

MODELING SITUATED ABSTRACTION: ACTION COALESCENCE VIA MULTIDIMENSIONAL COHERENCE

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ABSTRACT

Situated social agents weigh dozens of priorities, each with its own complexities. Domains of interest are intertwined, and progress in one area either complements or conflicts with other priorities. Interpretive agents address these complexities through: (1) integrating cognitive complexities through the use of radial concepts, (2) recognizing the role of emotion in prioritizing alternatives and urgencies, (3) using Miller-range constraints to avoid oversimplified notions omniscience, and (4) constraining actions to ‘moves’ in multiple prototype games.

Situated agent orientations are dynamically grounded in pragmatic considerations as well as intertwined with internal and external priorities. HokiPoki is a situated abstraction designed to shape and focus strategic agent orientations. The design integrates four pragmatic pairs: (1) problem and solution, (2) dependence and power, (3) constraint and affordance, and (4) (agent) intent and effect. In this way, agents are empowered to address multiple facets of a situation in an exploratory, or even arbitrary, order. HokiPoki is open to the internal orientation of the agent as it evolves, but also to the communications and actions of other agents.

Keywords: Situated agents, pragmatic hermeneutics, ontology

INTRODUCTION

When domains lend themselves to formal representation, the clarity and inferential power that becomes available is rewarding, even seductive. Unfortunately, the social domain manifests complexities that conventional formalism has been unable to capture successfully. Both natural language and situated action are heavily dependent upon context and based upon interactive interpretation by multiple participants. This may pose the greatest challenge confronting the development of effective (as opposed to suggestive or reconstructive) social models.

In part, the problem could be viewed as an issue of semantics, except that it concerns not only communication but action as well. Thus, the domain is one of semiosis (Hoffmeyer 1993), broadly conceived. That said, the issues that confront social action are very similar to those recognized as semantic. Some of the key issues are summarized in Table 1.

TABLE 1 Semiotic complexities

Issue	Description
Ambiguity (Empson 1966 [1930])	Words and actions have a range of meanings and implications, and their sense may differ from person to person, setting to setting, and time to time.
Vocality	Multiple actors bring multiple interpretations, intentions, and actions to a setting.
Fluidity	Comprehending and responding coherently to a multivocal state means that both situation and actor orientation are in dynamic flux.
Emergence	In discourse, whether interpersonal or collective, meanings and purposes evolve over time. Terms of the discourse are not fixed and, therefore, not definitive.
Thin coherence (Sewell 2005)	Complex and dynamic processes require that, while coherence is necessary for effective communication and action, it is a situated, provisional achievement that must be maintained.

The major premise of the present paper is that, in interpretive settings, formalization and abstraction may not succeed if they are overly general. On the contrary, in order for them to play the same clarifying roles that they do in natural domains, it may be necessary to identify abstractions that are strongly and inherently situated; their application may vary from case to case. They need to take forms that can be applied ‘from the inside out.’ That is, the situatedness of such abstractions can be utilized to refine and apply the insights that they carry. The paper discusses situated abstractions and then introduces a new structure that may be useful in social modeling.

ABSTRACTION

The efficacy of abstractions depends on their ability to be mapped to domains of interest in a regular way.¹ However, if a social domain is erratically dynamic, volatile, and/or self-organizing, it is difficult to identify a formalism that can exogenously represent its emergent patterns. Indeed, such a domain may require the use of *endogenous* abstractions, abstractions that evolve via the interaction of multiple self-organizing processes.

This insight is not new in sociology. Weber (1978) articulated formal organization (bureaucracy) as an ideal type that can be conceptualized but does not exist empirically. Subsequent generations of researchers found that the formalities of organization are immersed in a milieu of informal interactions that shape the results of organizational processes. Stinchcombe (2001) documents the role of interleaved informality in a wide range of domains, including: (1) construction blueprints, (2) civil law and procedures, (3) the commodification and liquidification of residential mortgage pools, (4) the

¹ This is not, of course, to deny that abstractions hold inherent interest, or that domains that are steeped in abstraction, such as mathematics, do not discover abstractions, the utility of which are not obvious and may not be known for some time.

classification of aliens at border crossings, and (5) the stratification of scientific knowledge.

In each domain, the informal and unscripted interaction determines how and in what ways the relevant formalism is to be applied. Rules can be defined formally, but decisions must still be made about when and under what circumstances it is appropriate to apply them.

FRAMING INDEXICALITY

The Interpretive Agent initiative addresses such complexities in multiple ways (Sallach 2003), including through: (1) integrating cognitive complexities through the use of radial concepts, (2) recognizing the role of emotion in prioritizing alternatives and registering urgencies, (3) incorporating Miller-range constraints in order to avoid oversimplified notions of agent omniscience, and (4) constraining actions to ‘moves’ in one of several prototype games.

