

Communication-Oriented Modelling – Transforming the Social Visibility of Communication Processes into Cognitive Visibility

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ABSTRACT

The visualization of communication processes or of their central structural aspects is of vital importance for the orientation of users and scientific observers of computer-mediated communication. Starting from this hypothesis, we would like to introduce a modeling approach that focuses on the “visible” part of communication: the *message sign*. To demonstrate the *Communication-Oriented Modeling* (COM) approach, we would like to proceed in four steps. The first step involves the localization of COM inside the Socionic Research Program, the second step shows the theory of communication behind COM, the third step focuses on the role of the message sign in communication processes, and the final part deals with the concept of social visibility.

Keywords

Communication, Communication-Oriented Modeling, Socionics, Message Sign, Dynamic Networks, Social Visibility.

1. INTRODUCTION

The visualization of communication processes and several of their central structural aspects is of definite value for the orientation of users and scientific observers of computer-mediated communication. Departing from that assumption, we would like to introduce a modeling approach that focuses on the “visible” – in the sense of observable – part of communication: the *message sign*. To demonstrate the *Communication-Oriented Modeling* (COM) approach, we would like to proceed in four steps.

The first step involves the localization of COM inside the Socionic Research Program, as a complement and an alternative to the dominating agent-oriented paradigm. Socionics is an interdisciplinary research program between computer science and sociology to build multi-agent systems (MAS) that incorporates social mechanisms to enhance cooperation and coordination of the agents and to achieve a new quality of social simulation. The focus on MAS has led to a dominance of agent-oriented approaches in Socionics.

Inspired by the diminishing role of traceable agents in computer-mediated communication, COM proposes an alternative approach that focuses on the modeling of communication processes, rather than on the modeling of agents.

The second step shows the theory of communication behind COM. This theory consists of a triadic concept of communication with two invisible and transient operations and a visible and more or less persistent message sign. The first of these operations is the *inception*, the production of a message sign, the second is the *reception*, the experience and interpretation of a message sign. The ongoing interplay between actions, interpretations, and observable signs constitutes the communication process as such.

The third step focuses on the role of the message sign in communication processes. The most important feature is the observability of the message sign. It is our contention, that the message sign – as an empirical object – is the hallmark of the constitution of communication processes out of cognitive and physical operations. Only the direct reference to a message sign specifies the operations of inception and reception as being communicative operations. COM uses the dynamic network of cross-referencing between message signs as the basic modeling level.

In the fourth step, we would like to demonstrate how to transform the social relevance of a message sign in a communication process into cognitive visibility for the observer. COM uses a *visibility function* that computes the social relevance of a message sign out of the incoming references it receives from following messages. This social relevance measurement is called *social visibility*. On that basis, it is possible to reconstruct the social visibility of a message sign from a dynamic network of cross-referencing messages and to transform it via different visualization techniques into cognitive visibility. This social visibility of a message could be an important structural information about an ongoing computer-mediated communication process for participants and other interested observers alike.

Finally, we will close this paper with a conclusion that tries to relate the fields of socionics, communication-oriented modeling, and computer semiotics according to their similarities and complementarities. We will illustrate the closeness of our approach to computer semiotics by referring to certain papers of previous COSIGN conferences and show that they elaborate research questions of great interest for communication-oriented modeling.

2. COMMUNICATION-ORIENTED MODELING AND THE SOCIONICS RESEARCH PROGRAM

The Socionic Research Program, funded by the Deutsche Forschungsgemeinschaft (DFG), introduces concepts, insights, and mechanisms from sociological theory into the scientific field of Distributed Artificial Intelligence (DAI) and the Research on Multi-Agent Systems (MAS). The interdisciplinarity of this approach is secured by a commitment of computer scientists and social scientists to fuse their research interests into the construction of prototypes of multi-agent systems. This endeavor, to construe artificial sociality in a controllable fashion, has a multiplicity of research agendas. From a sociological perspective, socionics should achieve the clarification of main concepts of social theory and high-quality social simulation. Computer science should profit from new mechanisms of coordination, cooperation and conflict resolution among autonomous agents (for a full programmatic see Malsch [16, 17]).

