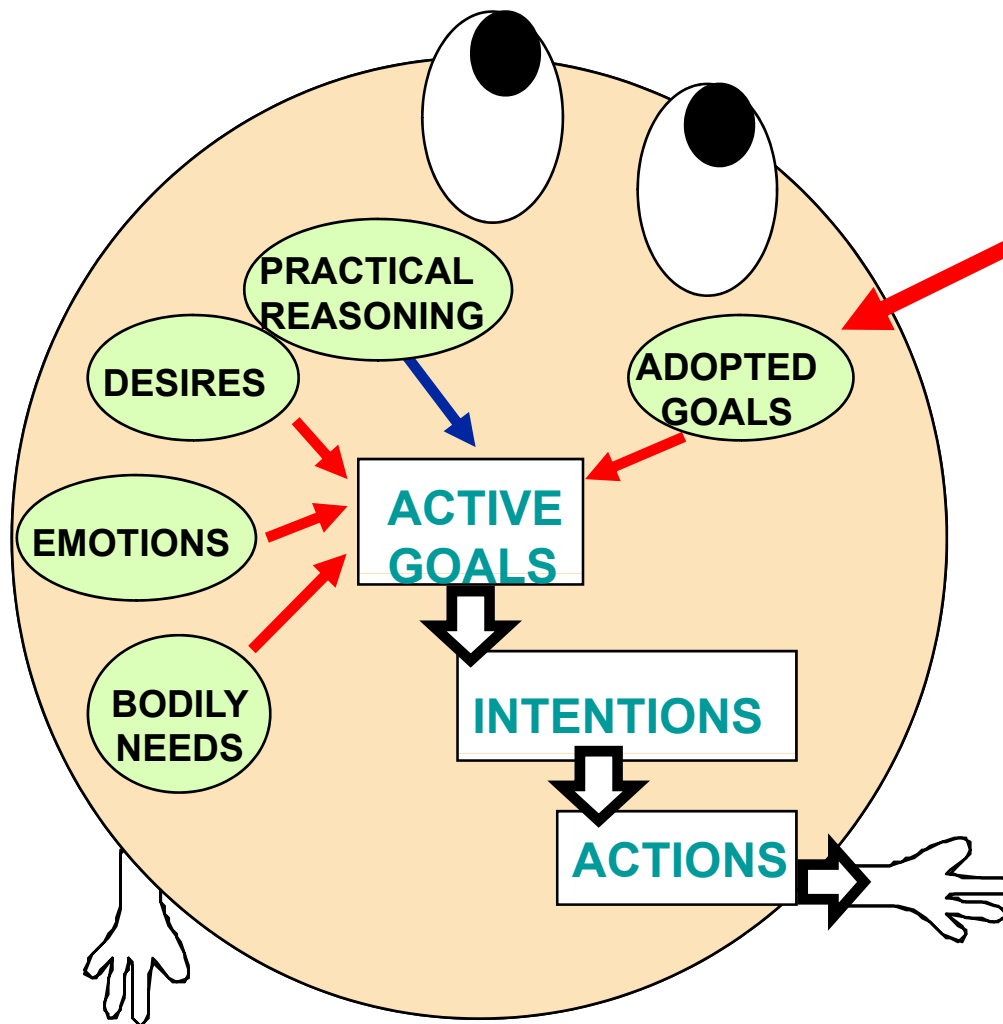
>> “Goals” are mental “representations”

- *“Representation” is not synonym of “knowledge” or of “doxastic/epistemic” representation*
- *“Representation” does not means “propositional representation”.*
- *The representation, object of the Mental Attitude is NOT the “object”, the content, of the Goal
(S. Tommaso)*

>> Goals are not necessarily (to be) ‘pursued’

**>> “Goals” are not “desires” (just a special kind of Goal:
pleasant & endogenous)**

Not all our GOALS are **endogenous** and comes from “Desires”



Help,
Requests
Promises,
Duties,
Norms,
.....

>> **Goals are not necessarily (to be) ‘pursued’**

“Passive” goal-states:

Reliance:

- > **To Wish/Hope** (I can do nothing);
- > **To Let:** I might interfere but I let that Ag1 (natural or social) realizes something;
- > **To Delegate:** I could realize my goal but I make/let Ag1 achieve it.

“Actively” pursued goals:

The realization depends on me, is up to me, I have to act:

- > **To Try** (the result is not subjectively sure);
- > **To intentionally pursue:** I confidently expect the desired outcome

HOWEVER: any possible action actually (consciously or unconsciously) relies on some external process/agent for its accomplishment.

2. Goal **Ontology**

(i) Goals: KINDS

Not all our goals are 'felt', also because not all of them are defined in a *sensory-motor format*.

>> Desires

(“*feel* the desire”, “foretaste”...: anticipating /imagining pleasant *sensations*)

>> Needs

(lack of something; current unpleasant sensations)

There is **complementarity and affinity between felt Needs and Desires**:

A felt need implies a pleasant relief; a felt desire implies a current potential lack and sufferance

2. Goal **Ontology**

(i) Goals: KINDS

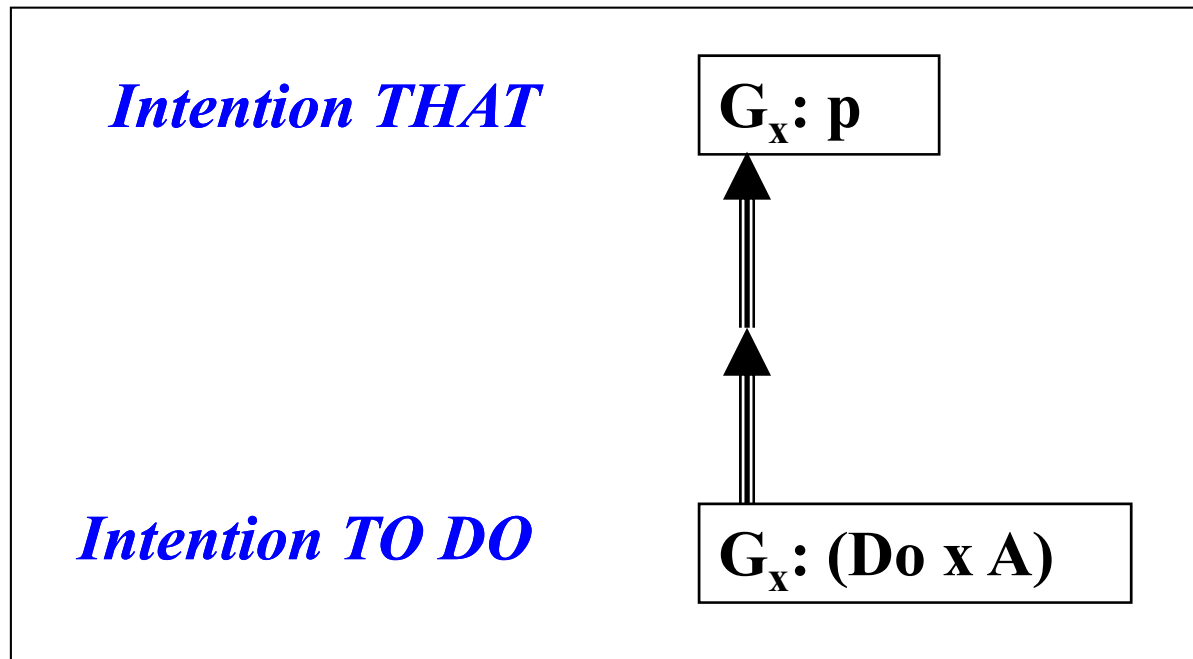
>> Intentions

Not another “primitive”: **just a kind of Goal:** *the final stage of Goal-Processing, after the choice, the decision to act, the formulation of a possible action/plan:*

the '**intention**' is the transformation, instrumental specification, and commitment of a preliminary goal (the source-goal), which is not always a desire (even when a desire motivates the 'adoption'). In our model, the original goal, the source-goal (which in BDI model is the 'desire') after the decision becomes part of the 'intention' guiding the behavior: it becomes the '*intention that*' motivating the '*intention to do*'.

The two-stages Structure of **INTENTIONS**

- > ***I intend to do*** a given action/plan **A** (I have decided and planned),
- > **in order to realize my higher moving goal *THAT* p** (that depends on me, I have preferred, I believe it is achievable, etc.)



2. Goal Ontology

(ii) Process-related notions and goal-kinds.

>> Instrumental goals or means

>> Higher-goals

>> Terminal goals or ends

>> Starting or motivating goals (*'motive'*)

>> Conflicting goals

- (i) The conflict is either due to intrinsic (unsolvable) reasons of logic contradiction between $G1$ and $G2$: $G1$ is or logically implies the negation of $G2$. $G1:p$ & $G2: \text{Not } p$.

or

- (ii) The conflict is due to resources scarcity, to contextual and pragmatic reasons: for achieving $G1$ it is needed the resource R (effort, time, money,), the same R is necessary for realizing $G2$, and it is not enough.

EXPECTED RESULTS

NEGATIVE:
costs, harms,
renunciations, ...
(frustrated goals)

POSITIVE (satisfied goals)

MOTIVATING
results

NON
MOTIVATING
results

Goals **DYNAMICS**

GOALS-DYNAMICS in DECISION:

MOTIVATED (goal-driven) RATIONALITY

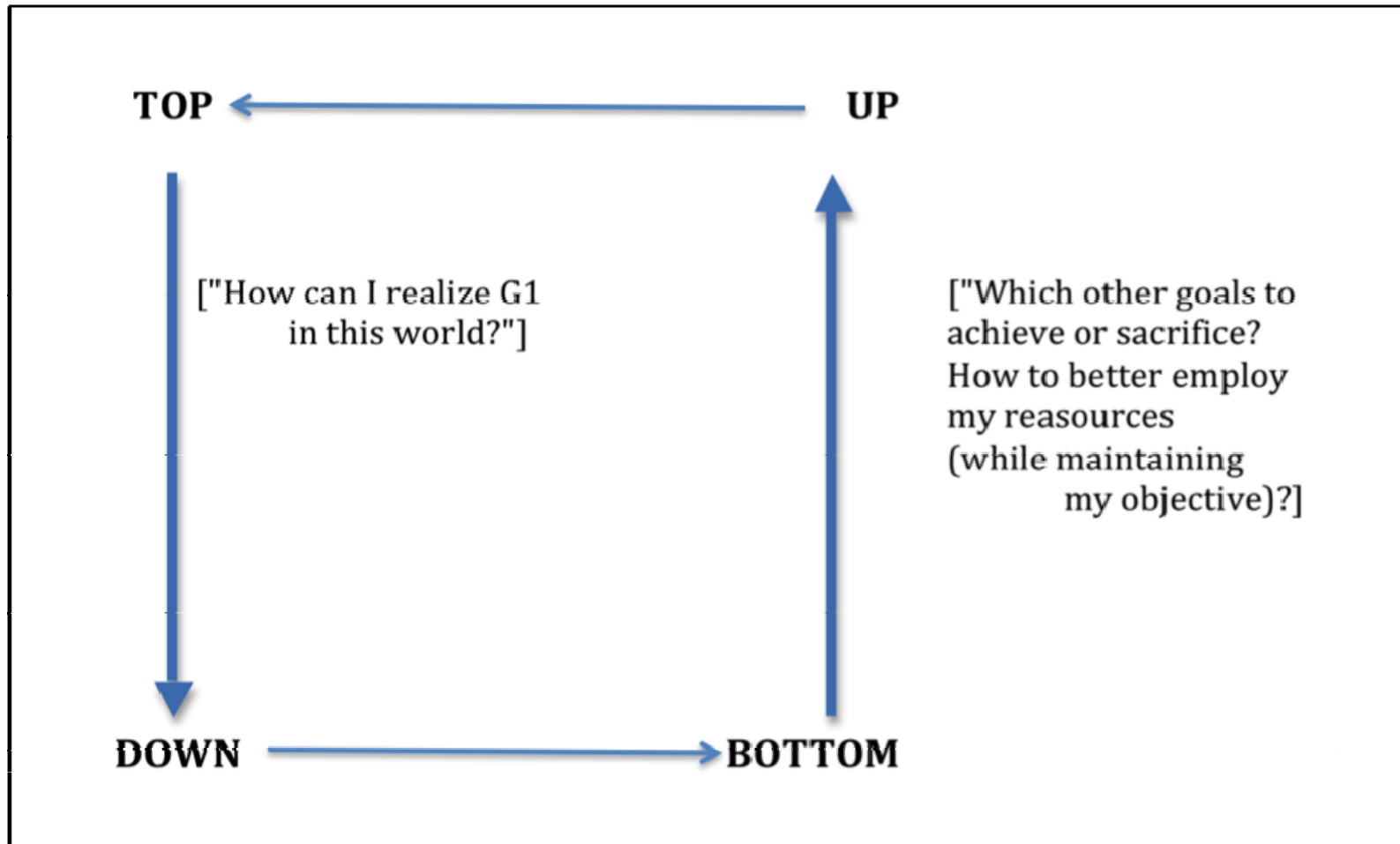
A TOP-DOWN and BOTTOM-UP process:

- > *From Ends to Means* (sub-goals, actions and plans for)
- > *from Means to additional Ends* in order to chose

The system has both: *to be sure to realize a given goal*, and, *to be sure to have a satisfying ‘economic’ balance*.

