Symbolic Environments of Agent Societies *

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Abstract. *This paper analyzes the concept of* symbolic environment *of agent societies and examines how the* symbolic systems *that constitute a symbolic environments represent the* cultural formations *(understood in a wide sense: morality, legality, art, science, politics, religion, ethnicity, etc.) of such societies. It also considers the general notion of* social actor *and illustrates, through a case study, how symbolic environments may support the* culture-driven *conducts of the social actors of agent societies.*

Resumo. *Este artigo analisa o conceito de* ambiente simbólico *de sociedades de agentes e examina como os* sistemas simbólicos *presentes em ambientes simbólicos representam formações culturais (entendidas em um sentido amplo: moralidade, legalidade, arte, ciência, política, religião, etc.) em tais sociedades. Considera, também, a noção geral de* ator social *e ilustra, através de um estudo de caso, como sistemas simbólicos podem suportar condutas dirigidas pela cultura em atores sociais de sociedades de agentes.*

1. Introduction

1.1. Computational and Cultural Symbolic Environments

The word "symbol" is ambiguous when applied in the context of the computational modeling of social systems.

On one hand, it has the special meaning that "symbol" has in Computer Science: a *physical mark* representing some concept or entity present either in a computational system or in the external world modeled by that the computational system. This meaning is derived from the meaning of "symbol" in Logics and Mathematics.

On the other hand, the word "symbol" has the general cultural sense of *anything* that has a meaning of any kind for someone. For instance: a *person*, taken as a symbol of some sportive game; a *tower*, taken as the symbol of a country or city; a *gesture*, taken as symbol of a political movement; a *god*, taken as a symbol of a civilization; etc.

When attempting to model computationally the social and cultural aspects of some social system, that ambiguity extends to the notion of *symbolic environment*: one comes to deal both with *symbolic environments* in the computational sense, and with *symbolic environments* in the cultural sense.

Of course, one can take computational symbols to be a particular kind of cultural symbols, as computer languages are taken as cultural objects.

In this paper, we introduce an approach to making use of *computational symbolic environments* to allow for the explicit embedding of *cultural symbolic environments* in agent societies, by taking computational symbols as *computational representations* of cultural symbols.

1.2. The Structure of the Paper

The paper is structured as follows.

In Sect. 2, we discuss a particular model of multiagent system that we call *agent society*. Also, we discuss a general concept of *social actor*, allowing for a uniform reference to social actions performed by agents, groups of agents, organizations, groups of organizations, etc., in the context of agent societies.

In Sect. 3, we introduce the formal concept of *symbolic environment of agent society*, to serve as the *computational* sense of the term "symbolic environment". *Symbolic systems* are introduced as the *main components* of symbolic environments of agent societies. Regarding the *cultural* sense of "symbolic environment", we discuss the way symbolic environments of agent societies may be used to reify the *cultural systems* and the *cultural symbolic environments* of agent societies[1].

In Sect. 5, we informally describe and analyze a hypothetical *social model* that makes use of symbolic environments to computationally represent the core cultural aspects of a particular historical moment of a society (colonial Brazil) where a *syncretic religious formation* was established, and became important for most of its population.

We conclude the paper, in Sect. 7, referring related works and some prospects for the use of *agent societies* and their *symbolic environments* in the effort to develop the notion of *agent culture*.

2. Agent Societies and Social Actors

In our work (see, e.g., [3]), we have been defining in the following way the concept of agent society:

> An *agent society* is a multiagent system that is:
> - *open*, meaning that agents can enter and leave the system freely;
> - *organized*, meaning that the working of the society is constituted essentially by *collective processes* (i.e., processes realized on a collective basis, by *groups of agents*, possibly structured in a hierarchy of nested groups), so that one can determine, in principle, the part that any *individual process* (i.e., process realized on an individual basis, by a single agent) has in any of those collective processes;
> - *persistent*, meaning that the system of collective processes that support the organization of the society persists in time, independently

[1]Notice that, regarding implementation issues, the concept of *symbolic environment of agent society* can lead to the concept of *cultural artifact*, an extension to all the cultural aspects of agent societies, of the concepts of *organizational* [1] *legal artifact* [2].