It seems obvious that socionics is mainly based on the development of agent technologies, agent interaction/communication protocols, platform development for multi-agent systems and agent-based social simulation. Therefore, socionics followed the path of agent-oriented modeling (AOM). In most cases this is quite consistent with wide branches of sociological theory, where the actor and his observations, evaluations, choices, and actions form the center and kernel of theoretical development (see for instances Coleman, Esser, or Giddens [3, 7, and 9]). The agents build the persistent part of the developed systems and research is focused on agent interaction and the relationships between agents (see Ferber or Weiss for overviews [8, 26]). Despite the considerable achievements of AOM in the realm of distributed and cooperative problem solving, there although exist certain shortcomings of that approach. A central problem according to Malsch & Schlieder [18] is the speech-act based modeling of communication in AOM, because of the inherent limitations concerning mass communication, caused by the sender-receiver pattern of speech-acts, also labeled as the “message sending paradigm” [18]. Large-scale communication processes tend to diminish the role of the sender and the receiver for the communication, so that agent-to-agent-relations are of generally less importance in these many-to-many communication processes, than traditional AOM approaches would assume. Focusing on agent relations, the message sending paradigm also misses the centrality of message-to-message-relations. The referential structure between the messages becomes more and more unclear and unobservable when the load of agents and messages rises to large amounts and has to be channeled through sending and receiving agents. Finally, such large amounts of momentarily participating agents and communicative activities involves an unbearable high modeling complexity. Cutting a long argument short: The message sending paradigm cannot be scaled beyond a certain limit, that falls definitely short of the many-to-many cases of mass communication.

These shortcomings of AOM lead us to shift attention from the interacting agents to the communication events and their referential relations. That is an fairly unconventional approach in socionics as highlighted above; but from a sociological point of view, it seems to be a plausible alternative. By such a shift of attention, we simply follow one of Luhmann’s

proposals: “If one begins with the possibility of a theory of self-referential systems and with problems of complexity, there is much to suggest simply reversing the relationship of constraint. Sociality is not a special case of action; instead, action is constituted in social systems by means of communication and attribution as a reduction of complexity, as an indispensable self-simplification of the system.” [14] Even in sociology such a proposal implies a paradigm shift from action theory to communication theory, so that COM has to rest necessarily on a well-developed theory of communication.

3. COMMUNICATION THEORY

A communication theory with elements from sociological theory (especially the theory of social systems, in the tradition of Niklas Luhmann [14] and the theory of symbolic interactionism, in the tradition of George Herbert Mead [19]) and semiotic theory (in the tradition of Charles Sanders Peirce [20]) constitutes the fundament of COM. We start from some proposals of Luhmann’s theory of communication, point out some theoretical problems of major interest to our own approach and develop the basic vocabulary of our theory of communication.

3.1 Points of Departure: Luhmann on Communication

Luhmann suggests to take “communication” as the basic term for understanding social systems and therefore, a theory of communication constitutes the core of his social theory. This approach departs from the common use of “social action” as the basic category for sociological theory, as introduced by Weber [25]. Communication is the operation that constitutes and reproduce social systems and the basic element for the analysis of such systems. COM shares that foundational hypothesis with the theory of social systems. Luhmann gives a threefold interpretation of communication:

1. **Communication as the mode of operation of social systems.**
2. **Communication as the basic and constituent element of social systems.**
3. **Communication as the temporal atom of social systems.**

This third interpretation describes communication as an event, a vanishing moment in the systemic reproduction. A temporal unit that cannot be further divided with reference to the social system. This temporal dimension of communication is of major interest to COM’s processual perspective on communication. Two characteristics of this definition of communication as the temporal atom of social systems are essential to the problematic we would like to address here: that communication is event-like and that every communication event is extremely runny. A communication event has to be substituted immediately by the next one or the communication process breaks down.¹ This process of

¹ This was a bit of an exaggeration. Due to the features of certain media of dissemination or other storage devices, some elements of the communication event can be preserved for quite a time. Here rests a grave problem of Luhmann’s approach to which COM tries to explicate a possible solution. (see below)

immediate substitution is what communication is all about; it could be called the autopoiesis of communication. [14]

According to Luhmann, communication is “coordinated selection” [14]. Every communication synthesizes three selections: information, utterance and understanding. Therefore, “... communication must be viewed not as a two-part, but as a three-part selection process.” [14] The information selection actualizes the referential horizon of the communication, by choosing one point of reference and not another one. The utterance is a selection of an expression behavior for the communication. The last selection – that of understanding – is of decisive importance. It is based on the distinction between information and utterance. Understanding – as making a difference between the information and the uttering action – completes a communication event. Communication organizes itself from that last selection backwards. Understanding some event as an uttering of an information coordinates all three selections in the last one and creates the unity of a communication as a singular event. Understanding attributes that utterance of an information as an action event and fixes the communication event at one point of time.

COM focuses on a special problem that arises from the temporal implications of the three-selections approach by Luhmann. There may be an immense time-span between the utterance selection and the understanding selection. Therefore the question is: how is it possible to describe communication as an event, as the temporal atom of social systems, when such an event is elongated to a considerable amount of real-time? Interpreted from a real-time perspective, utterance and understanding are different events and do not constitute a single event.

