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## **Solution thinking and team reasoning: how different are they?**

Elisabeth Pacherie<sup>1</sup>

### **Abstract**

In his book, *Understanding Institutions*, Francesco Guala discusses two solutions to the problem of mindreading for coordination, the solution thinking approach proposed by Adam Morton and the team reasoning approach developed by Michael Bacharach, Robert Sugden and Natalie Gold. I argue that the family resemblance between the two approaches is even stronger than Guala thinks.

### **Keywords**

Coordination, mindreading, common knowledge, solution thinking, team reasoning

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In his book, *Understanding Institutions*, Francesco Guala does a wonderful job at unifying equilibrium and rule-based theories of institutions. On the one hand, an approach that conceives of institutions as systems of rules fails to explain why some rules are effective (i.e., people follow them) and others not. On the other hand, the equilibrium approach that conceives of institutions as equilibria is too permissive as not all equilibria are institutions<sup>2</sup>. Guala proposes to combine the best aspects of both approaches by taking institutions as rules in equilibrium. The rules-in-equilibrium approach can provide an answer to the question what makes a rule effective: a rule is effective to the extent that the strategies it dictates correspond to an equilibrium from which no one has an incentive to deviate. On the other hand, by insisting that equilibria be represented by means of rules (i.e., symbolic markers), the theory can identify what is special about equilibria that qualify as institutions and is in a position to explain the flexibility, versatility and creativity of human institutions.

Yet, versatility and flexibility come at a price. In contrast to other social species, our coordination strategies are not hard-wired. In games with multiple equilibria, different players may select different equilibria. Similarly, different people may operate with different rules. Whether we choose a particular coordination strategy depends on what

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<sup>2</sup> As Guala points out, mutual defection is an equilibrium of the Prisoner's dilemma but clearly not an institution. If anything, it is a form of antisocial behavior. In addition, many non-human social animals can solve coordination problems, but they have no institutions. Rather, the specific equilibrium selected by evolution in a particular species takes the form of a hard-wired behavioral program.

strategy we think the other player will adopt, which in turn depends on what strategy the other player think we will choose. Whether we follow a certain rule depends on what rule we think the people we are interacting with follow and this in turn depends on what rule they think we follow. The equilibrium theory and the rule-based theory are both confronted with this difficulty, and the rules-in-equilibrium theory inherits it.

Guala calls it the problem of mindreading for coordination. While he rejects Lewis' solution to this problem (Lewis 1969), he retains his way of framing this problem and considers two other potential solutions to this problem, Morton's solution thinking approach (Morton 1994, 2003), discussed in Chapter 7, and the team reasoning approach developed by Bacharach, Sugden and Gold (Bacharach 1999, 2006, Gold 2012; Gold & Sugden (2007a, 2007b), discussed in chapter 8. Guala acknowledges the existence of a strong family resemblance between these two approaches, but maintains that there are nevertheless important differences between them: in Tuomela's terminology (Tuomela, 2007) solution thinking is an "I-mode" approach while team reasoning is a "We-mode" approach. In addition, solution thinking applies to all focal points, whereas team reasoning has a more restricted scope. I shall argue that the family resemblance between the two approaches is even stronger than Guala thinks. Before I do, I first say more about what Guala, following Lewis, takes the problem of mindreading to be.

For people to coordinate non-accidentally, they must have mutual expectations of coordination. As Guala puts it:

In theory, the players should form a complex set of interlocking beliefs: in a coordination game, if I expect you to choose X (to do your part in the equilibrium) then I must believe that you expect me to choose X. But then I must believe that

you believe that I expect you to choose X. And that you believe that I believe that you expect me to choose X, and so forth for every level of beliefs." (Guala, 2016: 91)

Beliefs with such a structure are what Lewis calls common beliefs<sup>3</sup>. Conceptually, they form an open-ended hierarchy of nested beliefs. In practice of course, no such hierarchy of beliefs need be represented in anybody's mind. A belief counts as a common belief, if this hierarchy could in principle be derived from what the players explicitly believe.

The question then is, how can such common beliefs be arrived at. Lewis solution can be captured by the following formula: An event E is the basis for common belief that P if (i) E is public and (ii) E indicates that P. For instance, a thunderclap is a public event and indicates that rain is approaching and is therefore a basis for the common belief that it will shortly rain. In the case of coordination problems, various types of public events, including behavioral regularities, public statements, signals or, as in the Hi-Lo game, the salience of a particular outcome make a profile of strategies salient and provide the basis for the common belief needed for coordination.