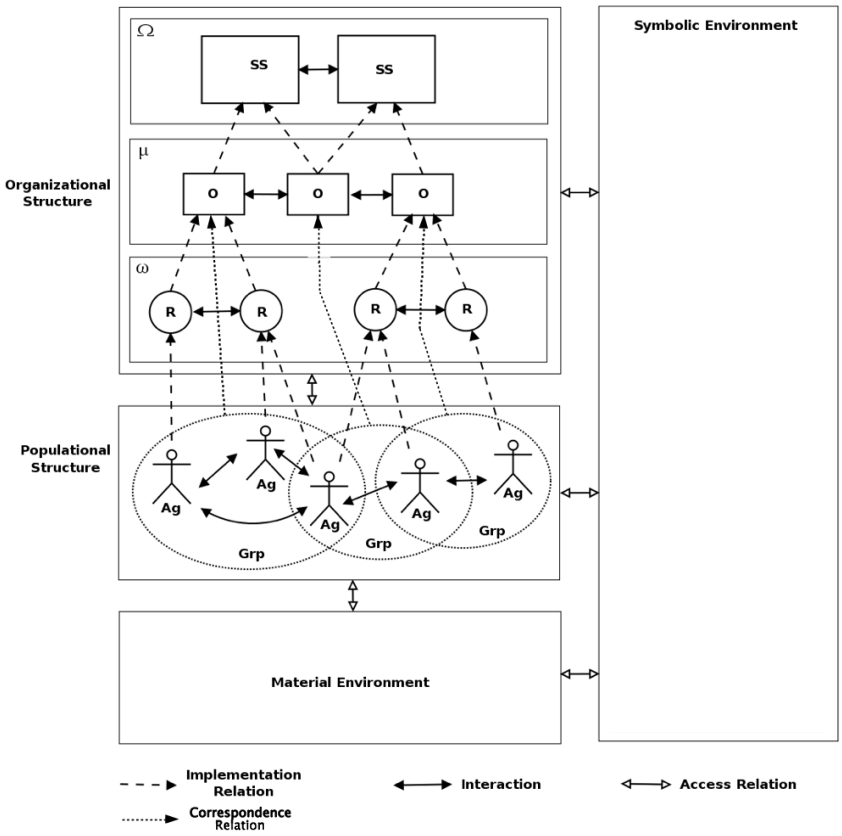

Figure 1. Architectural Overview of the Agent Societies

of which agent enters or leaves the society (up to a certain minimal size of the *population* of the society);

- *situated*, meaning that the agents operate in material and symbolic environments, possibly involving material and/or symbolic objects of those environments in their (individual or collective) processes.

Figure 1 gives a schematic, partial view of the architecture of an agent society (see [3, 4], for more details):

- the figure gives no detail of the *material environment*;
- the *populationl structure* is constituted by the agents of the society;
- the *individual* and the *collective* processes are assumed to be articulated in an *organizational structure*, structured in three levels of organization:
  - the *micro-organizational level* (ω), encompassing all the individual and collective processes that agents realize when implementing the *social roles* (R) existent in the society;
  - the *meso-organizational level* (μ), encompassing all the individual and collective processes that groups of agents realize when implementing the *organizations* (O) (i.e., associations, institutions, corporations, etc.) existent in the society;