In fact, also a (specific-goal)-directed system can eventually renounce, give up its moving goal; but its real “goal” is not just maximizing utility in any possible way, independently from the given objectives. Different from the Economic rationality view.

GOALS-DYNAMICS in DECISION: **MOTIVATED (goal-driven) RATIONALITY**



Goal Ontology

(ii) Process-related notions and goal-kinds.

Let's thus give the following definition:

Motivating Goals:

Necessary and sufficient foreseen/expected outcomes for deciding and for pursuing.

There are two kinds of *motivating* goals:

- (i) the starting ones, the “**motives**”, what activates and “moves” us in search of how to realize it.
- (ii) the ‘**diriment**’ additional ones: one wouldn't chose that (sub)goal, wouldn't do that action without also the perspective to realize that non-original goal.

Decision as ‘Negotiation’

Process-related notions and goal-kinds. ONTOLOGY for Negotiation Th

>> All/Nothing vs. gradable Goals:

Some goals can be achieved gradually (very much, quite a lot, not so much,...), or partially: 80%, 50%, 30%. (for example, “to be rich”, “to eat all this chicken”, “to by A and B”). Other goals on the contrary are Yes or No, all or nothing (for example, “to marry Paul”, “to take a degree”).

The psychology of those goals is very different

Fundamental distinction for “negotiation” and “compromises”.

>> Non-releasable / un-negotiable Goals

- Negotiation and decisions becomes impossible if there are conflicting but ‘non-releasable’ and irreducible goals.

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>> Avoidance Goals vs. Promotion Goals (Higgins)

The **'Value'** of Goals

The “reason-based” value of goals

due to **means-end reasoning (beliefs)** and decision-making

Goal Hierarchies and Value inheritance

Basic principle:

> *The value of Means derives from the value of their Ends*

Or better: *pros & cons* evaluation

➤ *It derives from the value of the **Expected Outcomes** (evaluated against goals): the motivating results, the additional positive results, the possible Costs, Harms, Risks.*

When it is reason based, “arguable”, (more or less well) supported and justified, **it derives in fact from beliefs** about instrumental and consequential relations: **pros & cons**

The *felt* value of Goals

In a lot of “decisions” preferences are not reason-based

The *value* of the goals, their weight in the decision, does not always depends only from beliefs.

Not “arguable”!

**the value of the goals (and their success in decision) can be
the outcome also of different mechanisms;
not of *cognitive evaluation*.**

Damasio (somatic markers) ; Bargh (post hoc evaluations); (“affective heuristics”)

The *felt* value of Goals

“sensations” - for example physiological needs, current felt emotions - can **modify the *value* of a goal** (Lisetti e Gmytrasiewicz)
(‘*impulses*’)
and thus the result of a choice

The more intense the sensation (the need, or the emotion) the more important the activated goal (Brehm,)

The **‘Value’** of Knowledge

The ‘Value’ of Knowledge

Also **knowledge** should be better
conceived in relation to goals.

We need for example a better

Theory of “Relevance”:

data informativeness, novelty, reliability/truth, efficient search and retrieval, circulation, sharing, ... are not enough.

>> We search and elaborate information, data, knowledge *for* something.

And “relevance” is not necessarily related to communication pragmatics and dialogue (Wilson & Sperber).

The ‘Value’ of Knowledge

Theory of “Relevance”:

*Relevance is the “value” and polarization of knowledge relative to our goals: its **utility**.*

- *How precious, useful, important is a given piece of knowledge? How much I would spend/invest for accessing it?*
- *What kind of information is “useful” for my goal/interest G, and **WHY**?*
- *The “instrumental” nature of Knowledge!*

Thesis:

The most valuable/important the GOAL G1 &

The most useful and necessary K for G1

==> The most valuable K

PART II

SOCIALITY and **GOALS**

4. SOCIALITY & Goals

The centrality of Goals

- > for Social (inter)Action and Relation
- > for Social Networks

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“Social computing” should be *goal-centered*,
since sociality means *coordination*, *cooperation*, or
competition and *conflict*, which are goal-based notions.

4. SOCIALITY & Goals

Cooperation

We cannot really model and support “cooperation” without **making explicit the *goals*** the agents pursue by their coordinated actions.

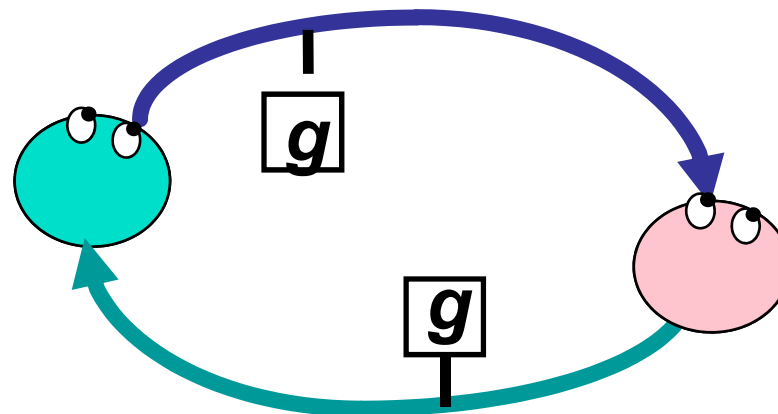
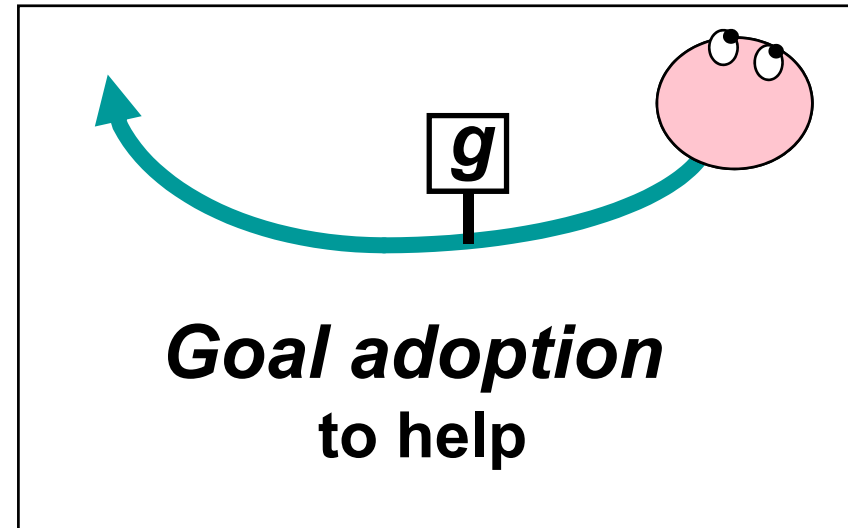
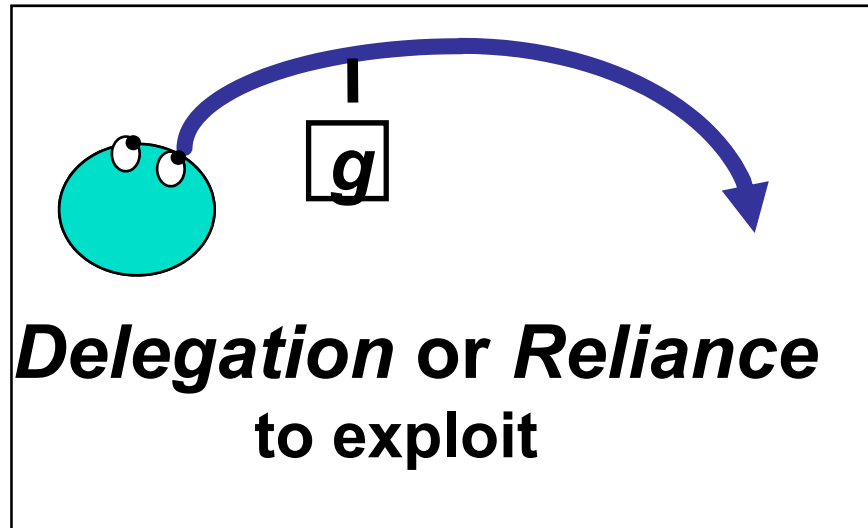
Are those goals shared? Are they mutually known? Do the agents converge on previous **common goals** or some agent adopts the goal of the other? Do they cooperate having in mind a **common plan**, and knowing the role and action of the other; or are they **unconsciously cooperating in a plan that is not in their own mind** (and they do not understand the final goal), or are they just parts of an emergent, self-organizing cooperative phenomenon?

4. **SOCIALITY** & Goals

BASIC SOCIAL MOVES:

- > **Goal Adoption,**
- > **Goal Delegation, Reliance**
- > **Influence: changing Goals**

SOCIAL AGENTS - Micro-Sociality



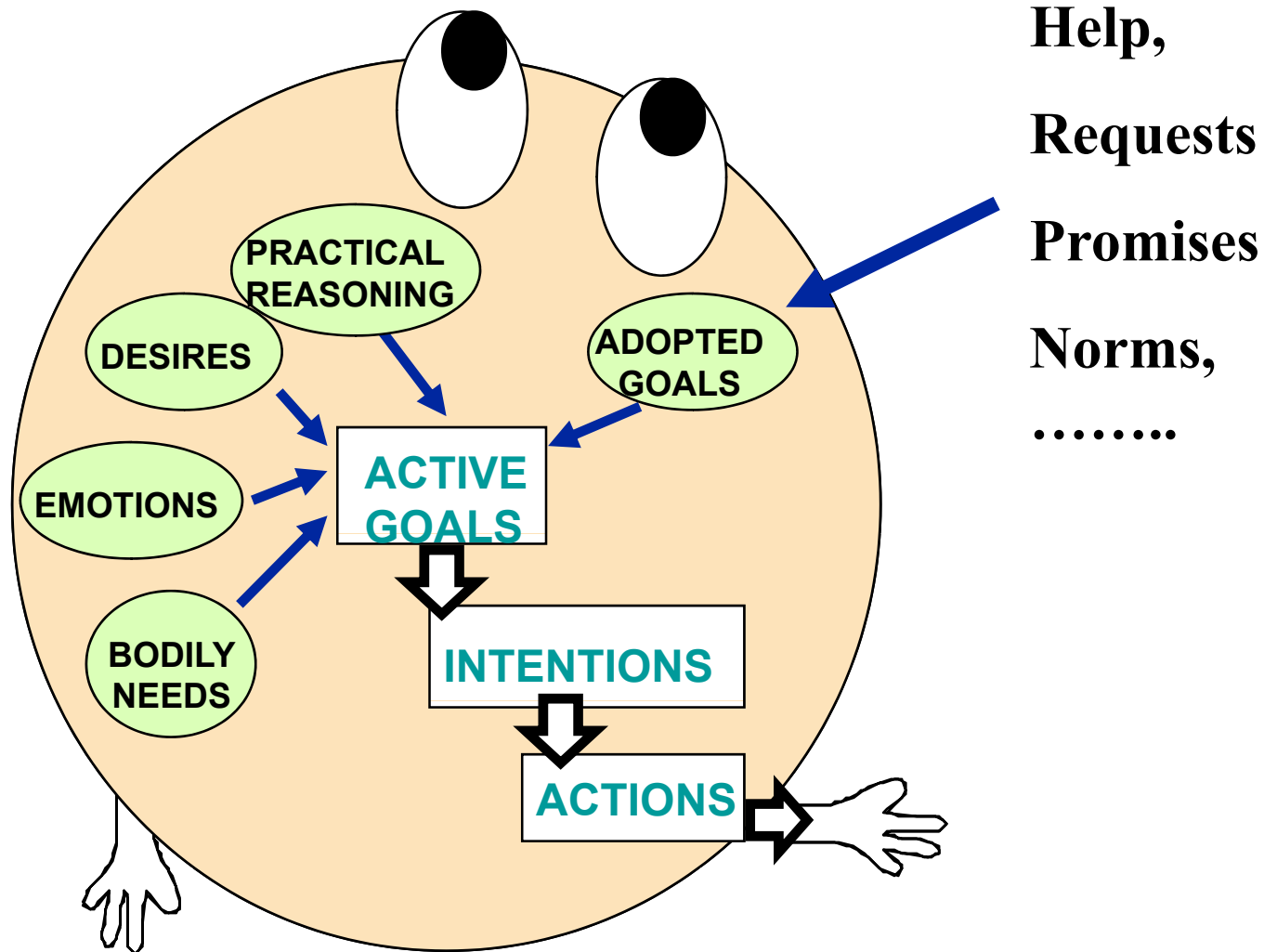
4. **SOCIALITY** & Goals

Goal-Adoption

How is it possible that the goal (need, desire, objective, request, order, ...) of another entity succeeds in regulating my own autonomous behavior?

How such a goal is ‘imported’ in my regulatory, purposive system?