An additional sphere of highly interesting problems for COM stems from Luhmann’s statement that communication is highly improbable. There are a variety of basic obstructions communication has to overcome. The three improbabilities of communication are: understandability, reachability, and successfulness. Every communicational offer is – without additional assumptions like context – likely to be misunderstood, probably unable to reach its addressee, and unlikely to be accepted and followed. These improbabilities of communication “... operate as thresholds of discouragement.” [14] No communication comes to pass without transforming these improbabilities into probabilities. COM has to address these problems, in order to develop a theory that helps to simulate the stabilization and reproduction of specific types of communication processes.

So far, two central insights from Luhmann’s theory of social systems are vitally important for the development of COM: the paradoxical signification of communication as a temporal atom of social systems and the thesis of the improbability of communication itself. These are the points of departure for the elaboration of our own communication theory.

3.2 Operations: Inception and Reception

The operational level of communication is concerned with the temporal aspects of communication processes. We try to point out possible discrete events that constitute communication. Therefore, COM uses a triadic model of communication (see figure 1.), consisting of two event-like operations – *inception* and *reception* – and a message sign – a specific formation of a medium of communication. The term message sign and its

special role in our theory and our modeling approach will be further explained later on. Here, we use message sign as a point of reference for the communicative operations of inception and reception. Only the direct reference to a message sign lifts the two operations from the mental to the social (communicative) level.

Right now, we will focus on this operational level. The two operations have an obvious background in the consciousness of actors that participate in communication processes. Both operations are not directly observable, because every psychic system is a black-box for any other psychic system. Both operations have to be conceptualized in a fashion that makes it possible to infer them from the observable part of the communication process.

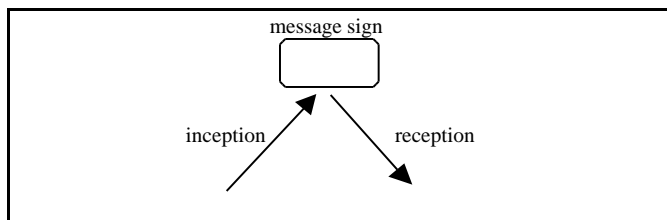


Figure 1. Triadic Concept of Communication

The inception may be conceptualized as the act of uttering, that is the production of a physically manifest sign. The inception is a form of action and is attributed to a person. To avoid misunderstandings: Inception is not the action of sending a message – that would be the case in the perspective of a message sending paradigm – it is the production of a message sign in the form of a “publishing” activity. In short:

inception ← production of a message sign

The reception, on the other hand, stands for the perception and interpretation of a message sign. A reception (re-)constructs some form of information from a message sign. So, there is also some activity involved in the reception, because somebody has to actively interpret and evaluate the signs used in the communication process. In short:

reception ← perception + interpretation of a message sign

Inception and reception as single operations are coupled in two ways. On the one hand, the message sign couples a foregoing inception with a plurality of receptions. On the other hand, actors or persons couple the reception of a foregoing message sign to the inception of a new one. This coupling of operations inside the psychic systems participating in the communication has to be observable as some form of referencing from one message sign to another.² To develop a theory of communicative operations right below the level of the Luhmannian synthesis, involves a strategic withdrawal from two central theorems implied by his approach. A possibly indefinite temporal stretching of a communicative event between utterance and understanding will be excluded

² As we will see later, COM is mainly interested in the build-up of such referential structures between message signs, rather than in the internal operations of a psychic system. Strictly speaking, these internal information processing of agents belongs to the AOM paradigm.

from our approach, as well as any form of dominance of the understanding selection over the communication process. In re-differentiating the operations of inception and reception as discrete events in the communication process, we address the problem of the definition of the temporal atom of communication, as formulated above. In the next section I will show, how we like to address the second problem – the problem of the improbability of communication.

3.3 Selectors: Significance and Relevance

The theme “improbability of communication” should be addressed on a structural level. COM prefers a bottom-up approach to modeling and simulation, so that an operational structure is introduced. Both operations – inception and reception – are constructed on the basis of a structural homology. They process two structural values, called selectors: *significance* and *relevance*. These selectors determine the probability for the connection of a new message to an old one. Significance and relevance are valuations attributed to a message sign. The inception tries to inscribe these valuations into the message sign, whereas the reception attributes these values in the form of an interpretation of a given message sign under observation.

The simplest mode to capture the notion of significance of a message sign seems to go by using the distinction appropriate/not-appropriate. Significance could be measured by some standard of similarity or correspondence in a thematic or semantic way. This may usually happen by the introduction of binary codes or nominal scales based on simple semantics or ontologies. It seems quite difficult to construe a more formalizable measure like semantic nearness or sameness. In short:

significance ← some standards of appropriateness of a message sign

Relevance, on the other hand, is captured by using the distinction important/not-important. A gradual measurement of and a formal approach to relevance seems more likely than in the case of significance. A difficulty for the modeling rests in the wide range of possible approaches to measure the relevance of a message sign. As we will show below, there is a striking similarity between relevance and visibility of a message sign, but the concepts arise from different perspectives on communication processes (see below). Whereas relevance is assigned to a message by a single agent and the attributions from different agents may contradict each other, visibility is assigned to a message sign from a process perspective indifferent to the interpretations of the individual agents. In short:

relevance ← some standards of importance of a message sign

The greatest difficulty concerning these structural values rests in the probable difference between the attributions of significance and relevance from different agents for the same message sign. The integration of these deviating interpretations and perspectives seems to be a great obstacle for our approach.³ A further problem arises from the difference