  - the *macro-organizational level* (Ω), encompassing all the individual and collective processes that groups of agents realize when implementing the *social sub-systems* (SS) (i.e., the *inter-organizational* systems) existent in the society.
- we call *social actor* any agent, social role, organization, social sub-system (or groups thereof) which is capable of both driving an individual process of its own, and participating in collective processes involving other social actors;
- of the *social actors*, the figure illustrates individual agents (Ag) and the *groups of agents* (Grp);
- the *symbolic environment* is constituted by the set of *symbolic systems* produced by the social actors of the society, each symbolic system concerning a specific *cultural domain* (moral, legal, political, scientific, religious, etc.) of the society, and by a set of *environment management operations*, such that:
  - each *symbolic system* is constituted by a set of *symbolic formations*, and by a set of *formation operations*;
  - each *symbolic formation* is constituted by a set of *symbolic frameworks*, each symbolic framework encompassing an articulated set of *symbolic items*, and by a set of *framework operations*;
  - the *formation operations* and the *framework operations* are used by the social actors to transform symbolic formations and frameworks, respectively;
  - the *environment management operations* are used by the social actors to create and delete symbolic systems, formations, and frameworks, as well as for other purposes, as explained in Sect. 3;

We say that a conduct of a social actor is a *symbolic conduct* whenever it involves an operation that refers to any of the components of the symbolic environment $SEnv^t$.

Formally, we state:

Definition 1 *An agent society is a time-indexed structure*

$$AgSoc^t = (Pop^t, Org^t, MEnv^t, SEnv^t)$$

where, at each time $t \in T$*:*

- Pop^t *is the current* populational structure*;*
- Org^t *is the current* organizational structure*;*
- $MEnv^t$ *is the current* material environment*;*
- $SEnv^t$ *is the current* symbolic environment*;*

For the sake of space, we leave undefined the details of much of such structure (see [3, 4]). What interests us, here, is the symbolic environment $SEnv^t$ and the symbolic systems that compose it, which we formally detail in the next section.

3. Symbolic Environments of Agent Societies

The concept of *physical symbol system* was introduced by Allen Newel and Hebert Simon, in [5], to capture in an abstract way the idea of the necessary physical substrate of symbol-based systems endowed with the property of "general intelligence" (in other words, the

necessary physical substrate of minds that can perform general problem-solving processes, see also [6]).

Later, to functionally account for the logical and epistemological relations between the contents represented in the physical symbols systems and the constraints involved in rational problem-solving processes, Newell construed, in [7], a higher conceptual level, the so-called *knowledge level*.

The notion of *symbolic environment of agent society*, which we are detailing in this section, should be taken as an extension to the notion of physical symbol system. It is conceived as the architectural component of agent societies that can give, to articulated groups of social actors (so, even to the society as a whole) the possibility of *collective rational intervention* in the solving of the problems that may be affecting them.

The *cultural level* [8] of the society can then be understood to correspond to the "knowledge level" of the society, realized for a collective purpose through the society's *symbolic environment* (see [9], for instance, for the idea of the rooting of the culture of a society in its collective symbolization of its collective knowledge).

The formal concept of a symbolic environment that is *operant* in an agent society assumes that:

- its *symbolic systems* are endowed with a *physical substrate*;
- its *symbols* are physical patterns that can occur on the physical substrates of the symbolic systems; their universe is denoted by $\mathbf{Symb}$;
- the structures of *symbolic formations*, *symbolic frameworks* and *symbolic items*, which are kept formally undefined here are denoted by $\mathbf{SForm}$, $\mathbf{SFrmwk}$ and $\mathbf{SItem}$, respectively, with[2]:
  - $\mathbf{SForm} \in \wp(\mathbf{Frmwk})$;
  - $\mathbf{SFrmwk} \in \wp(\mathbf{SItem})$;
  - $\mathbf{SItem} \in \wp(\mathbf{Symb})$;
- $\mathbf{Env}$ denotes the universe of possible *environments* (material or symbolic);
- $\mathbf{Symb}$ is assumed to have enough symbols to *refer to all the material objects* that may occur in the material environments; that is, if $\mathrm{MObj}[\mathbf{Env}]$ denotes the set of all the *material objects* that may occur in the material environments existent in $\mathbf{Env}$, then it holds that $\mathrm{MObj}[\mathbf{Env}] \in \wp(\mathbf{Obj})$;
- $T = 0, 1, 2, \ldots$ denotes the *time structure*, linearly ordered.