Social-Agent's Architecture and Multiple Goal-Sources



The ‘prodigy’ is that those *self-regulated*, goal-driven systems can *import goals* from other goal-driven, purposive systems, from outside:

- They put their ‘body’, skills, problem-solving capacity, and resources at disposal of the needs/desires of another agent.
- They spend their powers, and actively pursue the goal of another and for another; and , vice versa, **Y exploits X’s body/powers for her purposes.**

“*Auto-nomos*” “*self-motivated*” “*Goal-driven*” ...
doesn’t mean: **“Selfish”**

Goal-Adoption

X believes that Y has the goal that p ($G_y p$) and comes to have (and possibly pursue) the Goal that p ($G_x p$) just because he believes this.

$$(\text{Goal-adopt } x \ y \ p) =^{\text{def}} (\text{R-Goal } x \ p \ (\text{BEL } x \ (\text{Goal } y \ p)))$$

This is ‘goal-adoption’, and can be *motivated* by different reasons.

Beliefs about Y's goals

A fundamental condition is an intentional stance of X (the adopter) towards Y (the adopted guy), and more precisely – if Y is considered a cognitive agent – ***a mind-reading attitude in X towards Y.***

>> Not only *Communication*, but *Mind reading*!

X has to *ascribe* to Y a given internal goal (of any kind)

Bel x (Goal y p)

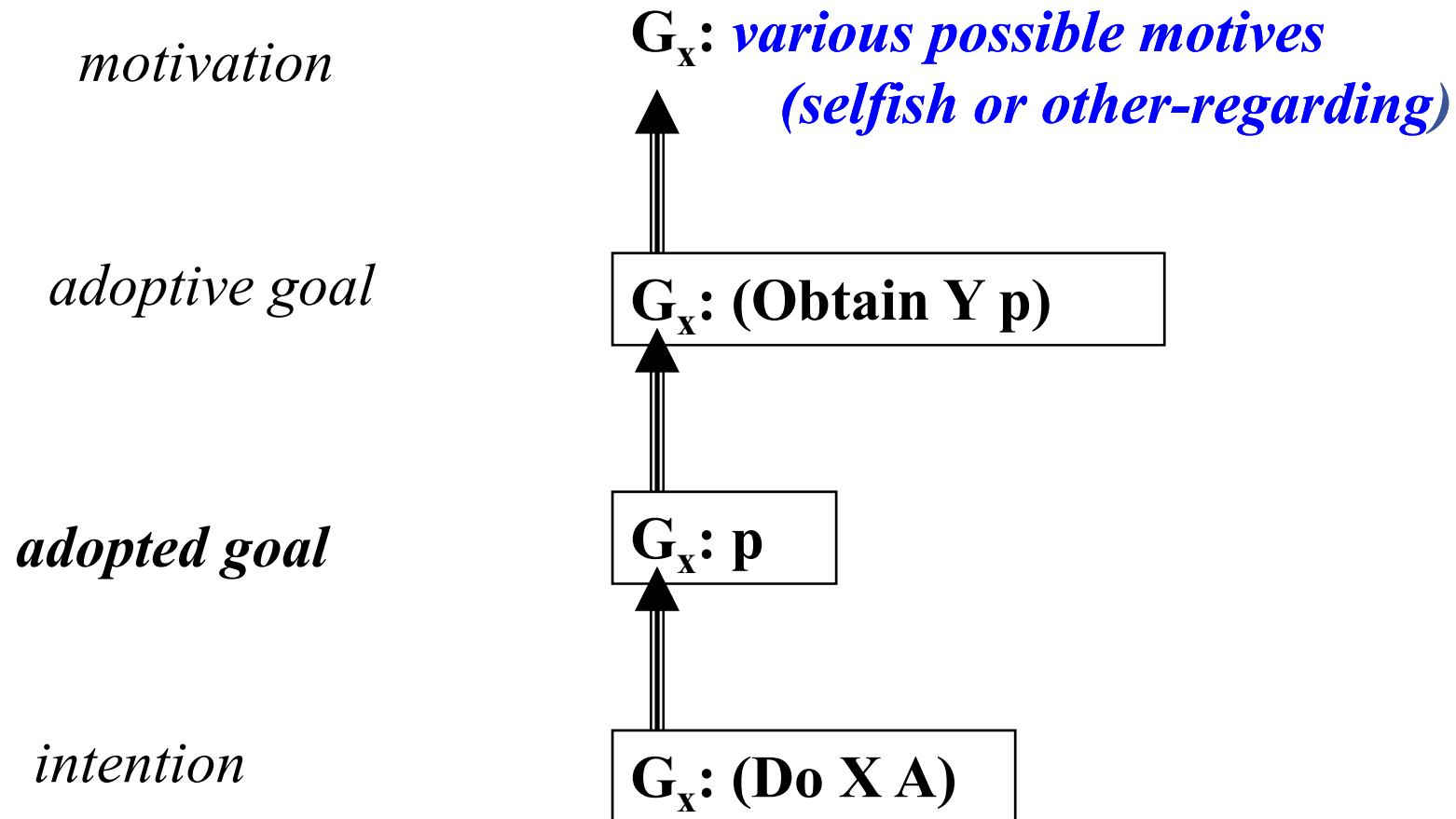
and X decides to “appropriate” that goal, since and until it is the goal of Y.

So X comes to have the same goal:

(Goal x p)

but *relativized* to that belief.

A Complex Goal Structure



Kinds & Motives of Goal-Adoption

Goal Adoption

is not 'benevolence' or 'altruism'
..... *Social Preferences*

there are various *Motives*
for doing something *for* the others

there are various Kinds of Goal-adoption

a) Terminal or Altruistic Adoption can (rarely) be ‘altruistic,’ that is disinterested, non motivated by, non instrumental to higher personal (non-adoptive) calculated advantages (goals);

b) Instrumental Adoption can be instrumental to personal/private returns, part of a selfish plan; like in commerce, where: “It is not from the benevolence of the butcher, the brewer, or the baker that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our own necessities but of their advantages” (A. Smith, *An Inquiry into the Nature and Causes of the Wealth of Nations*, 1776)

In Smith’s perfect description of exchange in merely selfish terms it is clear that there is non benevolence or altruism at all; and ~~that~~ X has the goal to *understand* and *realize* the selfish goal of Y (that per se is indifferent or bad- to X) only in order to satisfy (through Y’s reciprocal adoption) his own selfish and personal goal. So having the goal to realize your goal (as what you like and because you like it) is not ~~really~~ *really* altruistic at all.

c) *Cooperative*: it can be instrumental to a personal advantage, but shared with the other: for a *common goal* (strict ‘cooperation’): X and Y depend on each other for one and the same goal.

One might consider (c) a sub-case of (b) (instrumental adoption) but actually the situation is significantly different.

‘Cooperation’
is based on
Adoption

Intentional ‘Cooperation’ is Adoption (and Delegation) based

In ‘Exchange’ (bilateral dependence, individual goals)
X adopts the goal of Y
if and in order Y adopts her goal

In strict ‘Cooperation’ (common goal & mutual dependence)
X adopts the goal of Y
> because Y relies on her (and X accepts this); and
> because she relies on Y’s action
(do not interfere, to facilitate: true Collaboration)

4. SOCIALITY & Goals

GOAL DELEGATION

X allocates her Goal to Y; relies on Y as for realizing that Goal:

> X either exploits Y's autonomous actions; or

> Tries to “influence” Y, to induce Y to “adopt” her Goal

4. SOCIALITY & Goals

INFLUENCE/MANIPULATION:

changing the other's goals

“Sociality” is not just adjusting our own behavior to the others’ interference; it also is changing the others’ behavior.

When they are cognitive agents this means:

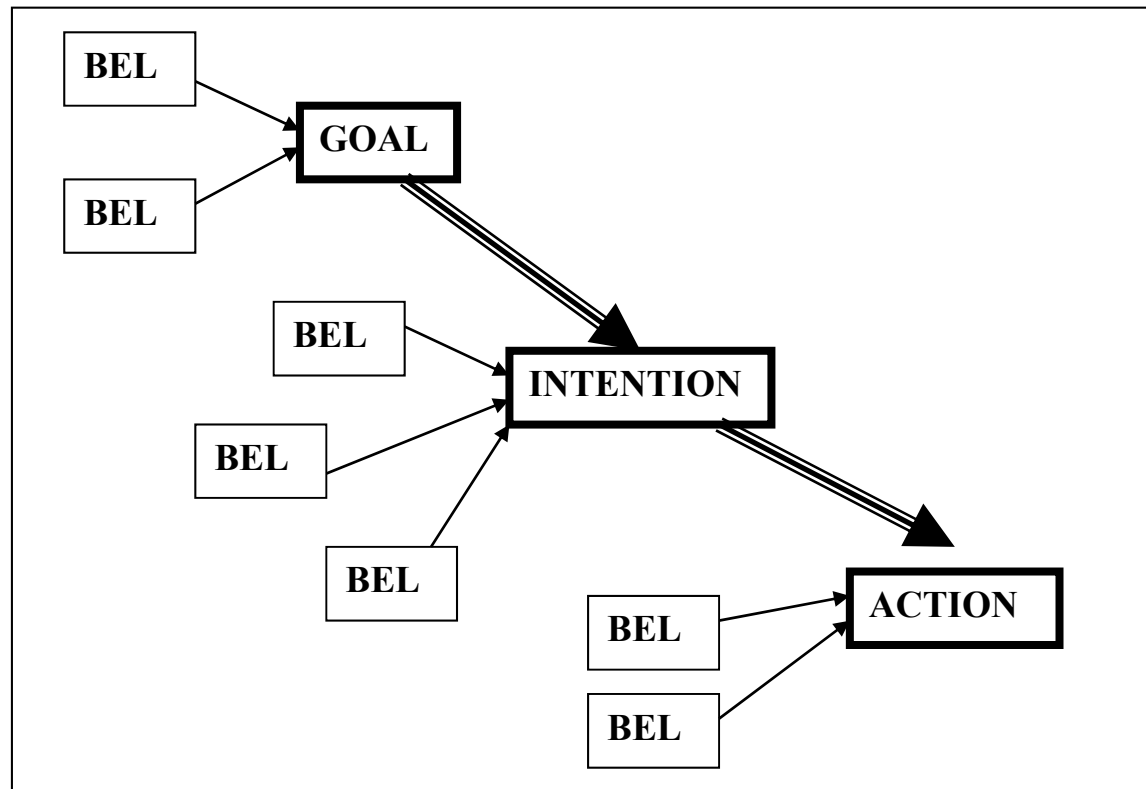
Changing their MIND (goals!) in order to change their behavior!

I have *goals* about the other mind,
not just beliefs

The problem is:

***Where, how, to act upon your mind
to change your behavior?***

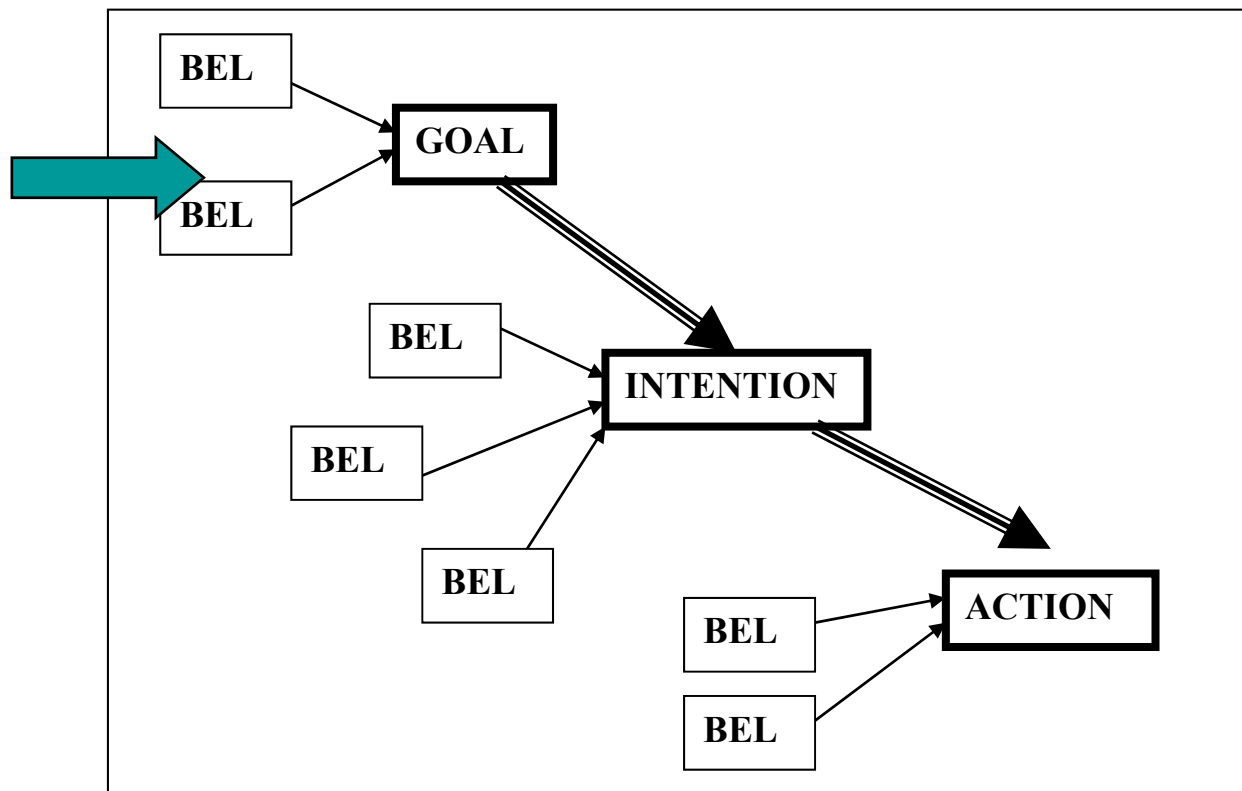
A model is needed: (putting aside 'affect')