Each of these mechanisms can be regarded as a facet of bounded rationality. However, it is also necessary to define how situated agent orientations are framed and refined such that they are dynamically grounded in pragmatic considerations and, at the same time, linked to internal and external priorities.

PRAGMATIC DECISIONS

Humans can be conceived of as boundedly rational agents acting within a complex world. While many models of cognition, intelligence, and/or action selection focus on a single task, situated social agents weigh dozens of priorities, each of which has its own complexities, urgencies, and timetable, with the latter sometimes being recurrent or recursive. Further, actors frequently find that the domains of interest are (or can be) intertwined, and that progress in one area either complements objectives from another area or, alternatively, conflicts with other priorities.

From within the web of complexities, decisions must necessarily be made on a pragmatic basis. This insight is not a new one. Graham (1989; see also Sallach 2007) indicates that ancient Chinese ethical thought follows an ethical form that approximates to [a] syllogism, applicable directly to concrete situations.

In awareness from all viewpoints, spatial, temporal, [social], and personal, of everything relevant to the issue, I find myself moved toward X; overlooking something relevant, I find myself moved toward Y.

In which direction shall I let myself be moved?

Be aware of everything relevant to the issue.

Therefore, let yourself be moved toward X.

The quasi-syllogism is suggestive, but how might the web of complexities be modeled? Historically, pragmatist philosophy has derived its orientation amidst situated complexities (Joas 1993; Mead 1934; Peirce 1992 [1898]). One of major considerations is the *context* that frames the relevant communication and/or action. In his overview of semiotic relations, Peirce (1955 [1897]) describes context as follows:

A sign, or *representamen*, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more developed sign. That sign which it creates I call the *interpretant* of the first sign. The sign stands for something, its *object*. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the *ground* of the representamen, ...

In this formulation, the ground defines the context of a semiotic process. Peirce continues (1955), stating that the task of the ground is “to ascertain what must be true of representamen... in order that they may embody any meaning.” Drawing upon Wittgenstein (1958), Sheriff (1989) describes the ground as the ‘language game’ that the actor is playing.

Peirce and Wittgenstein have each made important contributions to the ‘linguistic turn’ of the twentieth century, and these have been brought into sharper focus by lines of research they have inspired. In a formulation that draws upon both of their contributions, and also follows the lead of Silverstein (2003), Blommaert (2005) introduces the concept of “orders of indexicality.” This concept combines the idea that linguistic concepts and signs are ordered and that they occur in stratified complexes. The model construction of situated abstractions assumes a context defined by *orders of indexicality*.

Peirce’s other semiotic elements (representamen, object, and interpretant) have also been deepened by subsequent work. In particular, the hermeneutic tradition (Gadamer 1989; Palmer 1969), which emphasizes the reciprocal dependency between the whole and the part has provided a new approach to the interpretive process. Shalin (2007) has developed an embodied semiotics that incorporates symbolic discursive, somatic-affective, and behavioral-component components, each with a particular relationship between signs and their objects. The resulting rich hermeneutic process has the potential to provide an effective focus for computational models of interpretation.

Now consider a social actor immersed in a wide range of relationships, opportunities, persistent and situated purposes, etc. Suppose that these salient social objects are represented using a Miller range of situated games (Sallach 2006b). Each game provides a means of expressing problems and possible solutions, sources of power and dependence, constraints and affordances, and possible actions and likely consequences. Since these pairs (which may not be exhaustive) (1) are intrinsically complex, (2) must be mapped by the actor to the relevant domain and the situated particulars of that domain, and (3) have the potential to dynamically change each other’s state, there is clearly a need for an endogenous coherence-seeking process so that such

games can be played with greater or lesser effectiveness. Designing a formalism to support such dynamics is a challenge, and it is to this task that we now turn.

HOKIPOKI

HokiPoki is a self-organizing model of situated abstraction designed to shape and focus agent orientations. The design integrates four pragmatic pairs: (1) problem and solution, (2) dependence and power, (3) constraint and affordance, and (4) intent and effect (agent action, as coalesced, lies between intent and effect) (see Figure 1). For each couplet, the first pair member tends to indicate current effect, while the second can often be seen in terms of prospective effects. As in the homophonous children's song, each of the four pairs can independently flip in and out of agent focus. In this way, the agent is empowered to address multiple facets of a situation in an exploratory, or even arbitrary, order.