With such assumptions, we let (see Fig. 1, cf. [5]):

Definition 2 *A* symbolic environment *is a time-indexed structure:*

$$SEnv^t = (Symb^t, SSys^t, FormOp^t, FrmwkOp^t, dsgnt^t, EnvMngOp)$$

where, for each $t \in T$*:*

- $Symb^t \in \wp(\mathbf{Symb})$ *is the current set of symbols present in the symbolic environment;*
- $SSys^t = (SForm^t, SFrmwk^t, SItem^t)$ *is the current set of* symbolic systems*, where:*

[2] $\wp(X)$ is the powerset of the set X.

  - $SForm^t \in \wp(SFrmwk^t)$ *is the current set of* symbolic formations*;*
  - $SFrmwk^t \in \wp(SItem^t)$ *is the current set of* symbolic frameworks*;*
  - $SItem^t \in \wp(Symb^t)$ *is the current set of* symbolic items*;*
- $FormOp^t \subseteq (SForm^t)^n$ *(for* $n = 0, 1, 2, \ldots$*) is the set of* formation operations *that can be realized in* $CSSys^t$*, so that if* $op = (s_1, s_2, \ldots, s_n) \in FormOp^t$ *we say that* s_n *is the symbolic formation that results from the realization of the formation operation* op *on the tuple of symbolic formations* $(s_1, s_2, \ldots, s_{n-1})$*, at the time* t *(and so that if* $n = 0$ *then* op *is a constant value:* $op = s_0$*);*
- $FrmwkOp^t \subseteq (SFrmwk^t)^n$ *(for* $n = 0, 1, 2, \ldots$*) is the set of* framework operations *that can be realized in* $SEnv^t$*, so that if* $op = (s_1, s_2, \ldots, s_n) \in FrmwkOp^t$ *we say that* s_n *is the symbolic framework that results from the realization of the framework operation* op *on the tuple of symbolic frameworks* $(s_1, s_2, \ldots, s_{n-1})$*, at the time* t *(and so that if* $n = 0$ *then* op *is a constant value:* $op = s_0$*);*
- $dsgnt^t \subseteq \mathbf{Symb} \times SComp^t$*, where* $SComp^t$ *is the set of symbolic components of the symbolic environment* $SEnv^t$*:*

  $SComp^t = SSys^t \cup \{SForm^t \mid SForm^t$ *belongs to some* $S \in SSys^t\}$
  $\cup \{SFrmwk^t \mid SFwm^t$ *belongs to some* $SForm^t$ *of* $SSys^t\}$
  $\cup \{SItem^t \mid SItem^t$ *belongs to some* $SFrmwk^t$ *of* $SFrmwk^t\}$

  is the current designation relation*, such that if* $(s, C) \in dsgnt^t$*, we say that the symbol* s *designates, at the time* t*, the symbolic component* C*;*
- $EnvMngOp$ *is the fixed set of* management operations *that can be performed on the set of symbolic systems* $Symb^t$ *(such as the* creation *and* deletion *of symbolic systems).*

4. The Ideological Framewoks of Agent Societies

Ideological framework is the term we have used in [10] to refer to the set of *social views*, *values*, *norms*, and *behavioral patterns* that social actors use, in an agent society, to guide the behaviors, decisions and social assessments they perform in that society.

To formally present ideological frameworks, we have specified in [11] the elements of TinyIML, a toy language for the formal modeling of the *ideological aspects* of agent societies.

In this section, we show how *ideological frameworks* specified in TinyIML can be embedded in the *symbolic environments* of such societies.

4.1. The Ideology Modeling Language TinyIML

The toy language TinyIML was introduced in [10, 11] to illustrate a way to represent the ideological aspects of societies that are computationally modeled in terms of agent societies.