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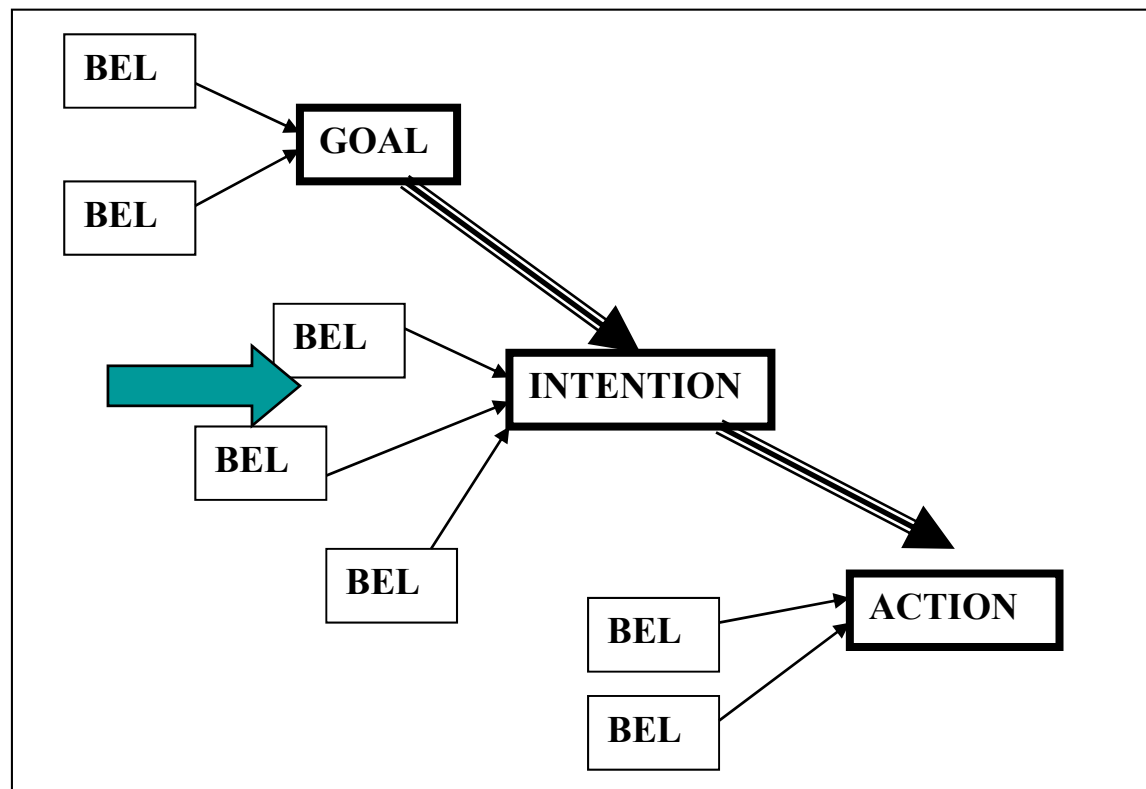
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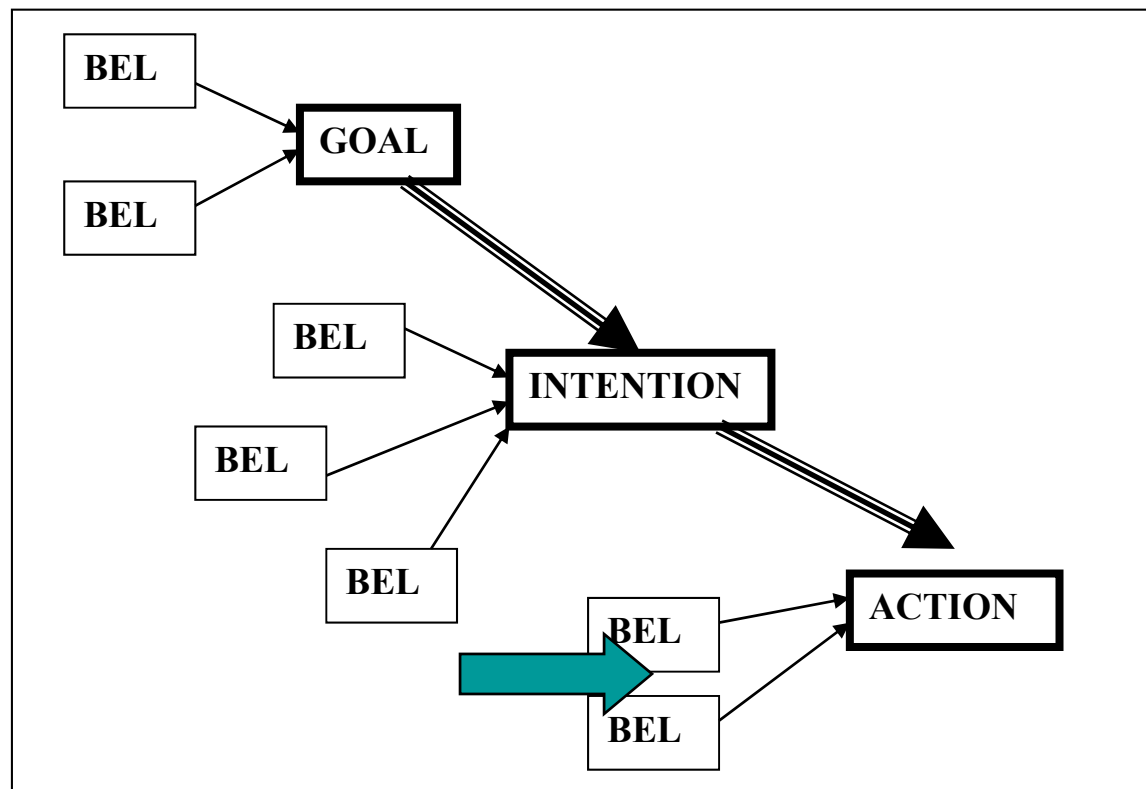
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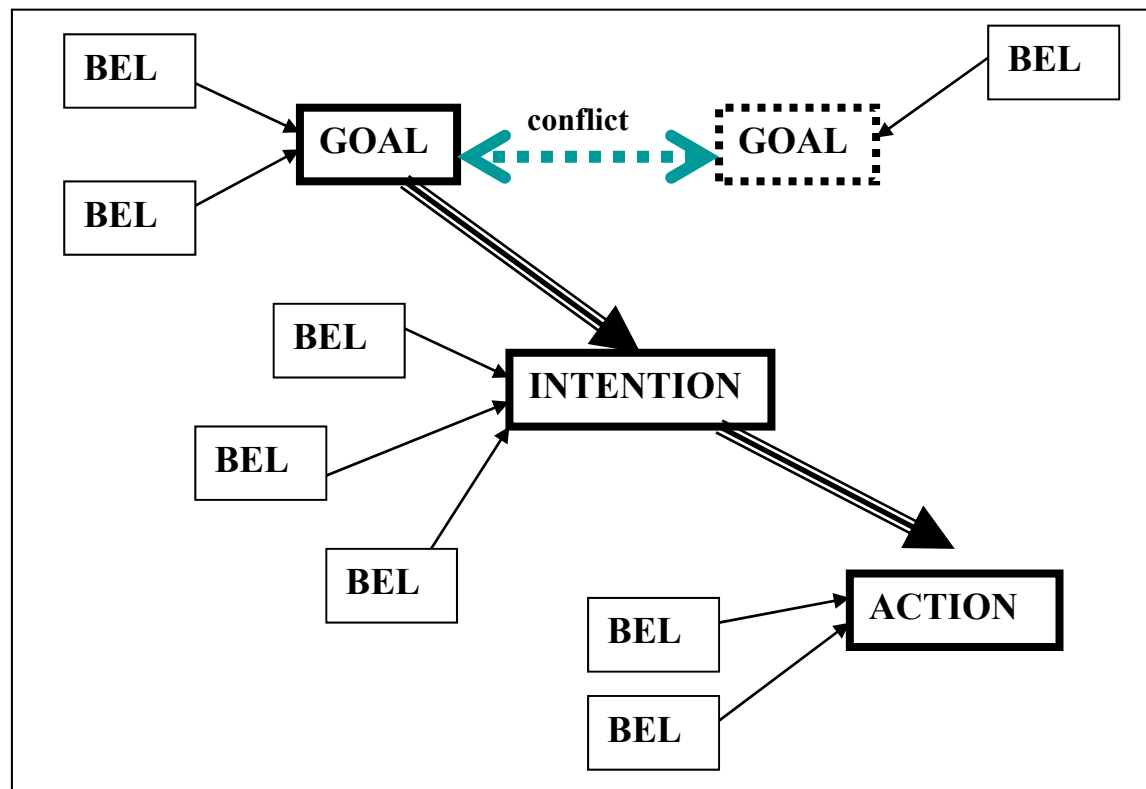
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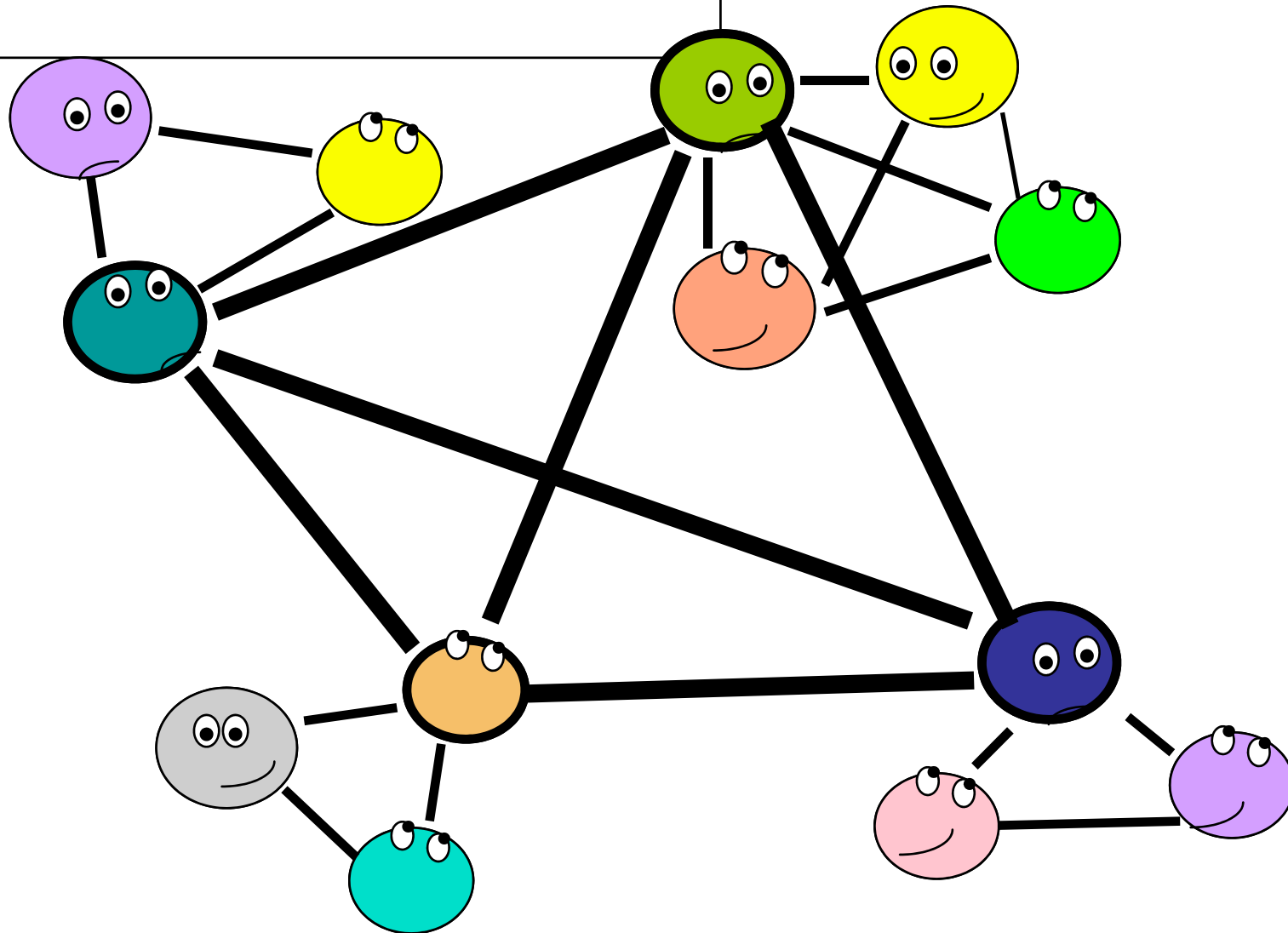
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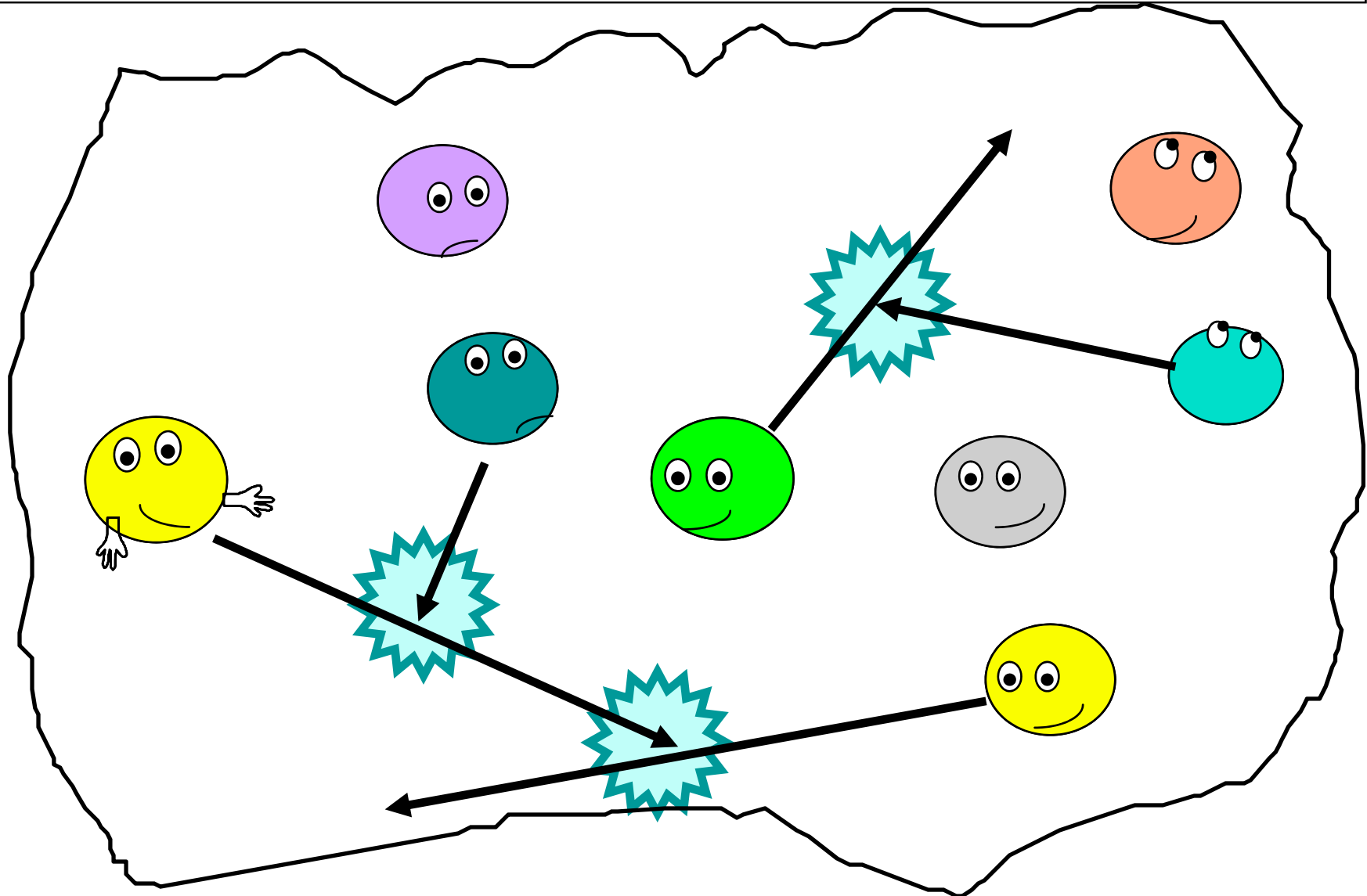