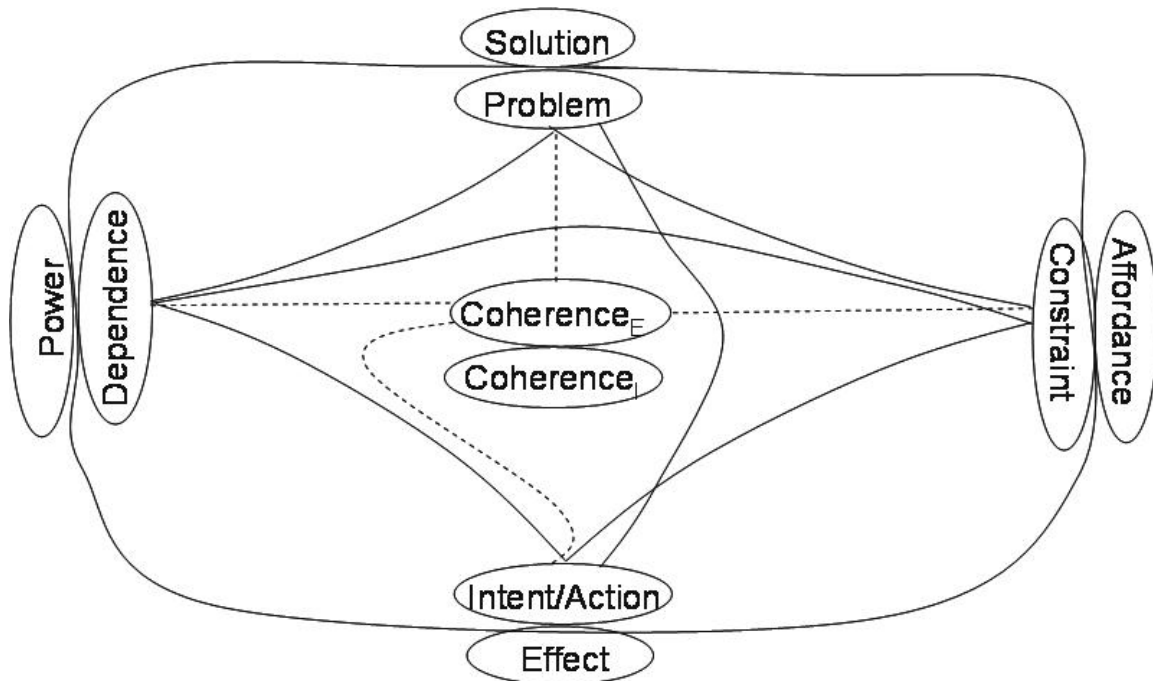


FIGURE 1 HokiPoki as a model of situated abstraction

Parenthetically, the designated pairs should not be viewed as definitive or exhaustive. On the contrary, the basic HokiPoki mechanism is designed to support exploration of diverse situated constructs, components that may be substituted exogenously by the designer or endogenously by agents within the model.

Notwithstanding the flexibility and expressiveness of the HokiPoki mechanism, a question remains as to how the multiple foci and priorities are to be integrated. The HokiPoki framework is guided by a dual internal/external coherence-calculation service

that operates on lower-level ‘parts’ (cf., Sallach 2002; 2006a). The accomplishment of both internal and external coherence allows a Miller range of priorities to be addressed by toggling multiple current/prospective pragmatic pairs.

In application, each pragmatic pair will be defined relative to a particular problem domain. Each paired term is treated as a prototype concept (Sallach 2003) and grounded in a particular pragmatic domain. In interaction, agents are able to suggest (propose, etc.) alternate priorities, emotional valences, and/or conceptual structuring. The implication is that HokiPoki is open to the internal orientation of the agent as it evolves but also to the communications and actions of other agents. The agents engaged in such interaction are themselves represented within the orientation of each focal agent and, thus, their inputs will be integrated accordingly.

Implementations of the HokiPoki mechanism seem likely to benefit from the emergence of dynamic object-oriented programming languages such as Ruby and/or Groovy. Implementation considerations will be considered in greater depth during the presentation of this paper.

ARCHITECTURE AND MODELING ASSUMPTIONS

The HokiPoki architecture has two defining principles: (1) heterarchical, pragmatically focused self-organization and (2) openness to both internal and external interactions. The purpose of its framework is to allow these principles to be implemented in a flexible, responsive, and dynamic way.

The application of the HokiPoki model to a particular domain requires the structured coupling of components. Each of the pairs in the HokiPoki model is integral, where each component (problem and solution, power and dependencies, constraint and affordance, and intent/action and effect, respectively) is defined relative to its reciprocal. For most domains, pairs are likely to require stochastic components.

In addition, there are domain-specific relations between pairs. An affordance, if and when it appears, for example, may be part of a problem or a solution and will be situated and need to be specified. Depending on the domain, more detailed structural and/or data characterization may be necessary as well.