The following are the main components of a TinyIML ideological model:

- *ideological envisagement*: a particular way to view, in an ideological way, a particular aspect of an agent society (e.g., a *segmenting envisagement* determines a particular ideological way of segmenting the population of the society into a set of *groups* or *classes*);
- *ideological framework*: an articulated combination of ideological envisagements, capable of providing a behavioral orientation, regarding social issues, to the social actors that adopt it;

- *ideological system*: the set of all ideological frameworks present in a given agent society;
- *ideology*: the set of ideological envisagements common to all the ideological frameworks adopted by a social actor, characterizing the general orientation of the typical social behaviors of that social actor.

The concrete syntax of TinyIML was informally presented in [11]. It is also informally presented and used in this paper (in section 5).

4.2. Embedding Ideological Frameworks in the Symbolic Environments of Agent Societies

The following establishes the correspondence between the *ideological aspects* of an agent society and the *components* of its symbolic environment:

- *symbolic items* are used to represent *ideological envisagements*;
- *symbolic frameworks* are used to represent *ideological frameworks*;
- *symbolic formations* are used to represent *ideologies*;
- *symbolic systems* are used to represent *ideological systems*;
- the whole *cultural level* of the agent society is represented by the whole *symbolic environment*.

5. Case Study: A Symbolic Environment Embedding an Elementary Ideological System in an Agent Society

The case study in this section concerns the issue of the *religious syncretism* that happened between Catholicism and African Cults, among the Afro-Brazilian slaves in Colonial Brazil (see slides presented in [12]).

The case study intends to present, in a more concrete way, the abstract concept of *symbolic environment* of agent societies that was introduced above.

5.1. The Social-Economic Context of Slavery in Colonial Brazil

Slavery (as a relation of production) was first established in Brazil early in the 16th century, against the indigenous peoples. Slavery of the Africans, supported by intense Portuguese and British slave traffic across the Atlantic ocean, began in the 17th century. The slavery of indigenous people was officially abolished in the 18th century. Slavery of Africans and Afro-Brazilians rested legal until the end of the 19th century.

The main type of social-economic organization that made use of slave labor, in Colonial Brazil, was sugar cane plantations [13]. Each plantation, in general, formed a mostly closed small "society", due to the usual geographical distance that they kept from each other and from the villages and cities with which they negotiate [14], and which served as brokers for the commerce with Lisbon, the royal metropolis.

There are many aspects of the daily life of such *plantation societies* that one could choose to formally model. As Gilberto Freyre has shown, in his classical study of the societies of the Brazilian colonial plantations [15], strong issues such as identity, genre, and moral sexuality, were present in the daily interaction between white masters and black slaves, in those plantation societies. And the ways those issues were handled by the slaves,

at the time, became historically important because they forged a *black culture* that, later, infused the culture of most of the Brazilian society.

As indicated by the title of this case study, we have chosen to look, here, at the *religious syncretism* that the slaves developed there, integrating Catholicism and their own African cults. The main question we shall face in this case study is this:

> *If we model sugar cane plantation societies as agent societies, what sort of information can be represented about the possible religious beliefs and attitudes of the social actors of the plantation societies in the symbolic environments of those agent societies?*

5.2. The Religious Syncretism of the Afro-Brazilian Slaves

Africans and Afro-Brazilians that were submitted to slavery, developed a whole repertoire of expedients in attempting to make their original cultures survive slavery. Among them (one that eventually developed a particularly strong impact on the overall culture of the country) was the *religious syncretism* between the Catholicism of their masters, and their own original African Cults.

The general central feature of such syncretism was the identification of each of the deities of the African cults (called *orishas*, in the widely spread *Candomblé* cult) with a saint of the Catholic Church. The most important reason, commonly reported [16, 17], for that identification was that it allowed the slaves to formally disguise the workship of the African deities under the appearance of a workship of Catholic saints.

In the following, we make use of the structure of the *symbolic environment of agent society*, introduced in Sect. 3, to model the basic ideas forming that religious syncretism. This should allow for both a concrete view of what we mean by a *symbolic framework*, a *symbolic formation*, and a *symbolic system*, and the *ideological system* of an agent society.