³ As we will show below (in section 5.), we try to surpass this obstacle at the moment by concentrating on a structural

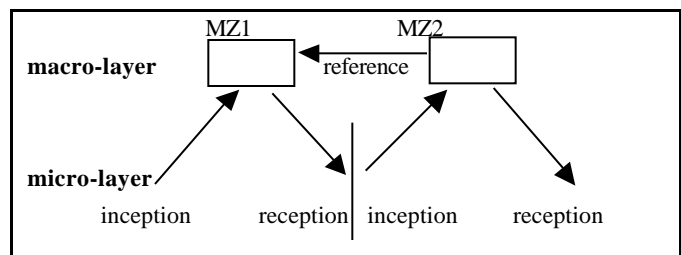
between the inscription of structural values by an inception and the interpretative valuation by a reception. Therefore, we have to rest on the observable part of communication expressed in message signs.

3.4 Selection Problems and Reproduction Problems in Communication

COM and the communication theory developed here are mainly focused on two problems. Behind those problems stand two different perspectives on communication. The first problem could be summarized in the question: “Where should I connect with my communication proposal?” It is a *problem of selection*. The problem is formulated from the perspective of the single agent. The second problem, on the other hand, concerns the reproduction of an identifiable communication process. The formulation of this problem draws from the perspective of the process itself. It is a *problem of reproduction*. Therefore, we are able to divide two layers inside our theory of communication, where both problems can be addressed separately.

The first layer, or micro-perspective, focuses on the problem of selection. Selection problems are addressed by the receptions and inceptions of agents directed by their attributions of significance and relevance to various message signs. Agents select references to the message signs they value as appropriate and important according to their interests. They may and probably will orient their attributions to the social visibility of the message signs for the whole communication process. The social visibility is a macro-effect produced by the selections of all the agents and is used by them to orient their valuations.

The second layer, or macro-perspective, focuses on the problem of reproduction. Reproduction problems are addressed by following the references between message signs, so that patterns of strong-referenced and weak-referenced message signs emerge from the ongoing communication process. We would like to find out functions that capture the reproduction of such patterns.⁴ Where the problem of selection has to be articulated on the operational level of reception and inception, the problem of reproduction has to be captured on the level of the message-to-message-relations indicated by the references (see figure 2.).



value from the process perspective (e.g. social visibility), rather than using the selectors described here. In future work, we will try to integrate the selectors into our simulation tool.

⁴ Such functions will be like the visibility functions elaborated in section 5.1 below.

Figure 2. Communication Model and the Problems of Selection and Reproduction

In future research, the central theme of our theoretical work will reside in the possible coupling and de-coupling of the two perspectives, the design of the micro-macro-link in communication. The task is to construct a plausible link between the process-oriented measure of visibility and the agent-oriented structural selectors significance and relevance. If you take up a communication-oriented approach, the agents should not determine the structural effects, but their attributions should have a significant effect on the social structures (referential patterns), especially when they express their attributions through message signs.

4. THE ROLE OF THE MESSAGE SIGN

The message sign is an important feature of our theory of communication, as well as for the visualization of communication processes in COM. In this section, we would like to discuss the semiotic background of the term “message sign” used here, the main attributes of the message sign and the value of that notion for the presentation of structural aspects of communication processes.

4.1 Semiotic Background

In this first section concerning the role of the notion *message sign* in our theory, we will point out some connections to semiotic theories to clarify our understanding and use of the term.⁵ From the two main traditions in semiotics – the European-Structuralist tradition based on the work of Ferdinand de Saussure [22] and the American-Pragmatist tradition based on the work of Charles Sanders Peirce [20] (a distinction also common for computer semiotics [1]) – we strongly tend and refer to the American-Pragmatist side.

The term “message sign” is an uncommon notion in semiotics. It is a composite term, that includes the central research object of semiotics – the sign – and a notion of a medium in which the sign and its usage materialize – the message. The two central traditions in semiotics – the Peircean and Saussurean tradition – develop definitions of the sign that share certain similarities but lead into quite different directions. According to Eco [6], Peirce views the sign as something which stands to somebody for something in some way, whereas Saussure defines the sign as the difference between the signifier and the signified. Peirce seems to be interested in the role of signs in the process of semiosis, Saussure, on the other hand, focuses on the inner structure of sign systems. From our sociological viewpoint, we tend to the perspective of Peirce, because our research interests do not reside in language itself, but in the role of language and other media in social (communication) processes. In viewing language as the medium that couples consciousness and communication, the sign system and its inner structure seems to be of less importance.

