THE ELEMENTARY-PRAGMATIC MODEL: A POSSIBLE APPROACH FOR SETTING UP USER MODEL

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ABSTRACT

This article sets out a quantitative theory of the interaction among "subjects" which allows a description of the pragmatic aspects of communication. Within a system of interacting subjects each individual is described by means of a set of interaction parameters. In this way an interaction pattern relative to each subject can be defined. The model provides a "change law" which describes the evolution of individual patterns as a consequence of different communication events. This allows interaction deficiencies to be identified and suggests possible strategies for dealing with them. The theory was first developed in the area of clinical psychiatry and underwent two kinds of external verification: one psychometric-diagnostic, the other clinical. The theory was then applied to an economic environment in the behavioral study of decision-making processes. In this paper we suggest that it may be applied to the development of user models in computerized environments for cooperation support.

1. Introduction

In this paper we argue that the development of support systems for cooperative work must first provide an explicit description of the behavioral attitudes of the cooperating subjects. We also contend that, in addition to a description of the semantics of the messages exchanged between subjects, it is essential to possess descriptive models of the pragmatics of inter-partner communication.

In dealing with this topic we shall use a line of thought (relational perspective) which derives from the work of Gregory Bateson and which, when applied to psychiatry, is known as the "Palo Alto School" [1,2]. According to these researchers the origin of mental illness lies in the relations that the subject holds with other subjects. Their work has shown that communication among subjects, and therefore their potential ability to cooperate, is independent of the desires and goals of individual participants. Hence one must consider:
"... the symptoms, the defences, the structure of the character and the personality as expressions which describe the typical interactions of the in dividual in response to a particular context rather than as intrapsychic entities" (D. Jackson, [3]).

This approach is extremely interesting from the point of view of the development of computer-assisted cooperation support systems. The aim of these systems, as we know, is to improve the communication process among human beings. It is possible to achieve this aim by providing the cooperating subjects with software instruments that make explicit the network of reciprocal commitments established in the course of a conversation [4].

In fact, communication by means of computerized networks places individuals in a communicative situation that is simultaneously controlled and deprived. In particular, one observes that:
- exchanged messages can be subjected to mechanisms of abstraction, for example classified as speech acts;
- extralinguistic messages (at least in the most frequent cases) are not exchangeable and therefore cannot play a part in forming the behaviour of the subjects;
- the punctuation of conversations [1] is perfectly clear (the beginning and end points are known; a conversation starts and finishes at two known points on the time axis);
- all the elementary interactions, and therefor the whole history of the conversation, are available for detailed analysis.

The usefulness of a cooperation support system lies in the possibility it offers, through the study of conversations, of establishing retroactive mechanisms for the correction or enhancement of the communicative situations that have been observed. But a posteriori evaluation of the relational paradoxes generated during a conversation cannot be conducted using interpretative models based exclusively on speech acts (see [5] for detailed treatment of the problem, and [6] for an exhilarating demonstration of it). A sort of principle of indetermination [7] holds in human relations which prevents the observer from being neutral with respect to the phenomenon s/he is observing. In a cooperation support system the situation is aggravated by the fact that the participants in the conversation are both observers and observed [2].

Let us now suppose that we possess an interpretative model of the pragmatics of communication and that we can use it to design an "agent" able to make more or less accurate forecasts concerning the communicative attitudes of the subjects. This agent mediates between us and our corespondents by filtering and interpreting both our communicative actions and those of our telematic interlocutors, and can advise us as to the most suitable pragmatic attitudes to adopt in the communication.
This paper explores the theoretical possibilities of constructing such an agent. To obtain this result, the agent must construct a representation of the communicative behaviour of the conversational subjects based on analysis of their preceding communications. We shall call this representation "user model". From our point of view, a user model is an appropriate formalized description of the relational attitudes of the participants in conversations.

If we assume that it is possible to develop an agent of this kind, we may hypothesize that there will be a change in the communicative situation of two subjects. If we use A and B to stand for the two communicating human beings and A* and B* for their respective agents, then the normal relations A:B and B:A that describe the communication between the two human beings must be supplemented by the relations A:A*, A*:B*A:B*, B:B*, B:A* and B*:A* describing the attitudes of the two human subjects towards their agents and the attitudes of the agents towards each other.

In a pragamatic model of communication no communicating subject or any artificial subject can be excluded from the system described by the model. The agents constructed prior to the conversations that they must manage may be considered as akin to the therapist in a family therapy session, i.e. as not being wholly external to the system but acting to shift it in a desired direction [8].

The principle of the indetermination of human actions also holds true in a pragmatic model of communication, only that now the human beings involved possess mirrors in which they can observe themselves. They may adopt strategies (even complex ones) for doing without their mirrors (breaking them, avoid being reflected in them, deliberately making them reflect distorted images). However, unlike a model based exclusively on speech acts, they cannot escape their responsibilities [9].

2. The pragmatic dimension of the agent

In our discussion of the theoretical possibilities of constrcting an agent able to behave in the manner described above, certain questions arise which have not yet been given a definitive answer.

We will use the term "agent" for a software instrument which is able to intervene autonomusly in a conversation between a user and his correspondents. The agent is a sort of "deus ex machina" of communications. Its task is to use a pre-defined "theory" to interpret the flow of messages between the participants. To do this, it must possess a formalized description of the partners; and this description is what we have labelled as "user model". From the point of view of the agent, a "theory" is a formalized model of the induction process used by the program to forecast the possible bahaviours of the users. The user model is instead the data structure that stores and organizes information relevant to the theory.