Guala agrees that Lewis' solution works in many cases but thinks it lacks generality. First, following Binmore (2008), he notes that there are institutions that provide perfectly robust coordination devices and yet do not seem to be grounded on any publicly observable event. Thus Lewis' condition of publicity appears to be too strong. Second, the notion of indication is not as straightforward as it may first seem. As noted by Lewis himself, for indication to work, the agents must be symmetric reasoners: they must

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<sup>3</sup> Lewis (1969) used the term "common knowledge", but later insisted it was preferable to speak of "common belief" (Lewis, 1978).

have the same background information and apply the same inference procedures in order to take E to indicate P. For instance, someone who lives in a region where dry storms are very common may not take thunder to be indicative of rain.

We are thus confronted with two issues: How can common beliefs be grounded in the absence of public events? How can we be assured that the symmetric reasoning condition necessary to ground the relation of indication holds? These two issues together constitute what Guala calls the grounding problem for common beliefs.

Guala proposes that the simulation theory of mindreading may constitute a solution to the grounding problem. Specifically, he suggests that Morton's account of mindreading in coordination games may do the trick (Morton, 1994, 2003). Morton proposes that when two individuals have a goal in common, they use a procedure he calls solution thinking to predict each other's actions and interpret each other's beliefs. In a nutshell, each agent asks what is the best or most obvious solution to the problem. If there is a clear answer, the same reasoning is attributed to the other player by default.

On Guala's reconstruction, solution thinking from the point of view of the individual can be seen as involving four steps, the second and fourth of which involve simulation:

At step 1, I look at the problem and identify a focal point (the "obvious solution"). Step 2 replicates the procedure for the other player: she identifies the same focal point because she is just like me. Once the solution has been identified, I can derive my own actions and the actions of the other player by simple instrumental reasoning (step 3). Using the same procedure ("she reasons in the same way"), finally I predict what she will do and what she believes I will do. (Guala, 2017: 97)

Guala contends that solution thinking solves the two halves of the grounding problem. On the one hand, since I use my own reasoning processes to simulate the reasoning of the other player, the principle of symmetric reasoning is satisfied and the problem of grounding the indication relation is solved. On the other hand, simulation need not involve public events. If a solution is obvious to me, I will take it to be obvious to you, since I take it you are just like me, but the salience of the solution for me, and by simulation for you, need not be based on a public event.

I will come back later to the question in what sense this approach can be seen as a solution to the common belief problem. But before I do so, let me introduce another approach, team reasoning, an extension of standard game theory developed by Bacharach, Sugden and Gold.

The key move in the team reasoning approach consists in replacing the question "What should I do?", asked separately by each individual, with the question "What should we do?". Roughly, as Bacharach puts it, "somebody 'team-reasons' if she works out the best possible feasible combination of actions for all the members of her team, then does her part in it" (2006: 121).

In team reasoning, the team itself is considered an agent and the first step in the reasoning consists in determining what is the best action from the point of view of that team-agent. Once this is done, the second step in the reasoning involves working out the distribution of the action components among the agents.

As Guala points out, there are strong similarities between solution thinking and team reasoning. Both approaches rely on simulation. In solution thinking one simulates the reasoning of the other agent, while in team reasoning one simulates the reasoning of the team-agent. Both approaches also work backward, first identifying a solution and then

deriving the actions of the individual agents from that solution.

However, Guala sees two main differences between team reasoning and solution thinking. First, he argues that solution thinking has an advantage over team reasoning in that it is applicable to all focal points and not just to situations where one outcome is socially optimal and there is no conflict of interest between the players. He uses a coordination game with unequal equilibria to drive his point.

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Figure 1 about here

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Here's what he says about this game:

The idea that the players think as a team seems a priori rather implausible, and empirical data indicate that payoff inequalities tend to undermine coordination in games like these. However, suppose that one of the two equilibria has been made salient by history, for instance because one of the players is identified by a biological marker (sex or race) that has been used for centuries as an indicator of morality, power and privilege. In this case, it would not be surprising if the players coordinated smoothly on the focal point solution. (Guala, 2016: 112)

I agree that in such a historical context the players may coordinate smoothly, but this might be done through the use of team reasoning as much as via solution thinking. First, note that in the case of ahistorical, decontextualized experimental studies, where players are anonymous and the only available facts are those recorded in the bare game representation, solution thinking is not more likely to yield coordination than team reasoning in a game with very asymmetric equilibria.

Second, and more importantly, the historical factors mentioned by Guala may well be



reflected in team utility functions. As several authors have noted, the question how group utility functions are constructed and how they relate to individual utility functions remains a largely underdeveloped aspect of team reasoning approaches. Clearly taking the group utility function to be the sum or the means of individual utility functions is only one option among many. As acknowledged by Bacharach (1999) and emphasized by Hakli et al. (2010), a group utility function need not even reduce to the individual utility functions of the group's members. For instance, Hakli et al. (2010), propose that they are based on the goals, values, norms, standards, beliefs, and practices of the group, what Tuomela (2007) calls the group ethos. So, if a group has, say, strong patriarchal values, this is likely to be reflected in the group utility function. Thus, in a highly asymmetrical coordination game, the option that gives men the better deal may be ranked the highest.