Coming back to the notion of “sign” in the sense of Peirce implies three characteristic features of the sign that we would like to highlight. According to Peirce, every sign consists of a material quality (it is something), a demonstrative application

⁵ We acknowledge that such a term seems to be quite uncommon in semiotics, but we would like to point out our major interest in actual sign usage in communication and the material realization of that usage as the observable part of communication.

(it stands for something in a real causal connection), and an idea in a mind (to somebody) [20]. We take-up that definition of the sign, but we would like to add something to denote the communicative usage of the sign. Therefore, we call the observable part of communication “message signs”, in order to shed some light on the production and interpretation of signs as a communicative behavior. The notion should include an explicit media reference, a difference of signifier and signified (self- and other-reference) and a reference to some communicative activity. Mostly, a message sign contains not only a basic sign or a single symbol, but a composite sign like a sentence or a whole website on the internet. A plausible alternative to our term could be the notion of “used sign” or “communicative form”.⁶

4.2 Persistency and Observability

As described above, we focus on two properties that message signs inhere prior to communication: *persistency* and *observability*. The role of the message sign, as the expression plane of communication, the part of communication that can be observed by a detached third party, is constituted by these two properties. Both aspects point to perception, rather than to communication. In our perspective, that does not lead to a contradiction, because perception is a decisive prerequisite of communication and here rests the central role of the message sign. Communication is forced to attract conscious attention to continue. This attraction of attention is one of the main functions of message signs. To achieve this, some form of persistency and observability has to be realized. Based on these two properties – produced through a formation of a medium – the message sign connects communication and perception, it effects either social and psychic systems.

Persistency describes the physical survival of the message sign and is bound to the material quality of the sign. The persistency is mainly an attribute of the medium which is used to produce the message sign. For the social persistency of message signs we reserve the term “social visibility” (see below), that just couples loosely to the material quality of the message sign.

Observability seems to be more closely related to the visibility of a sign in communication processes. In opposition to persistency, the observability of a message sign is not solely determined by its material quality. It has to be reachable by the senses of certain agents as well. If an operation of reception cannot occur, then we would not speak of a proper message sign. This attribute realizes the potential for a reference to that message sign, but tells us nothing about the attention it actually receives, nor about the attention it is likely to attract.

Therefore, persistency and observability can be viewed as prerequisites for the functioning of message signs in

⁶ We acknowledge that this direct reference to communicative activity is included in Peirce notion of the “sign”, because semiosis is a process of sign usage by a mind or by communication to generate meaning (see for instances the interpretations of Eco [5, 6] and Simon [24]). Our terminological add-on should just highlight our sociological interest in sign usage in communication. To be clear, in congruence with Luhmann [15], the message sign is not a communicative operation (no sign is), but it plays an important role, because it hints towards such operations.

communication and as nothing more. They are also necessary conditions for the observation of communication by third parties. All further aspects and characteristics of communication can only be inferred from this plane and to make such inferences possible could be designated as the role we would like to ascribe to the message sign. One of these aspects is the build-up of a referential structure between the message signs, another aspect is the social visibility of a single message sign that emerges from the referential structure of the communication process.

4.3 The Referential Structure

Communication can be viewed as the build-up of a referential structure between message signs. The referential patterns represent the structure of the underlying communication processes. In COM, we would like to follow and simulate the emergence and stabilization of such referential patterns in communication.

A reference between message signs is established by a reception of a previous message sign that leads to the inception of a new one (see figure 2. above). That these two operations have been come to pass has to be noticeable or inferable from the following message sign, so that we could also say that the reference has to be inscribed into the message sign in some way. We can differentiate a push-model of communication, where the referential structure of the process is produced by operations of reception and inception and a pull-model of communication, where following messages ascribe references to previous ones. These models represent different perspectives on communication and a communication-oriented approach should lean to the latter one, without forgetting or ignoring the former. We would like to try out both approaches to model the emergence of referential patterns in communication in our further research and hope that our communication theory will combine the models in a plausible way.

Apart from the question of the origin of referential patterns in communication processes, we are especially interested in the formation and reproduction of specific patterns over time. This theme of pattern reproduction (as mentioned in section 3.4) is vitally important for the scientific analysis of communication and for the orientation of participating agents alike. In the following section, we will show that such patterns could be described by the distribution of social visibility between message signs and that this distribution is generalizable by a specific visibility function. What we would like to model by the generation of reference patterns in communication are conditions for the reproduction/ stabilization of structures and processes over considerable time-scales, as well as the differentiation of types of communication processes according to their referential structure. The results from the simulation and empirical analysis of pattern formation in communication may even lead to a plausible typology of processes according to the underlying distribution of visibility.