5.3. Outline of the Formal Model of the Religious Formation of Typical Planation Societies of Colonial Brazil

In this section, we assume as the object of the case study the *religious formation* of typical plantations of Colonial Brazil. Figure 2 illustrates the overall plan of the typical plantations, with: the master's house (M), the senzala (S), the slaves overseer's house (O), the road to the plantation area (P), the road to the village (V), the backyard of the senzala (B).

Figure 3 shows the result of the formal modeling, making use the TinyIML notation [11], of the *religious formation* of that plantation. Two *ideological frameworks*, already mentioned in Sect. 5.2, constitute together the religious formation: the religious framework of the typical *slaves* (denoted by `RFrm_Slaves`) and the religious framework of the typical *masters* (denoted by `RFrm_Masters`). We have not modeled, however, the religious framework of the typical *slave overseers* (`SOverseers`) of the plantations.

A few general comments are in order about Fig. 3. About TinyIML in general:

- the following denote *set operations and relations*:
  - "=<" denotes the relation of *set inclusion*;
  - "^" denotes the operation of *set intersection*;
  - "{}" denotes the *empty set*;
- the following are types of ideological envisagements:

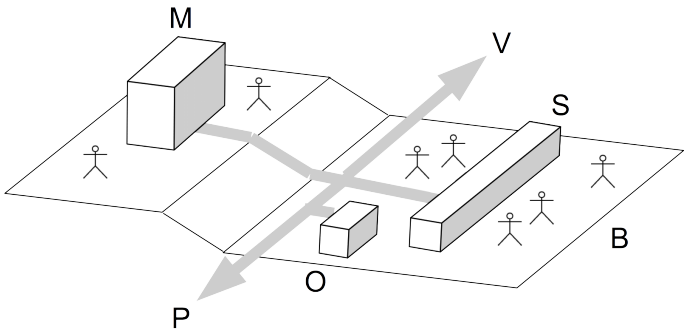

Figure 2. Basic plan of a typical Brazilian sugar cane plantation, with the master's house (M) overseeing the whole area.

  - "`SegmEnvis`": segmentation envisagements;
  - "`NormEnvis`": normative envisagements;
  - "`ValuatEnvis`": valuation envisagements;
- the following are specific notations:
  - "`TypeCndts`": the keyword for a list of *types of conducts*;
  - "`<`": the order relation *less than*;
  - "`<<`": the order relation *much less than*;
  - "`<_C`": the comparison relation regarding the competence "`C`";

About the religious model itself:

- `ACFollowers` are the followers of African cults, `SocActors` are the social actors of the plantation society;
- `Masters` and `Slaves` coincide in the way they segment the set of social actors, including the way `Masters` and `Slaves` relate to `Catholics` and `ACFollowers`;
- but masters and slaves diverge about the possibility of entities that are both `Saints` and `Orishas`;
- in consequence, they diverge about the possibility of someone being both a `Catholic` and an `ACFollower`;
- `Slaves` consider `Overseers` as `Masters`, while `Masters` themselves do not;
- for `Slaves`, who work, *religious practices* are more important than *work*;
- for `Masters`, who don't work, *work* is more important than *religious practices*;
- `Slaves` are much more liberal than `Masters`, regarding *norms* that determine admissible *religious practices*;
- while `Slaves` see themselves as more competent than `Masters` in religious matters (i.e., being more faithful), regarding both Catholicism and African cults, `Masters` see themselves as better `Catholics` than `Slaves`, while acknowledging that `Slaves` are better `ACFollowers` than themselves;
- the *religious frameworks* of each type of social actor, `RF_Slaves` and `RF_Masters`, simply aggregate their respective *religious envisagements*;
- the *religious formation* of the plantation society is modeled by the set of those two *religious frameworks*.