The integration of variegated dimensionality within a model has been described previously (Sallach 2007) and so will not be described here. Pair-wise operations and sequencing, however, will be described. On each turn, a pair examines both modes and determines which of the two will contribute to the greatest increase of coherence, a step which is then executed. Coherence-calculation is a service invoked by the activated pair. Exogenous changes may have modified overall coherence since the previous pair focus.

The progression from one pair to another may employ different rules, ranging from sequential to random order, to make-it/take-it, depending on the domain. Since HokiPoki has a problem-driven architecture, when the necessary solution(s) have been

achieved (or the specified number of iterations have been completed), the process terminates.

DISCUSSION

The development of the HokiPoki model is an attempt to align social and computational realities in a different way. Social actors are immersed in complexities that bear directly or indirectly upon our condition. We must coherently organize communications and actions that improve, maintain, or (if nothing else) manage the deterioration of our circumstances. Our vantage point is from the midst of this field of propensities, and this field is flux. As a result, our orientation field must be immersed in complexity, and in flux, as well.

All of this is quite unwieldy from the perspective of most formal models. HokiPoki is an embryonic mechanism that supports the dynamic self-organization of agent orientation within complex and continually changing environments. It can be applied to many domains, which points to the work that lies ahead. The experience derived therefrom will provide the basis for further evolution of the mechanism.

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REFERENCES

- Blommaert, Jan, 2005, *Discourse: A Critical Introduction*, New York: Cambridge University Press.
- Empson, William, 1966 [1930], *Seven Types of Ambiguity*, New York: New Directions.
- Gadamer, Hans-Georg, 1989, *Truth and Method*, New York: Continuum International Publishing Group.
- Graham, A.C., 1989, *Disputers of the Tao: Philosophical Argument in Ancient China*, La Salle, IL: Open Court Press.
- Hoffmeyer, Jesper, 1993, *Signs of Meaning in the Universe*, Translated by B.J. Haveland, Bloomington, IN: Indiana University Press.
- Joas, Hans, 1993, *Pragmatism and Social Theory*, Chicago: University of Chicago Press.

- Mead, George Herbert, 1934, *Mind, Self and Society*, Chicago: University of Chicago Press.
- Palmer, Richard E., 1969, *Hermeneutics*, Evanston, IL: Northwestern University Press.
- Peirce, Charles Sanders, 1955 [1897], "What is a sign? Three divisions of logic," pp. 98–101 in *Philosophical Writings of Peirce*, edited by J. Buchler, New York: Dover Publications.
- , 1992 [1898], *Reasoning and the Logic of Things*, Cambridge, MA: Harvard University Press.
- Sallach, David L, 2002, "Situated social ecology: An integrated design hermeneutic," in *Agent 2002: Ecology, Exchange and Evolution*, edited by C. Macal and D. Sallach, Chicago: Argonne National Laboratory.
- , 2003, "Interpretive agents: Identifying principles, designing mechanisms," pp. 345–353 in *Agent 2003: Challenges in Social Simulation*, edited by C. Macal, M. North, and D. Sallach, Argonne: Argonne National Laboratory.
- , 2006a, "Coherence and interpretive agency: Mechanism design," in *North American Association for Computational Social and Organizational Science*, South Bend.
- , 2006b, "Complex multigames: Toward an ecology of information artifacts," pp. 185–190 in *Proceedings of the Agent 2006 Conference on Social Agents: Results and Prospects*, edited by D.L. Sallach, C.M. Macal, and M.J. North, Chicago: Argonne National Laboratory.
- , 2007, "Logic for situated action," pp. 13–23 in *Advancing Social Simulation: The First World Congress on Social Simulation*, edited by S. Takahashi, D. Sallach, and J. Rouchier, Tokyo: Springer.
- Sewell, William H., Jr., 2005, *Logics of History: Social Theory and Social Transformation*, Chicago: University of Chicago Press.
- Shalin, Dmitri N., 2007, "Signing in the flesh: Notes on pragmatist hermeneutics," *Sociological Theory* 25:193–224.
- Sheriff, John K., 1989, *The Fate of Meaning: Charles Peirce, Structuralism and Literature*, Princeton, NJ: Princeton University Press.
- Silverstein, Michael, 2003, "Indexical order and the dialectics of sociolinguistic life," *Language and Communication* 23:193–229.
- Stinchcombe, Arthur L., 2001, *When Formality Works: Authority and Abstraction in Law and Organizations*, Chicago: University of Chicago Press.

Weber, Max, 1978, *Economy and Society: An Outline of Interpretive Sociology*, Berkeley, CA: University of California Press.

Wittgenstein, Ludwig, 1958, *Philosophical Investigations*, translated by G.E.M. Anscombe, Upper Saddle River, NJ: Prentice-Hall.