5. SOCIAL VISIBILITY AND COGNITIVE VISIBILITY

As noted above for several times, one of the central features of communication processes – and the central feature of our approach to a communication-oriented modeling – is the construction of a kind of “social visibility” from the referential patterns between message signs. This visibility of message signs in the communication process seems to be a

promising structural value for the analysis of communication processes in general. The social visibility of a message sign is a compact expression for the probability that it will be referenced by a new message sign. Social visibility of a message sign signifies its potential for future attraction of attention and results from the attention that the message sign has already attracted during the communication. A case of “preferential attachment” as you may call it.

The first of the two following sections demonstrates the construction of visibility functions to simulate communicative patterns and the distribution of social visibility in different types of communication processes. The second section will develop a description of our simulation tool COMTE and address the problem of transforming the social visibility of message signs into cognitive visibility for the participants by means of a variety of visualization techniques. This transformation is the key to support agents confronted with the problem of selection.

5.1 Visibility Functions

In the following, we will describe visibility as an ordering principle in communication processes, that directs their further development. The actual distribution of visibility between the message signs can be generalized into a “visibility function” for the whole process.

As has been mentioned, we introduce visibility as a principle of order in communication processes, a principle of order that can be generalized from referential patterns between message signs. A single message sign receives a high visibility, when it attracts a lot of attention in communication. Obviously, this involves a circular definition, because a high visibility leads to further attraction of attention. There is a positive feedback-mechanism at work. The visibility functions describe the distributional patterns of visibility in whole communication processes. With this functions we have got formulas to produce certain pattern-specific communication processes.

The basic assumption behind the construction of visibility functions for simulations suppose that the function should depend on an aging factor and on an attention factor for message signs. The aging factor could be given by the medium of communication in use or by the speed of the process itself. The attention factor could be measured by the references a message sign receives from other message signs.

There are two ways to construct a visibility function. On the one hand, you could take empirical data of communication processes and derive a possible visibility function from the referential structure. Or, on the other hand, you could determine what type of communication process or what pattern you would like to simulate and create the visibility function in advance that is able to produce such a process. We would like to proceed in both ways: Analyze empirical data from internet forums, scientific citation indices and some additional forms of computer-mediated communication and simulate various forms of communication processes with an expanding arsenal of usable visibility functions.

Up to the moment, we have got a small range of visibility functions to run simulations with. The most interesting one is a degree-based visibility function with aging. This function

includes the desirable factors of aging and attention.⁷ We are able to create some interesting referential patterns with this relative simple visibility function. We have simulated three different scientific citation procedures: a historicist mode, a classicist mode, and a modernist mode of citation. In the historicist mode (see figure 3.), aging is a neglectable factor and a “first comes first”-pattern of citation is stabilized. In the classicist mode (see figure 4.), both factors are of considerable influence and a balance between attention and aging is established, so that classic works appear over the whole time-span of the process. Finally, in the modernist mode (see figure 5.), aging is a much more influential factor and only a block of recent message signs is visible in the process.

In the future research, we would like to expand our sample of visibility functions, to include more sociological relevant factors and finally try to supplement and/or substitute the globally working visibility function with a set of different locally working visibility functions or subjective visibility functions for specific agents participating in communication processes. To reach this research goals we have to further integrate the micro-perspective and the macro-perspective on communication on the basis of inferences from the observable part of communication.