Social Structures

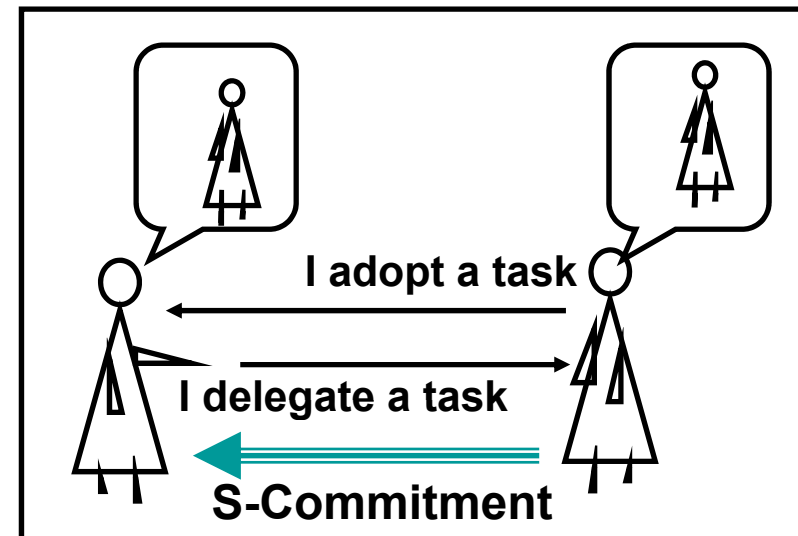
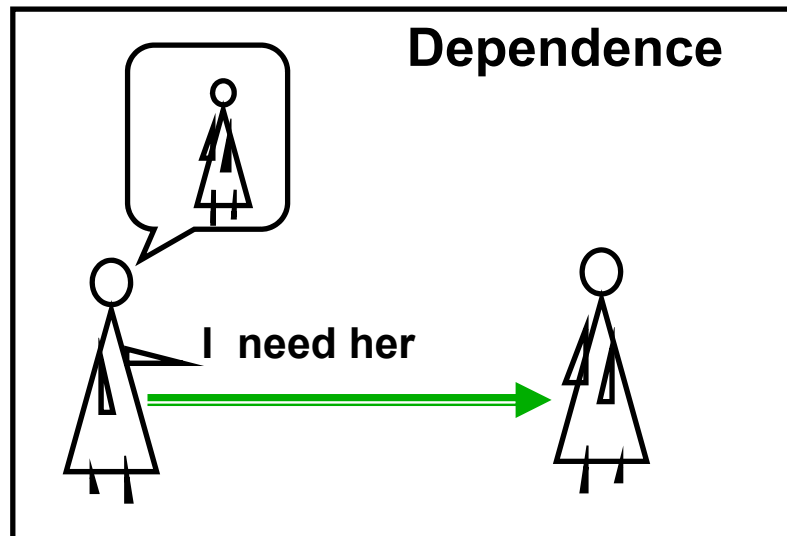
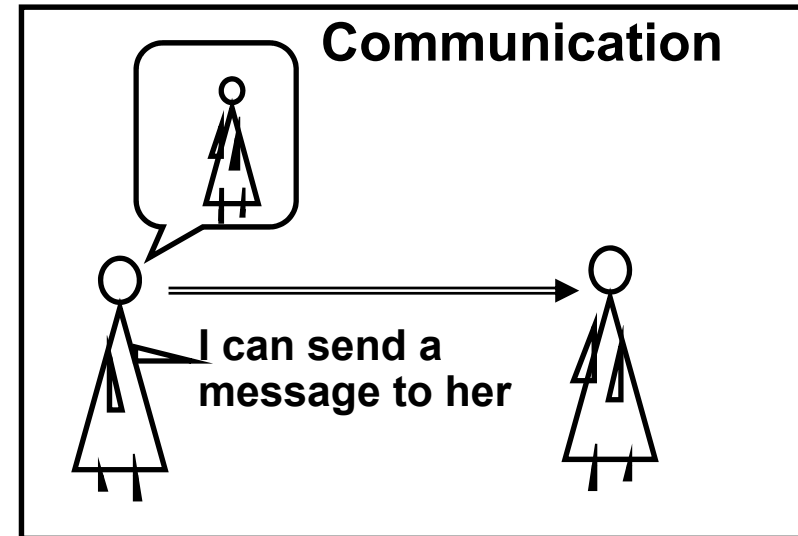
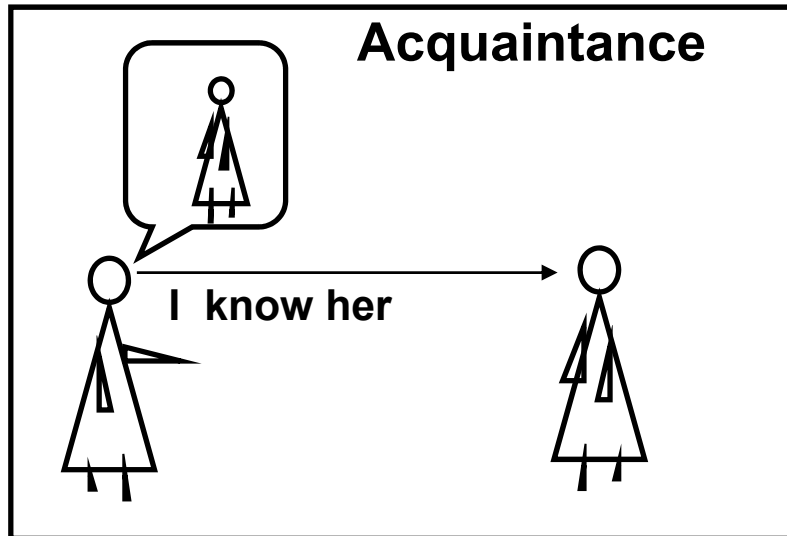


Common world = INTERFERENCE

NOT necessarily "COMMUNICATION"



Social Structures



NETWORKS

A central construct of social studies

> their **STRUCTURE & DYNAMICS**

Fundamental

for **EMERGENT PROPERTIES** and **COMPLEXITY**

Complex systems are characterized by:

- non linear behavior/dynamics, in part casual;
- many components and many interactions among them;
- multi-layered (self-organizing, emerging); ..

NETWORKS

What must be carefully preserved and taken into account are:

- (i) The **“semantics” of the link**, the specific nature of the relation (**GOAL defined**) it represents, with all its properties and arguments;
and the "nature" of the link: (unilateral? bilateral? reciprocal/mutual?)

The **qualitative & quantitative aspects** of links;
their strength and so on;
the “transmission” and transitivity properties.

- (ii) The **cognitive aspects** that qualify that relation (given that the network nodes are “actors/agents”): what the agents believe, understand, prefer,... :
their “mind” in the network (*mind-based links*: Trust) and about the network.

It is not only a network on actions and of positions; **it is a network of minds** (ex. shared non-shared mental states; contagion or not; ..)