According to Guala, the second main difference between solution thinking and team reasoning is that they provide different explanations of coordination failures. On the solution thinking approach, coordination may fail "because I cannot be confident that the others see the same obvious solution I do (it is a simulation failure)"; on the team reasoning approach, it may fail "because there is no 'fusion of egos' in the collective agent." (Guala 2016: 113). At the same time, though, Guala claims that simulation solves the problem of coordination by "'merging', so to speak, the two minds" (2016: 109). I confess that the subtle distinction between a "merging of minds" and a "fusion of egos" escapes me.

Rather, it seems to me that the relation between "I-mode" solution thinking and "We-mode" team-reasoning presents some interesting parallels with the relation between regulative rules and constitutive rules as analyzed by Guala and Hindriks (Guala 2016, Guala & Hindriks 2014, Hindriks & Guala 2015). Contra Searle (1995), Guala and

Hindriks claim that constitutive rules can be derived from regulative rules via the introduction of theoretical (i.e. institutional) terms and that these theoretical terms are in principle eliminable.

They illustrate their point with the fictional story of the Nuer and the Dinka settling in the Sobat Valley, named after the river that flows through it. The Nuer coming from the north grazed their cattle on the northern side of the river Sobat, as moving them across the river would have been difficult, and the Dinka arriving from the south grazed their own cattle on the southern side of the river for the same reason. Over time, the river dried out, making passage across the old river bed easy. However to avoid conflict, the Nuer and the Dinka continued their old practice of grazing their cattle on their respective side of the now defunct river. Their behavior can be described in terms of two regulative rules: (i) graze if the land is north of the river, and do not graze otherwise (the Nuer regulative rule); and (ii) graze if the land is south of the river, and do not graze otherwise (the Dinka regulative rule). If the institutional term *property\**, a pared down version of our complex notion of property, is introduced to denote all the patches where the members of a tribe graze their cattle, institutional rules can be derived from existing regulative rules at no cost. For instance, from the regulative rule "if a piece of land lies north of the river, then the Nuer graze it", one can derive the regulative rule: "if a piece of land lies north of the river, then it is Nuer's property\*", and if a piece of land is Nuer property, then the Nuer graze it". Guala and Hindriks point out that constitutive rules are akin to theories of sorts. Their theoretical terms refer to phenomena that exists independently of the theory itself. I suspect that the relation between solution thinking and team-reasoning is somewhat analogous to the relation between regulative and constitutive rules. Solution thinking describes patterns of reasoning we use to solve coordination problems. Team-reasoning

introduces theoretical terms, such as "We-mode", "team-agent" or "group utility function", that refer to these patterns of reasoning and are meant to more explicitly capture the sense in which we, you and I, are alike and reason alike.

Guala also emphasizes that the fact that theoretical terms are eliminable doesn't mean that they should be eliminated. On the contrary, he says, "the introduction of theoretical terms has an important pragmatic function: it promotes economy of thought and language, bundling together a set of regulative rules that we use to coordinate behavior in a set of related games" (2016: 65). Here again, I think, the parallel holds. "We-mode" terms – group ethos, group preferences and attitudes, group utility functions, team-agent, etc. – may in principle be eliminated but shouldn't be eliminated because they promote economy of thought and language. In particular, their use often buys us some generalization power allowing us to extend solutions to coordination problems beyond their original domain.

To conclude, let me briefly return to the problem of common belief and the sense in which solution thinking and team reasoning are solutions to this problem. One's initial reaction to the claim that either solution thinking or team reasoning provide solutions to the problem of common belief might well be one of outright disbelief. It may strike one as obvious that the purported solutions rest on unjustified assumptions and involve a regress. On the solution thinking approach, the culprit would be the tacit assumption that the players are alike and on the team reasoning approach, the assumption that they form a team. Yet, I agree with Guala that they are solutions of sorts to the common belief problem. They are, one might say, practical rather than theoretical solutions to this problem. They are solutions because, as Guala points out, more often than not they work. I suspect that Guala might be willing to go one step further and claim that the only

solutions to the problem of common belief are practical solutions. If so, I would be ready to follow him down this road. Just as the proof of the pudding is in the eating, the proof of common belief may well be in successful coordination. This doesn't mean that past instances of success at coordination guarantee that this or that particular future instance will be successful. However, our track record of successes and failures may nevertheless be a reliable guide and tell us when engaging in simulation or team reasoning is likely to help us. Common beliefs and coordination would then be mutually scaffolding and progress in concert.

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Elisabeth Pacherie is a senior researcher with the French Centre National de la Recherche Scientifique (CNRS) and the leader of the "Agency" team at Institut Jean Nicod

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	White first	Black first
White first	6, 3	0, 0
Black first	0, 0	3, 6

Figure 1: Coordination game with unequal equilibria. From Guala (2016: 112)