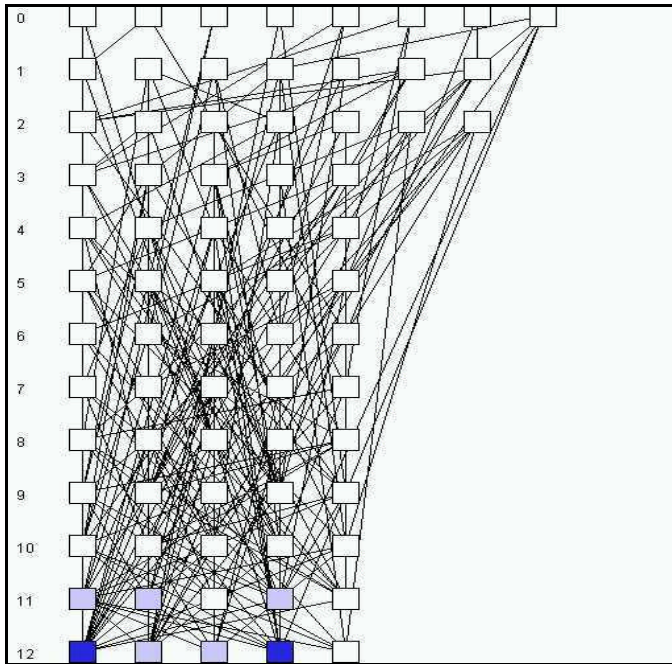


Figure 3. Historicist Mode of Communication⁸

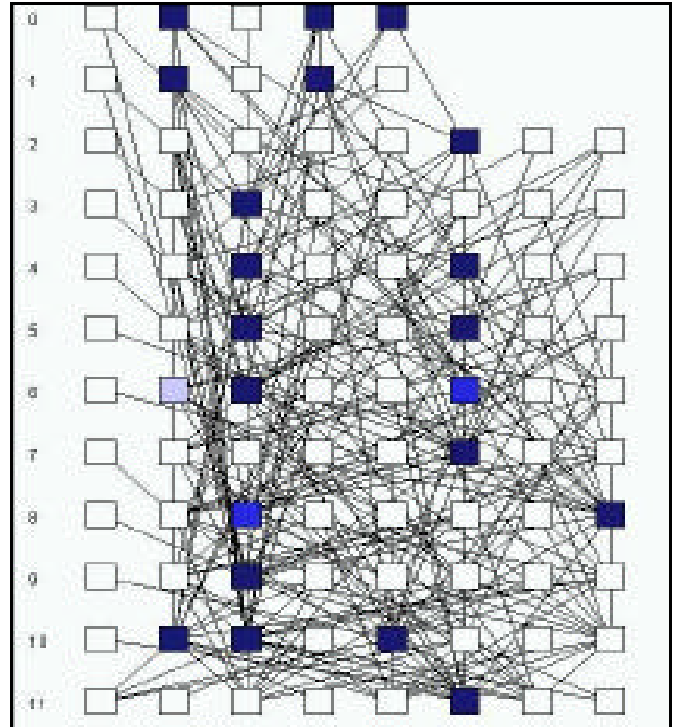


Figure 4. Classicist Mode of Communication

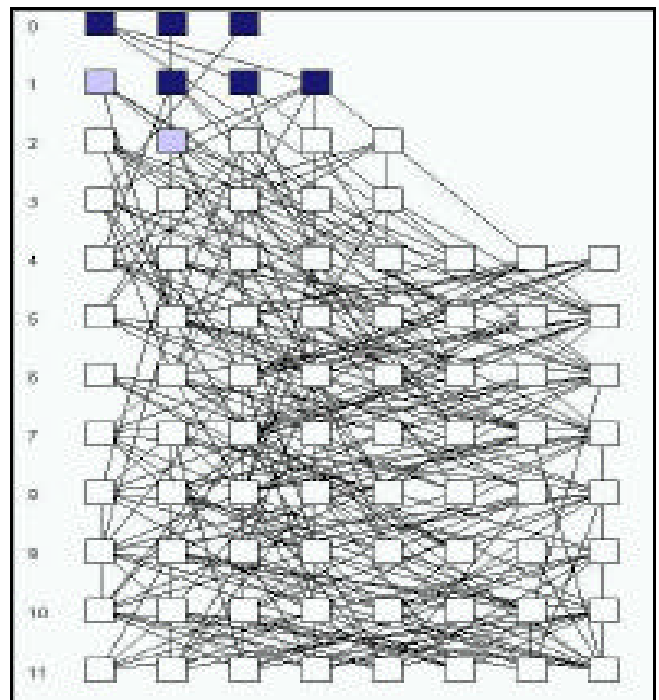


Figure 5. Modernist Mode of Communication

⁷ We would like to skip the mathematics here and refer interested readers to the project homepage, where a short paper introduces the mathematical basics [4].

⁸ A darker shading signifies a higher social visibility.

5.2 Simulation and Visualization

We have developed an simulation tool – the COM Test Environment (COMTE) - to simulate, analyze, and visualize communication processes and their basic patterns. COMTE is a prototype and includes, up to now, just the most basic features

of the COM theory (see figure 6.). These features include a limited range of usable visibility functions, a distribution function to simulate the production of message signs and the inscription of references by autonomous agents, an interface to change the values of certain factors in the visibility and distribution functions and to change these functions themselves, and a simple visualization of the ongoing communication process and the resulting distribution of visibility between the message signs. A high social visibility is indicated by a darker shading of the message sign. It is possible to filter invisible messages and references to enhance the orientation and to highlight the resulting patterns.

This prototypical simulation tool enables us to analyze and simulate simple patterns in communication. What we would like to do in the future, is to expand this prototype in several directions. One direction is the inclusion of an aggregate level, where a couple of new structural aspects could be visualized; another direction is the differentiation of types of message signs and reference types from each other; we would also like to include an interface for empirical data and real run-time communication in MAS; and finally, there should be a possibility to show process differentiation in communication. The visualization of these features is vitally important, because the selection problem of the users can only be addressed by some form of transformation of social visibility into cognitive visibility. This transformation is directed via the visualization of the emergence and reproduction of patterns of social visibility by the COMTE tool.

