

# The Dutch eat at 5:30 pm: Shared Strategies for Agent Reasoning

## (Extended Abstract)

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## 1. INTRODUCTION

In the Netherlands, almost all people have dinner around 5:30pm. As a foreigner in that country, it is almost impossible to plan a (working) meeting around this time, which would be a ‘normal’ time in many other countries. On the other hand, having dinner that early is not an obligation. No one will be offended or would even care if you choose to eat later. This is an example of a *shared strategy*, i.e. an institutional arrangement where different actors have the intention of performing the same task at a certain time or setting [4].

Even though the concept of shared strategy is socially and computationally very instrumental, it has not yet been implemented nor formalized in the MAS literature. First, it determines the general behaviour of the system thus providing expectations that accommodate the behaviour. For example, restaurants should start preparing meals early since there will be many people coming at that time. Second, this notion adds a new dimension to the deontic classical concept where there is no obligation, permission or prohibition, yet a shared behaviour takes place.

In MAS research, shared strategies can be a new way of expressing conventions that cannot easily be fitted into norms as they have no deontic ‘flavour’ to it. Moreover, shared strategies are an expectation on individual behavior, rather

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that an individual plan or goal. Shared strategies are also different from collective intentions [2]. A collective intention is a goal shared by everyone in a team. Moreover, members of the team are aware of other agents intention to meet the common goal. For a shared strategy however, while all agents possibly have the same goal, their execution of tasks to fulfil the goal are independent of each other and if one agent does not perform the task, the general goal can still be met. In other words, a shared strategy does not necessarily have to be activated for all the agents every time.

Regarding the benefits of implementing the concept of shared strategies in MAS, in this paper we take inspiration from the Institutional Analysis and Development framework (IAD), an institutional economic framework developed by the Nobel laureate Elinor Ostrom [4]. IAD is an analysis framework for understanding social systems with the purpose of (re)designing social rules (i.e. norms). The ADICO structure, part of the IAD framework, provides a language for institutional statements, such as shared strategies, institutional rules and norms [1].

## 2. TOWARDS A DEFINITION

According to E. Ostrom, a shared strategy is a social concept that refers to a type of behavioural pattern that is observed by a significant number of individuals although it is, *prima facie*, neither associated with any deontic modality, nor having a reward or punishment linked to its performance.

Ostrom, in [4], pg. 143, proposes as an example of shared strategy, the rule of “calling back when a telephone conversation is cut”. This strategy is a conditional that under objective circumstances triggers an action. It does not explicitly entail an obligation or a prohibition and no reward or punishment ensues. On a closer look, however, it does entail an *expectation*, that, depending on the context in which the interruption took place, may be a strong, possibly asymmetrical and, if not fulfilled may be consequential. Strategy: “When in Rome, do as Romans do”, is an ostensible *directive for action* whose —relatively inconsequential— deontic component may guide the adaptive behaviour of foreigners, on one hand, and the leniency of natives towards non-standard behaviour of foreigners, on the other. Strategy, “Dutch eat at 5:30”, asserts a *factual regularity* but it

also hides a directive for action whose compliance by an individual is indifferent to the rest of the world; nevertheless, it creates expectations that under certain circumstances, may have practical consequences (in Holland, for an individual's eating plans or for the operation of restaurants). These three strategies may be deemed shared strategies only if we make explicit some assumptions about the expectations involved, otherwise they would be examples of *common* and *collective* strategies. Thus, the third strategy would be not a shared strategy but a "common strategy" if we understand it as a prevalent behaviour. However, it becomes a "shared strategy" when we understand it as an expectation of common behaviour; for instance, saying that most people believe that most Dutch eat at 5:30. Finally, the first strategy also fails to be a shared strategy when the two parties expect that both parties should follow the rule, or technically, when there is collective belief.

### 3. SHARED STRATEGIES IN MAS

The intuition of the formal definition of shared strategy is that each agent expects that under certain conditions, other agents will behave in a certain way. Based on this expectation, we assume that agents can take two approaches to use shared strategies in their planning, referred here as an *optimistic* and a *pessimistic* approach.

In order to discuss the difference between these two approaches, we take as example the shared strategy: drivers will break when there is an obstacle in the road. An optimistic pedestrian agent will assume that all drivers will break when she crosses the road, and therefore will plan to cross the road even if she sees a car approaching. On the other hand, a pessimistic pedestrian will assume that you cannot know which drivers will adhere to the shared strategy, since not all have to follow it, and therefore will plan to stop at the curb when she sees a car approaching.

From an institutional perspective there are two issues worth identifying. The relationships between shared strategies and institutional design and evolution, and the role of shared strategies in agent-based simulation.

Since shared strategies constitute a regularity of the aggregate behaviour, institutional conventions may be designed to promote or to control the consequences of that regularity. The approach is straightforward when the existence of a shared strategy is known in advance and it is likely that its execution affects institutional objectives. In this case, it is reasonable to include specific evaluation mechanisms to monitor the effects of the strategy, and use these to assess transaction costs that would in turn guide the adaptation of the institution to actual performance (see [3]). When the existence of a shared strategy is not known in advance, ordinary performance monitoring does not necessarily identify the behavioural regularity, even when performance indicators might signal a hidden cost. In such case, institutional reaction may be untimely and ineffectual. To contend with such eventuality, one may attempt to foresee undesirable outcomes and, at the risk of overregulation, legislate against them. The opacity of undesirable outcomes, however, may sometimes be appropriately addressed with conventional mechanism-design techniques or by a clever use of modelling and simulation methodologies.

In addition to their value for visualizing the effect of shared strategies on institutional performance. In this context, the modeler deals with the system as a regulated MAS, making a

shared strategy a feature of individual agents and harnessing individual actions through institutional conventions of different sorts. The use of shared strategies may be fruitful for some forms of agent-based simulation. One relevant form is to use shared strategies as a salient part of the agents' internal decision models. This way, the designer may study different aspects of normative, motivational and goal-directed attitudes (for example the interplay of norms and strategies in different agent architectures, norm internalization processes, norm emergence, norm compliance vs. conflict resolution approaches, value formation, achievement degrees). Another form of using shared strategies in agent-based simulation is to factor the analysis of aggregate behavior by designing populations partitioned by shared strategies, thus measuring cost and value of interactions within populations with pure and mixed strategies, rational or spontaneous triggering of the shared strategies, etc.

Finally, as Ostrom remarks, the ADICO structured is meant to be for the analysis of institutional evolution. i.e. one type of statement becoming another type (e.g. passing from shared strategy to norm, etc.)

### 4. CONCLUSION AND FUTURE WORK

In this paper we presented the concept shared strategy as an alternative concept to that of norm in MAS. Based on the work of Ostrom, namely the notion of ADICO institutional statement, we presented an integrated formalism to describe the semantics of norms and shared strategies, based on a temporal epistemic logic.

A shared strategy is a low priority statement leading to action among a group of agents. Since the expectation is *shared*, each agent believes that *most* other agents will perform the action but does not necessarily know who. Therefore, agents don't have expectations for a particular other agent to perform shared strategies because they cannot know whether that particular agent follows the strategy or not, even though as a group, most will. This yields that no deontic type and no sanction can be assigned to a shared strategy.

Shared strategies are a crucial part of agent societies as they result in global behaviors that may need to be taken into consideration by other agents who may be part of the system or merely global viewers. A shared strategy can change into norm and vice versa depending on the level of norm internalization and the context which facilitates the implementation of norm emergence and evolution.

For future work, we are further extending the formalization of shared strategy. We are also exploring how shared strategies can be implemented into BDI architecture.

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