NETWORKS

Few examples focused on

The **CENTRALITY of GOALS** in the links:

- > **Dependence Net**

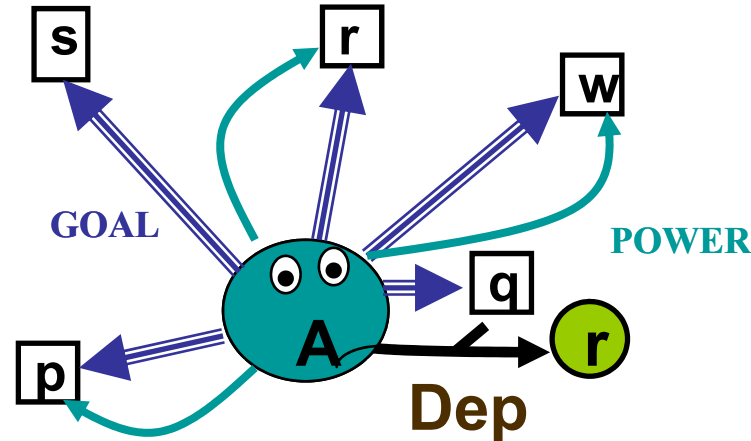
- > **Trust Net**

DEPENDENCE-Network

DEPENDENCE-Network

The basis/ground are

INDIVIDUALS with their personal **GOALS** & **POWERS**



DEPENDENCE-Network

The basis/ground: **relative to Goals!**

POWERS (skills, resources): the basic layer

- *If A has Goal q and is NOT able & in condition to achieve it, &*
- *If B has the “power of” realizing q by action α ,*

\Rightarrow Then: *X objectively DEPENDS on B as for action α and goal q*

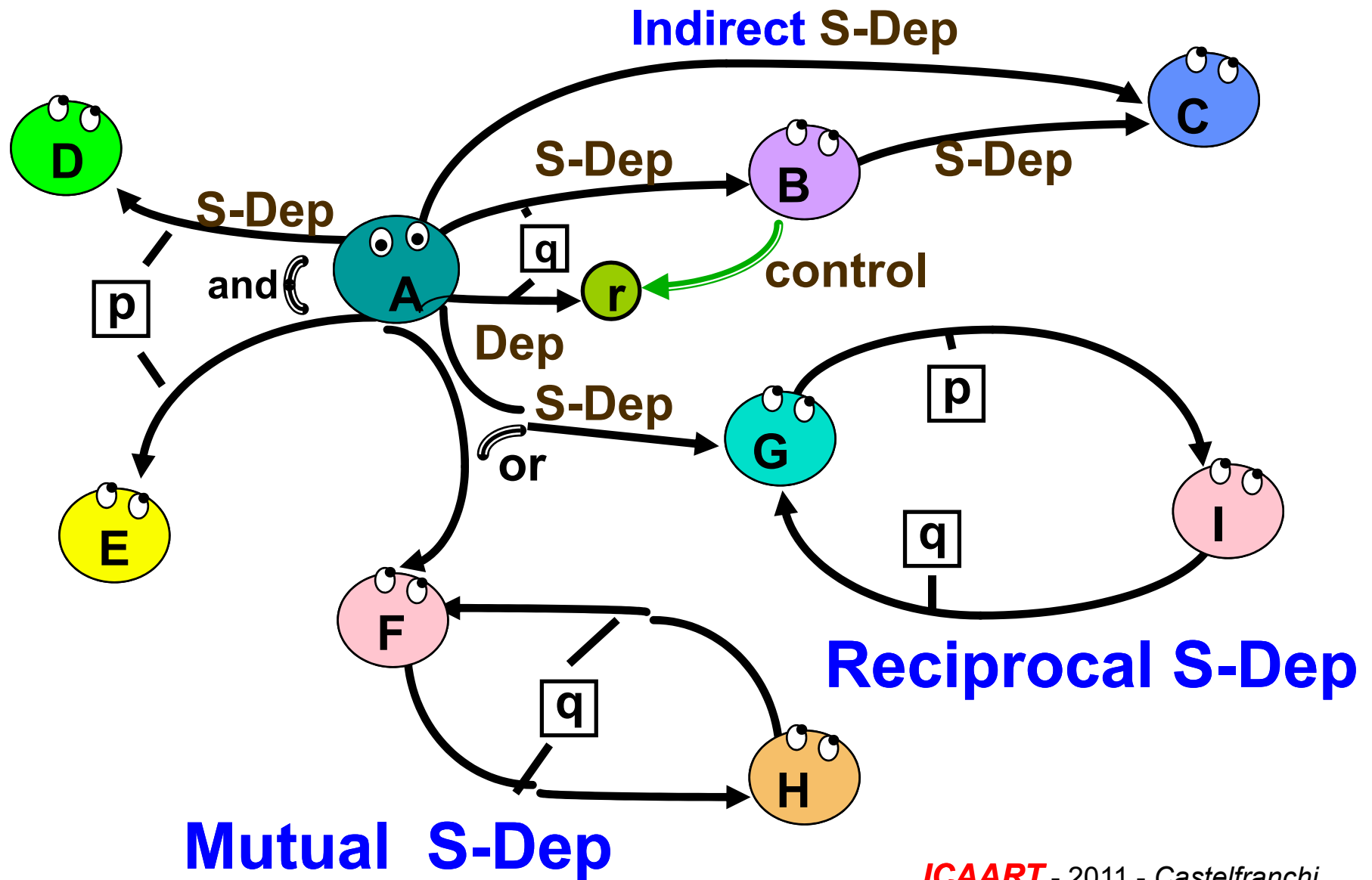
The basis of DEPENDENCE are:

- “power of” & “lack of power of”

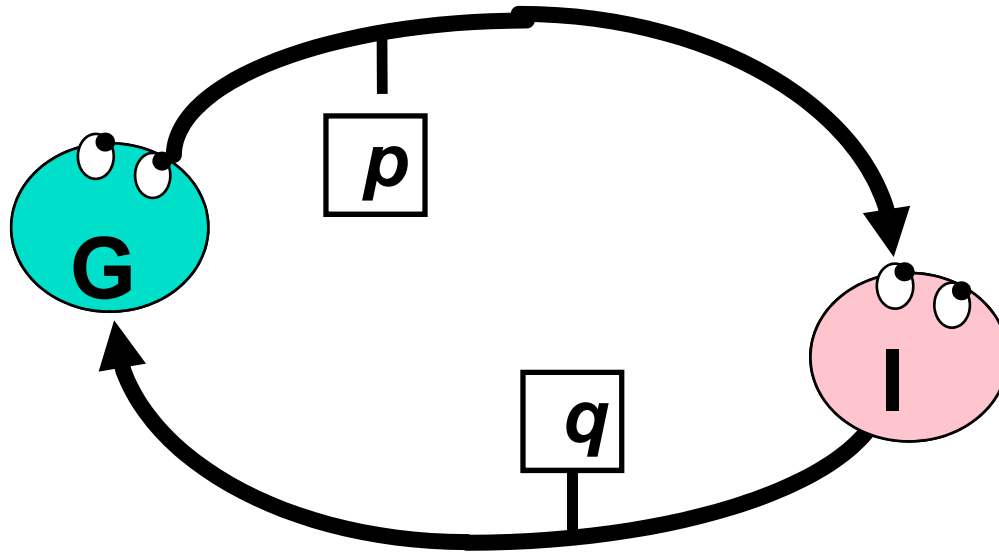
GIVEN A BUNCH of AGENTS (with their needs (goals) and personal powers (skills and resources),

an *OBJECTIVE DEPENDENCE NETWORK* EMERGES

DEPENDENCE-Network



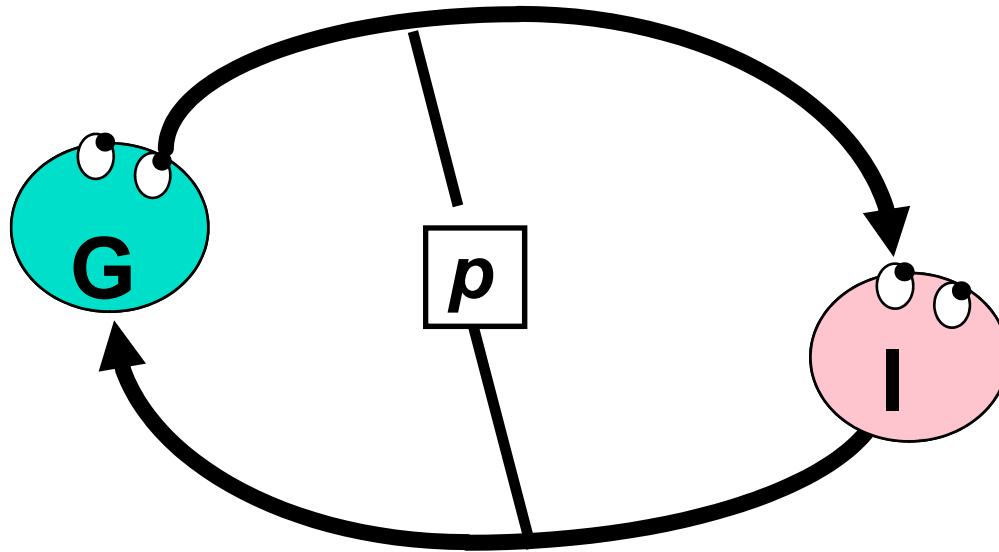
Reciprocal S-Dependence



Exchange: they depend on each other for two different and individual GOALS

- cheating, defeating,
- problems of reciprocation,

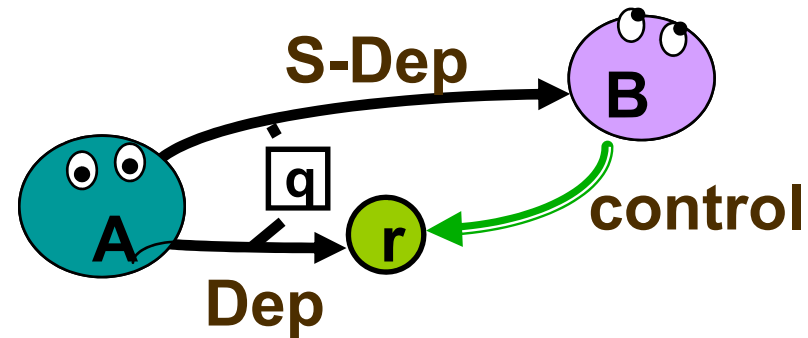
Mutual S-Dependence



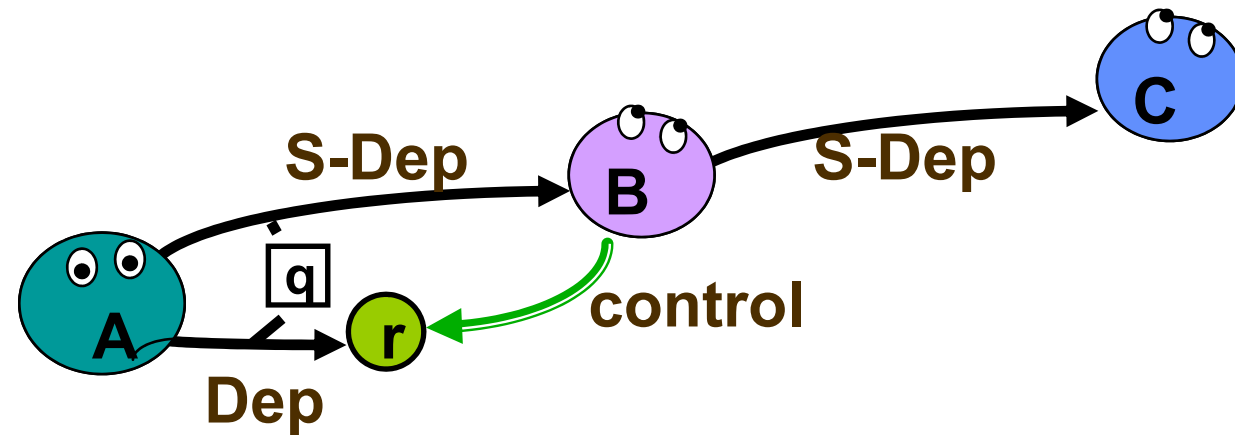
strict **cooperation**: they depend on each other for just one and the same GOALS

- common goal, co-interested agents,
- to defeat is self-defeating....

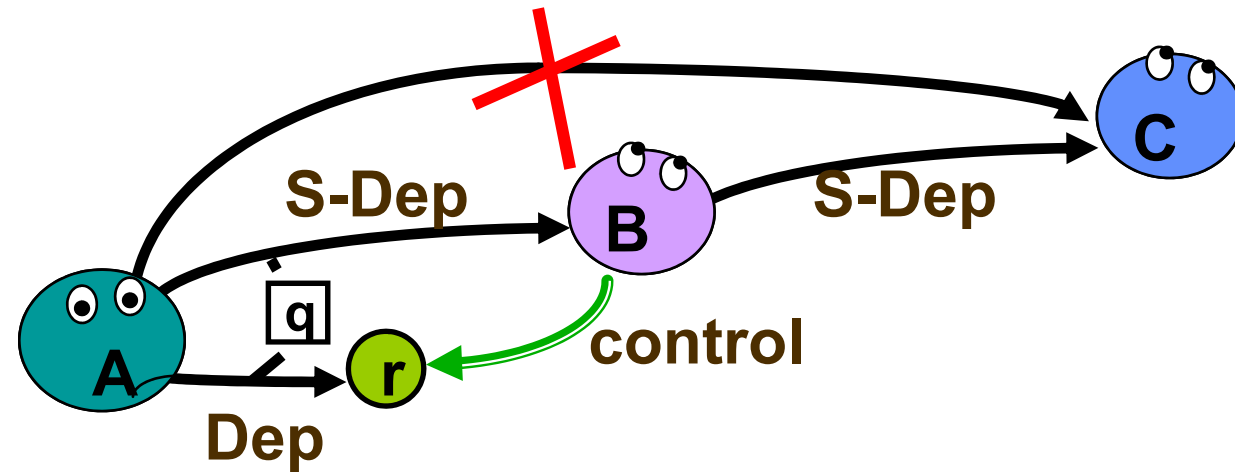
DEPENDENCE-Network



DEPENDENCE-Network



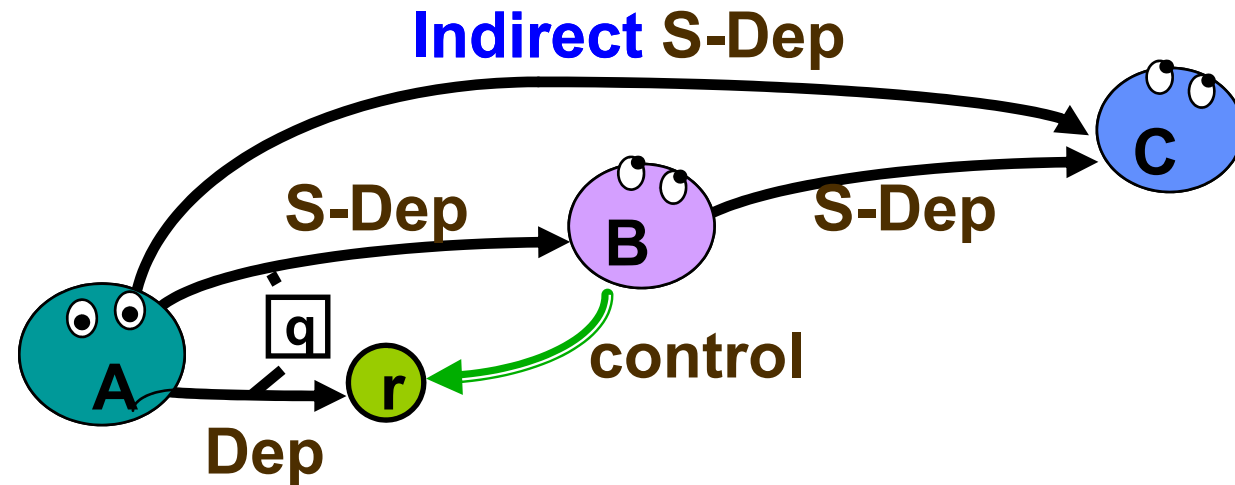
DEPENDENCE-Network



NO trivial “transitivity”:

$A \text{ Dep on } B \ \& \ B \text{ Dep on } C \implies A \text{ Dep on } C$

DEPENDENCE-Network



NO trivial “transitivity”:

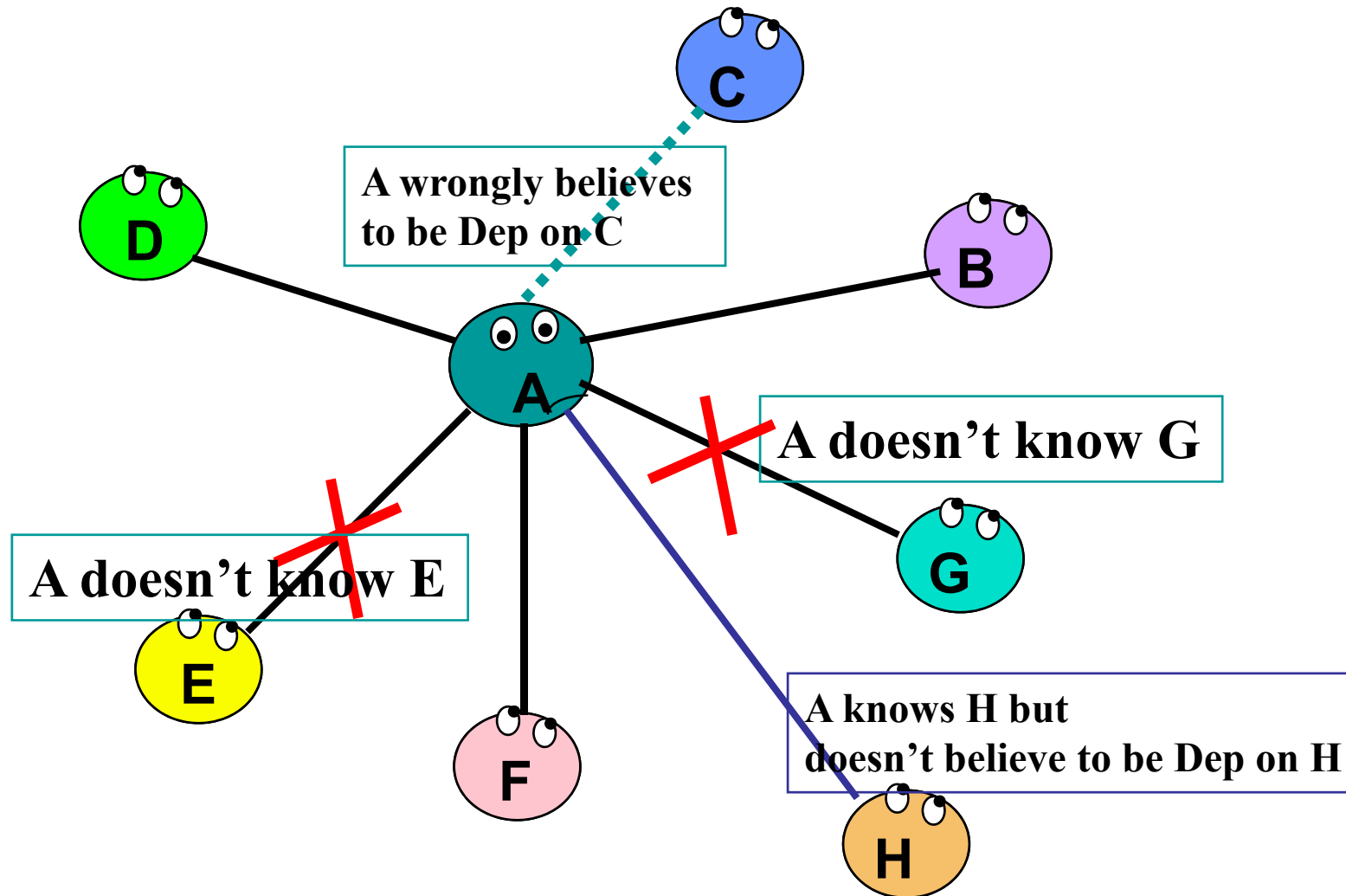
$A \text{ Dep on } B \ \& \ B \text{ Dep on } C \implies A \text{ Dep on } C$

$A \text{ Dep on } B$ as for action α for realizing GOAL q , but
 $B \text{ Dep on } C$ as for performing α

Then: $A \text{ Dep on } C$ as for realizing his GOAL q \square

Subjective DEPENDENCE-Network

DEPENDENCE-Network

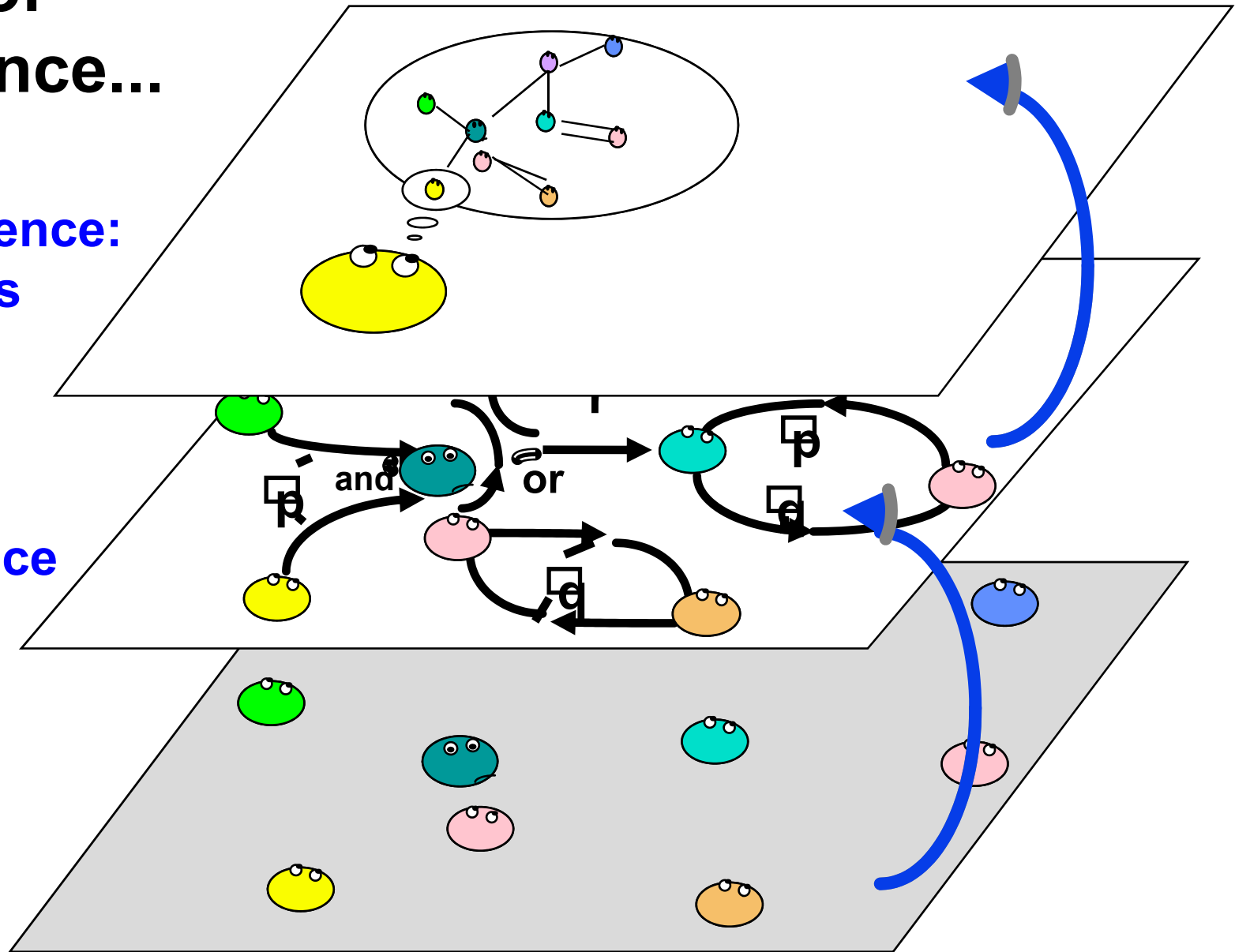


Levels of emergence...

cognitive
emergence:
awareness

objective
dependence
network

agents
in a common world



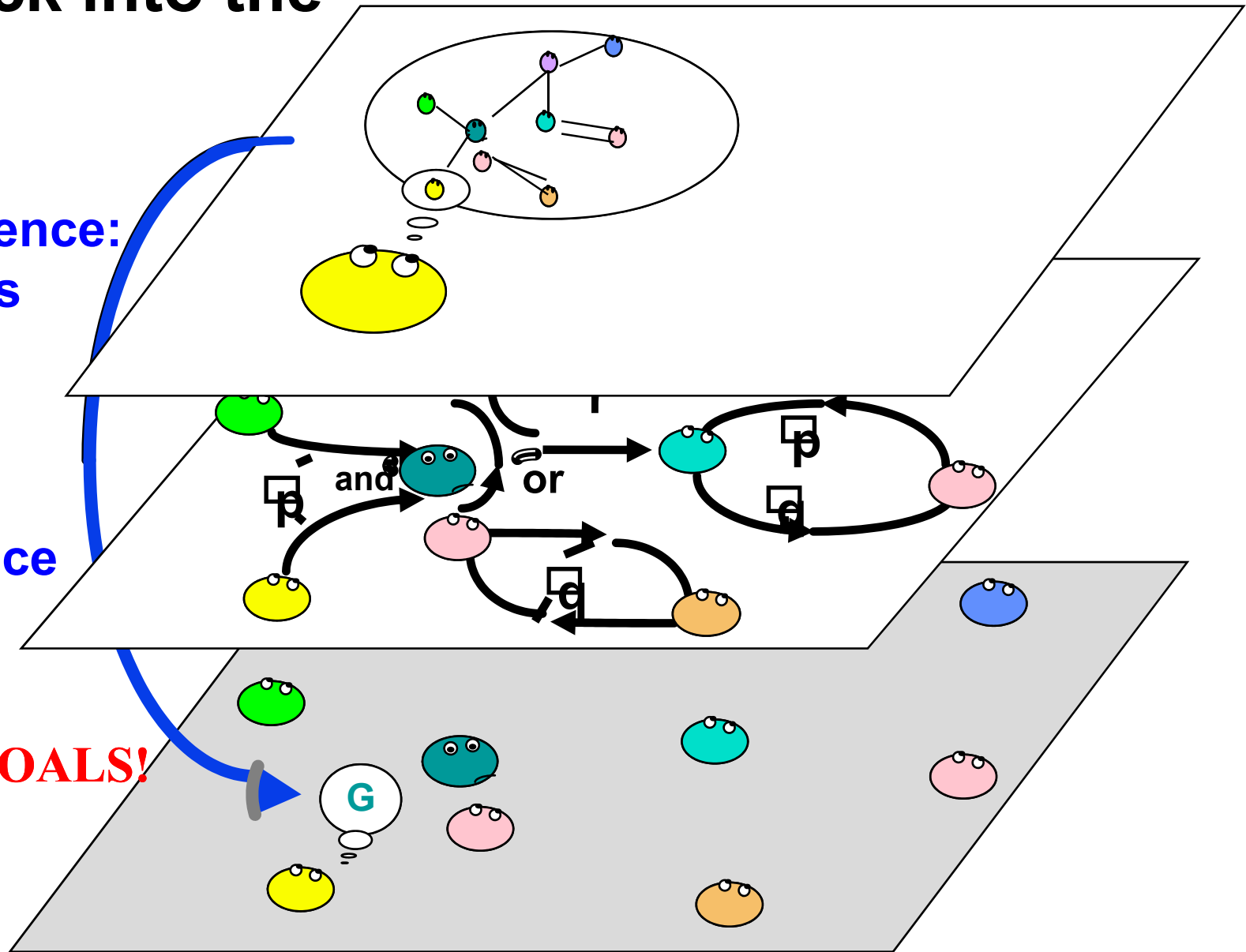
Feedback into the minds

cognitive
emergence:
awareness

objective
dependence
network

NEW GOALS!