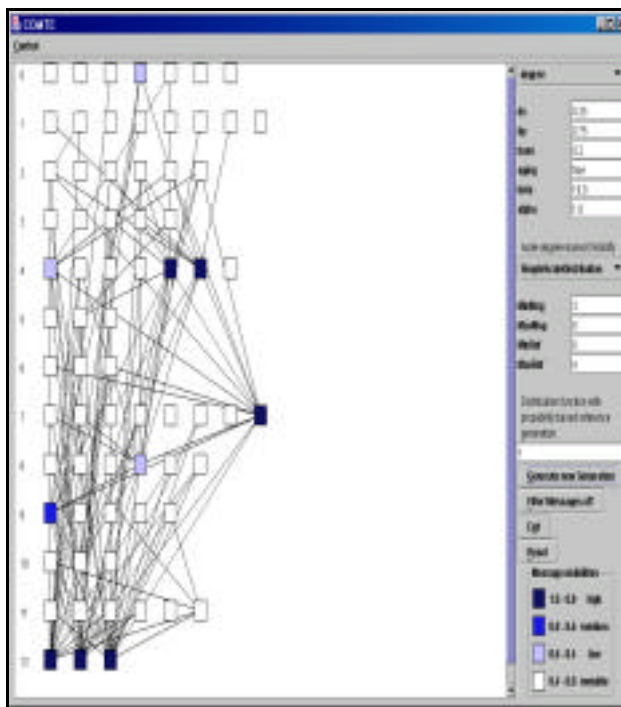


Figure 6. COMTE Interface

6. CONCLUSION

In this concluding section, we would like to point out some aspects of the possible relations between the field of computer semiotics, socionics, and communication-oriented modeling. With reference to some articles published in previous COSIGN-Proceedings [2, 11, 13, 21, and 23] and to Andersens

groundwork on computer semiotics [1], we try to outline similarities and complementarities concerning the foundational scientific questions and the possible ways to answer them.

To focus on the central questions: Socionics is mainly concerned with the use of social mechanisms (in the sense of Hedström & Swedberg [10]) or more generally social theories for the development of “better” multi-agent systems; communication-oriented modeling is essentially about simulating the self-organization of communication processes by a modeling approach that focuses on the cross-references between observable message signs; and computer semiotics tries to establish a new branch of semiotics by applying semiotic concepts to computer-based signs.

Beyond the obvious differences of the three fields, there is also a striking similarity: All three approaches deal with computers and signs⁹ play an important role in them. Based on that common features, we would like to point out some research agendas of interest for socionics and COM inside the field of computer semiotics (represented by articles published at previous COSIGN conferences).

Of general interest for socionics is the article of Petric et al. [21] with its direct references to the role of signs for the development of multi-agent systems and “socially intelligent agents”. As noted above, we think that sign usage is of high significance for the socionic research agenda. The introduction of terms like semiosphere and cultural encyclopedia could lead to a greater concentration on the modeling of environments for agents instead of a purely agent-oriented modeling. This seems in some respects quite similar to our own intentions behind communication-oriented modeling.

Another point of connection between communication-oriented modeling and computer semiotics is a focus on visualization. There were a variety of papers concerning the construction of visual signs that enhance the cognitive visibility of information in computer-mediated communication. The “Crystal Hy-Map™”, introduced by David Bihanic [2], gives some interesting hints for the creation of a visual representation of aggregate data on structural aspects of communication, like semantics or process differentiation. Another interesting approach in the area of visualization of meta-data is demonstrated by Kerne and Sundaram [11] and their “CollageMachine” that gives a visual representation of browsing activities by recombining the constituent media elements of a variety of internet documents.

Two further branches of computer semiotics could be of considerable interest for our project. On the one hand, the problem of transforming social visibility into cognitive visibility is not only a question of representing meta-data, but also a question of interface design, a theme of some relevance in computer semiotics (see Scalisi [23] and Andersen [1]). On the other hand, computer semiotics seems to be as interested in the structural aspects of computer-mediated communication as is communication-oriented modeling. So we are quite interested in work like the paper of Lucia Leao [13] that analyses the structure of hypermedia communication from a semiotic point of view.

⁹ Signs could be viewed as a vitally important social mechanism and some form of signs or symbols are relevant in a lot of socionic projects (Kron [12] shows some examples).

So that we could finally summarize, that we think that communication-oriented modeling and sociotics can profit from the work done in the field of computer semiotics and that both approaches share an interest in sign usage as an organizing principle in communication. Especially COM shares a considerable interest in the question of visualization with computer semiotics, because every support for agents trying to solve their selection problems in computer-mediated communication depends on the transformation from the social to the cognitive level, in our case on the transformation of social visibility into cognitive visibility and the achievement of an enhanced form of coupling between communication and perception.

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