Notice that we have considered here that *religious frameworks* are composed of four *religious envisagements*:

```
%----------
SegmEnvis SE_Slaves:
   Slaves, Masters, SOverseers, Saints,
         Orishas, Catholics, ACFollowers
                              =< SocActors
      Slaves =< ACFollowers
      Masters =< Catholics
      SOverseers =< Masters
      Saints = Orishas
      Catholics ^ ACFollowers = {}
SegmEnvis SE_Masters:
   Slaves, Masters, SOverseers, Saints,
         Orishas, Catholics, ACFollowers
                              =< SocActors
      Slaves =< ACFollowers
      Masters =< Catholics
      Saints ^ Orishas = {}
      Catholics ^ ACFollowers = {}
%----------
NormEnvis NE_Slaves:
   TypeCndts: Pray-for(_), Dance-for(_)
      permit(ACFollowers,Pray-for(Orishas))
      permit(ACFollowers,Dance-for(Orishas))
      permit(ACFollowers,Pray-for(Saints))
      permit(ACFollowers,Dance-for(Saints))
%----------
NormEnvis NE_Masters:
   TypeCndts: Pray-for(_), Dance-for(_)
      permit(Catholics,Pray-for(Saints))
      prohib(Catholics,Pray-for(Orishas))
      prohib(Catholics,Dance-for(Saints))
      prohib(Catholics,Dance-for(Orishas))
%----------
ValuatEnvis VE_Slaves:
   TypeCndts: Pray-for, Dance-for, Work
      Work < Pray-for
      Work < Dance-for
ValuatEnvis VE_Masters:
   TypeCndts: Pray-for, Dance-for, Work
      Pray-for << Work
      Dance-for << Work
%----------
QualifEnvis QE_Slaves:
   QualifRel: <_Work
      Masters <_Work Slaves
   QualifRel: <_Pray-for(_)
      Masters <_Pray-for(Orishas) Slaves
      Masters <_Pray-for(Saints) Slaves
   QualifRel: <_Dance-for(_)
      Masters <_Dance-for(Orishas) Slaves
      Masters <_Dance-for(Saints) Slaves
QualifEnvis QE_Masters:
   QualifRel: <_Work
      Masters <_Work Slaves
   QualifRel: <_Pray-for(_)
      Slaves <_Pray-for(Saints) Masters
      Masters <_Pray-for(Orishas) Slaves
   QualifRel: <_Dance-for(_)
      Masters <_Dance-for(Orishas) Slaves
%----------
IdeoFrm RFrm_Slaves:
   SegmEnvis: SE_Slaves
   NormEnvis: NE_Slaves
   ValuatEnvis: VE_Slaves
   QualifEnvis: QE_Slaves
IdeoFrm RFrm_Masters:
   SegmEnvis: SE_Masters
   NormEnivs: NE_Masters
   ValuatEnvis: VE_Masters
   QualifEnvis: QE_Masters
%----------
IdeoSys Plantation:
   IdeoFrm RFrm_Slaves
   IdeoFrm RFrm_Masters
```

Figure 3. Some of the religious frameworks of the social game about colonial Brazil.

- a *religious segmenting envisagement*, which determines a *religious segmentation* of the social actors of the agent society in question;
- a *religious normative envisagement*, which determines *religious norms of conducts* for the religious segments determined by the religious segmenting envisagement;
- a *religious valuating envisagement*, which determines *religious valuation relations* among the possible conducts of the religious segments, establishing a valuating hierarchy among them;
- a *religious qualifying envisagement*, which determines, for the religious segments, their relative qualification (or competence) to perform the various conducts valuated by the given valuating envisagement.

In [11], the religious aspects of the social situation represented in the theatrical play *O Pagador de Promessas* (*The Keeper of Promises*) were analyzed in terms that are similar to the ones just mentioned, identifying analogous *religious frameworks* and *religious formation* in that situation.