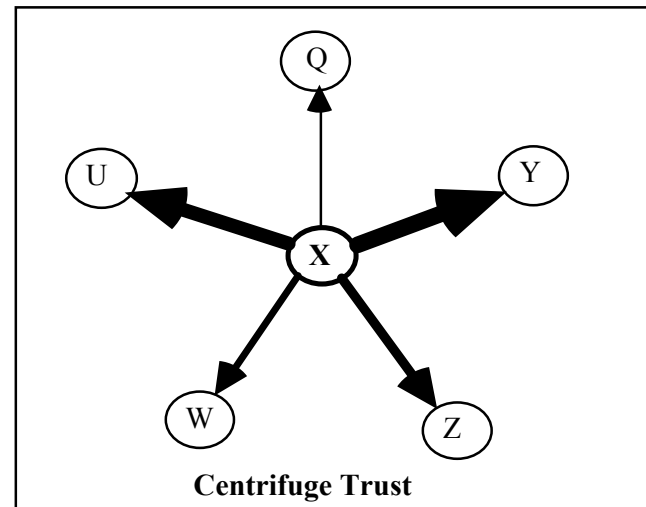
agents
in a common world



TRUST-Network

TRUST-Network

The TRUSTOR's perspective



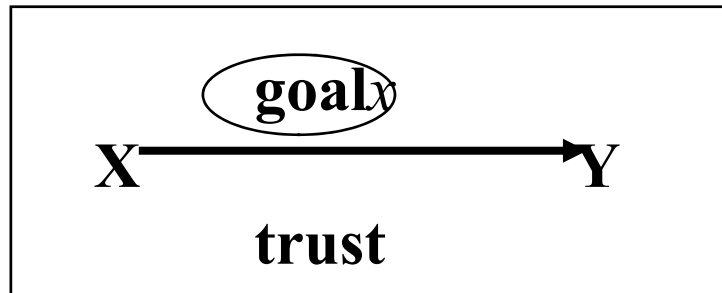
Predictions

The *strength* of X's trust in Y is a predictor of X's choosing Y for reliance, of X's counting upon Y. But this is not a perfect predictor, i.e. the differential amount of X's trust in Y (compared with X's trust in Z or W) does not completely determine X's choice. There are also other factors. How much is X dependent on Y, Z or W? How much does X need each of them? And which is the cost of relying upon Y rather than upon Z or W? Not always the chosen partner is the most trusted. Although more risky certain relationships can be preferable.

TRUST-Network

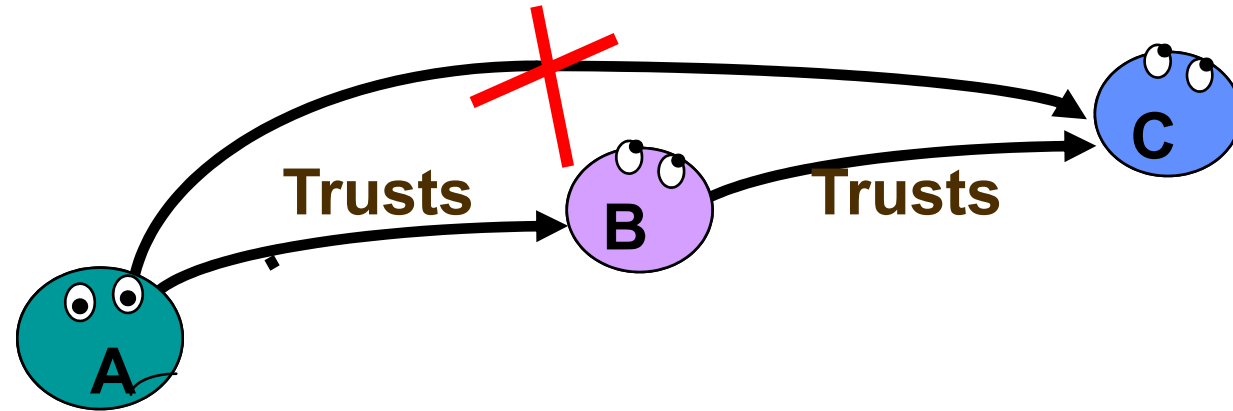
BUT.... All trust relations are **GOAL-RELATIVE:**

X trusts Y *AS FOR* a given *outcome, result, action, good, service,...*
he NEEDS or DESIRES!



IMPORTANT for the LINK DYNAMICS!

TRUST-Network

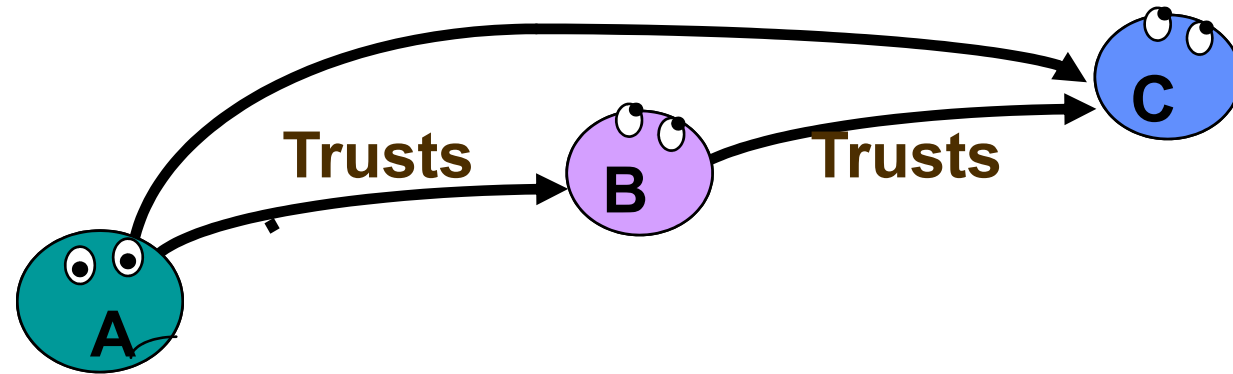


NO trivial “transitivity”:

A Trusts B & B Trusts C \implies A Trust C

A “trusts” B for what?! and B “trusts” C for what?!

TRUST-Network



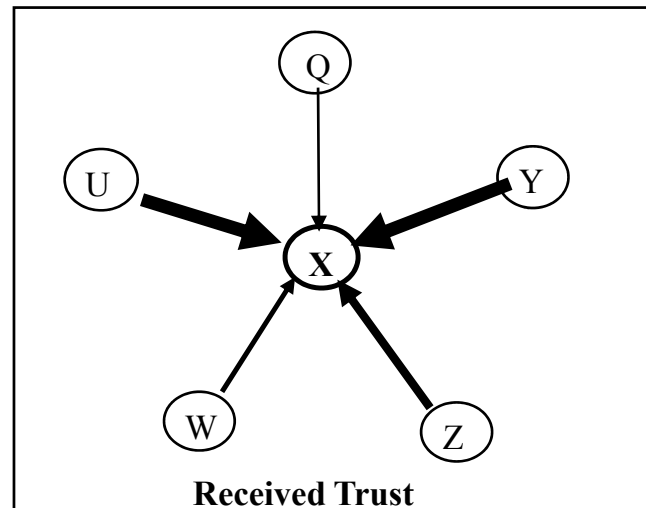
IF

*A Trust B as for being a good evaluator of α performances, &
B Trusts C as for performing α (two kinds of Trust!)*

Then: A Trust C as for performing α

TRUST-Network

The **TRUSTEE's** perspective: **TRUST “CAPITAL”**



For which **GOALS** the others trust X and search for X?
Which are X's perceived *“virtues”*, *“qualities”*, *“skills”*, .. ?

TRUST-Capital

*Trust as **Relational Capital***

To be trusted:

- > gives me power!*
- > increases my chances to be requested or accepted as a partner for exchange or cooperation;*
- > improves the 'price', the contract that I can obtain.*

Dynamics of Relational Capital

- *There is a cost of this Capital.*
- *One has to invest to acquire it*

Example: in iterated strategic games, *the cost of building my Reputation is an investment for future interaction*

Thank you for your attention!



I like to **thank our research group** in Cognitive Science at
ISTC: the ***‘GOAL group’***

Maria Miceli

Rino Falcone (T3 Lab)

(Emiliano Lorini- IRIT)

Fabio Paglieri

Giovanni Pezzulo

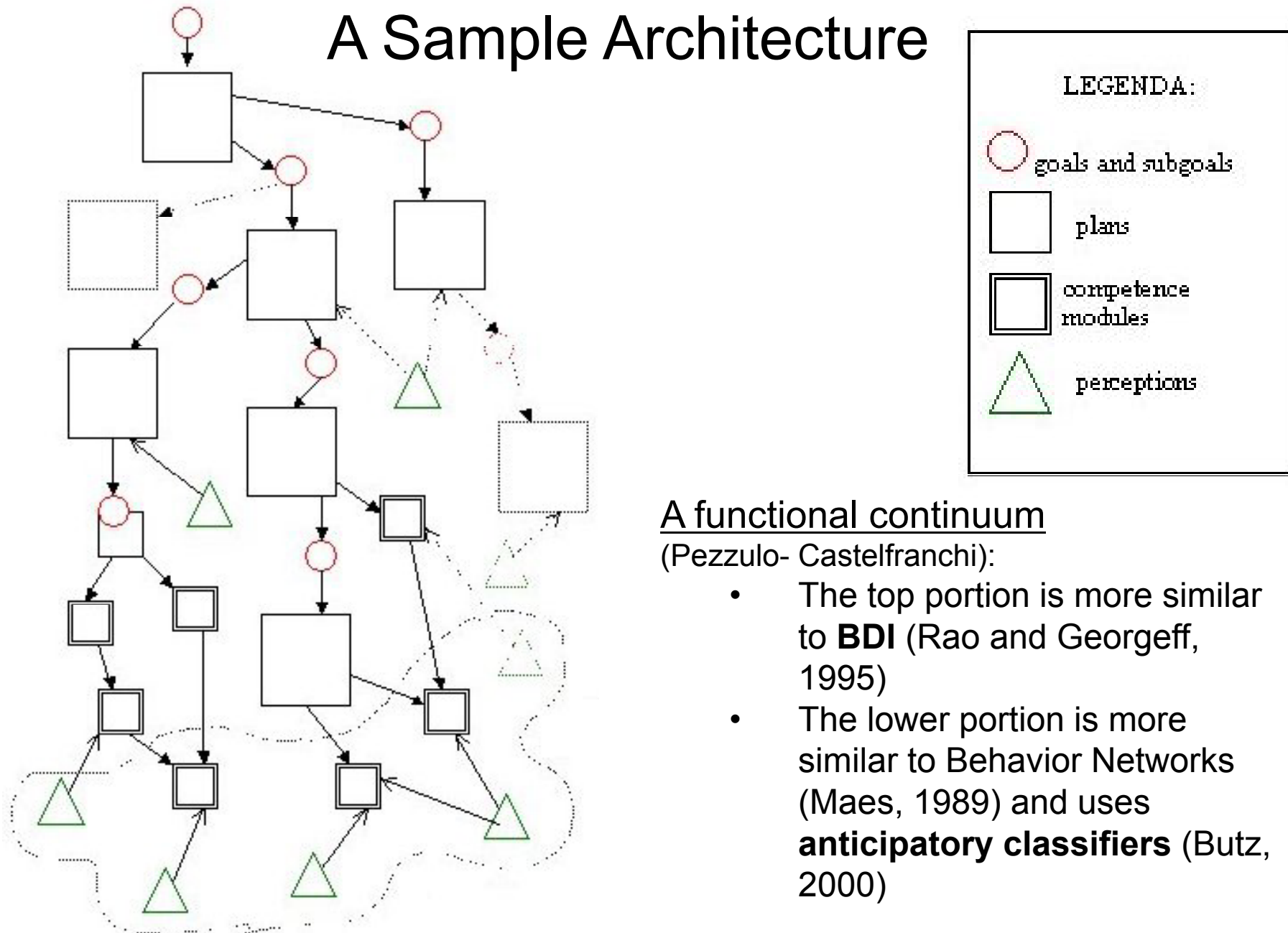
Michele Piunti

Luca Tummolini

A part from *Rosaria Conte (LABSS Group)*



A Sample Architecture



A functional continuum

(Pezzulo- Castelfranchi):

- The top portion is more similar to **BDI** (Rao and Georgeff, 1995)
- The lower portion is more similar to Behavior Networks (Maes, 1989) and uses **anticipatory classifiers** (Butz, 2000)

POWER-Networks

from **DEPENDENCE-Network** to **POWER-Network**