5.4. An Aside: Running the Model in a Hypothetical Simulation Game

Imagine that you, together with several other users, have access to a *cooperative simulation system* concerned with the daily life of a Brazilian colonial sugar cane plantation.

Let the game put the group of users in a participatorily simulated sugar cane plantation, where they can be avatared by some simulated *people* (the population of the plantation) and make use of some *things* (like houses, slave shelters (*senzalas*), animals, farmstead, work tools, etc.). Let the *population* of the sugar cane plantation be composed of the (white) *owner* of the plantation and his family, the *free employees* (including the *slaves overseer*) and their families, and the (black) *slaves* and their families (also slaves).

Consider now that you are playing the game in the role of a *slaves overseer*, and that the *owner* of the simulated plantation is (apparently) a religious man, a faithful catholic, that has commanded you both to impose the Catholic faith and rituals on the *slaves*, and to preclude, using any available means, the realization of non-catholic religious rituals from their part.

Assume that, late in a certain night, you find that all slaves secretly gathered in the backyard of the *senzala*. You go there and you find them dancing in front of the image of a Catholic saint.

You interrogate some of them and you get as their unanimous response that they are worshiping that Catholic saint. You know that the slave owner's religious framework does not acknowledge dancing as a way to worship Catholic saints. But the statue in front of you is the statue of a saint.

The question, then, is: Do you decide to accept the response you got (even knowing that the slaves identified Catholic saints and orishas) and don't punish the slaves, thus effectively taking their side in their religious dispute with the slave owner, or do you stick to the side of the slave owner and punish the slaves for participating in the dancing ritual, with which they were clearly (from the point of view of their owner's religious framework) worshiping an orisha?

Naturally, it is not important, for the case study, which decision you take, in the given situation. The important thing is that the hypothetical simulation software, making use of the *symbolic environment* to model the *cultural level* of the plantation society, is able to store, process, and provide to you, if requested, detailed information about the religious formation of that society, about the religious beliefs and conducts of each of its social actors and, eventually, the possible reactions of the master and of the slaves to the decisions you make an to the actions you perform.

6. Related Work

Classical papers on the modeling and simulation of ideologies are, for instance, Carbonell [18] and Schank and Carbonell [19], which reduce ideologies and ideological frameworks to the individual social actors' systems of goals. More recently, Ophir[20] presented an alternative modeling, where ideologies are immediately tied to the social actors' interactive behaviors.

Ana Paiva and collaborators [21, 22] introduced a *cultural model*, based on a set of *cultural dimensions*, to culturally assess the effects of cultures on organizations and nations, but the set of such ordinally defined cultural dimensions is, as in [20], effectively used to assess the behaviors of individual social actors.

None of those works consider ideologies as socially constructed collective symbolic constructs, which can be variously interpreted by different social actors.

7. Conclusion

Clearly, *ideological systems* can be seen to inhabit both the *minds* of the social actors and the *symbolic environments* of agent societies. In this paper, we have focused on such symbolic environments and how ideological systems can be embedded in them.

We first introduced the notion of *symbolic environment* as a computational means for representing the *cultural level* of agent societies [8] (see also [10] and [11]). Then, we examined a case study that exemplified the use of the symbolic environment of a typical plantation society to computationally support the religious system of that society.

Notice that, since social actors are often not demanded to be *objective* and *rational* (in the epistemological meaning of these words), but only to be *sensible*, the applicability of the concepts of *cultural level* of agent societies (and its realization in *symbolic environments*) seems to depend on the determination of fruitful ways to computationally realize the forms of reasonings (e.g., the *artistic* or the *religious* reasonings) that are employed in areas of culture where objectivity and rationality are not the *sole* (possibly, not even the *primary*) characteristics of the reasoning of social actors.

Finally, we remark that the classical sociological study of the Brazilian colonial sugar cane plantation is Gilberto Freyre's *Casa Grande & Senzala* [15], first published in 1933. For more recent reviews of religious syncretism see, e.g., [16, 17, 23], which also consider other cases of religious syncretism in Brazil.

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