For Kass & Finin [10], who draw on and modify a definition by Wahlster & Kobsa [11]: "A user model is a systems knowledge source that contains explicit assmptions on all aspects of the user that may be relevant for the dialog behavior of the system".

According to Kass and Finin, a user model should contain information concerning:

- user aims
- plans (strategies)
- preferences
- knowledge and prejudices.

However, development of an instrument of this kind raises a many problems, each with a different level of complexity. The focal point of the question is the inadequacy of theories dealing with human behavior when used in computerized environments. For this reason our definition of user model (less general than Kass & Finin's) relates to the pragmatic aspect of communication.

It is standard practice to define the set of rules which allow the construction of well-formed messages in a particular language as syntax, the set of meanings that these well-formed messages simultaneously convey to the transmitter and to the receiver as semantics, and the effect that these message may have on the receiver as pragmatics.

"While syntax and semantics may be, at least in principle, conventionally defined in a rigorous manner on the basis of agreements between transmit ter and receiver, (this) is not always the case of the pragmatics of a message, insofar as the effect on the receiver may differ quite considerably from what was intended by the transmitter" [12].

Winograd & Flores [4] distinguish two aspects of pragmatics: action and context. The language/action perspective emphasises pragmatics as a description of what the subjects intend to do through communication.

Winograd and Flores use a model based on the theory of speech acts originally proposed by Austin and subsequently developed by Searle [13,14]. A speech act is made up of two elements: its referential component and its force [13]. The referential component of a

speech act is given by the semantic situation; its force is defined in terms of pragmatic interpretation. The important aspect of a speech act is the speaker's intention rather than the acts linguistic symbol. Performing a speech act therefore entails committing oneself to a form of behaviour governed by rules that are not so much grammatical (although these still have to be respected) as communicative. According to the theory, speech acts can be divided into 5 main categories: Assertives, Commissives, Declaratives, Directives and Expressives. Speech acts exchanged between two partners constitute a conversation. Two types of conversation are commonly distinguished: a) conversations for action, where commitment concerns an action that one of the two subjects must perform; b) conversations for possibility, where the two subjects explore the eventuality of altering their usual relationship.
De Michelis [15] provides a graphic illustration based on Petri Networks of the utterances exchanged during the two types of conversation.

As regards the pragmatics of context, interpretation of all terms and all sentences depends a) on the set of meanings that the well-formed messages convey simultaneously to the receiver and to the transmitter, b) on the situation in which the two subjects undertake their actions, and c) on the personal *backgrounds* (experiences) of the interacting subjects.

The language/action perspective is too general for our purposes: the universe of possible actions is difficult to interpret on the basis of concepts of communication and information alone. We shall therefore introduce a more limited definition of the term "pragmatics" which will provide the basis for the elementary pragmatic model set out below.

3. The elementary pragmatic model

3.1 Theoretical presuppositions

According to the relational approach [16], interaction among organisms constitutes a mind, not merely a manifestation of one. The resultant network of relationships is what Bateson calls "the structure that connects", and it is this structure that must be investigated if one wishes to formulate models of behaviour. If this perspective is to be applied to communication, one must treat the whole network of communicative relationships as a system and focus one's attention on the modifications in it deriving from subjects' communicative acts.

One of the axioms of pragmatics postulates different logical levels for every message or communication unit that, apart from containing information on content, contains a command or information on the relation [1]. Just as there are rules governing syntax and semantics which may be used to give formal treatment to these aspects of communication, so we may suppose that there also exist rules able to describe its pragmatics. This hypothesis is supported by observation of interactive systems where interactions take place according to systematically recurring patterns, regardless of the multiple conditions that characterize them and of their vast range of contents.

A model is constructed on the basis of these regularities displayed by interactional processes. These may therefore be regarded as the invariants in an interaction process and be seen in terms of patterns [1,17]. Thus pragmatic redundancies, i.e. models or patterns extractable from interaction processes in a subject system, are looked for [2]. There is empirical evidence for the relevance of interactional patterns. These are not static arrangements: they change through time and according to the situation [18]. Winograd and Flores talk of recurrent conversations: "The rules of conversation are not arbitrary conventions..., but reflect the fundamental nature of language and of human action" [4]. Moreover, an analysis of the interaction mechanisms in a structural model see a subject as

belonging to a particular system in which the interactions that modify his/her relational pattern take place.

Most cooperation support systems preserve traces of the interactions (cf. systems such as Coordinator, Glbis, CHAOS etc., which preserve them [19,20,21,22,15,23]; or systems which use semistructured messages [24]). These traces can be reconstructed as a succession of elementary interactions. If a suitable model is available, behaviour can be studied as a systemic phenomenon and the traces of interactions can be interpreted from a pragmatic point of view.

3.2 Assumptions

- The system constituted by interactions among subjects is a closed one.

- Each subject is represented as a <World, Mechanism> couple. The World is made up of a finite but indeterminate set of propositions, each one of which having a meaning perfectly known to the subjects (sharing of the semantic). These propositions are interpretable as the subjects' positions *vis-à-vis* a previously uttered proposition. The Mechanism component (or interaction pattern) is a device elaborating the elements of the World as the interactions unfold.

- The elements of the World are incorrelate (there is no correlation among the subjects of successive elementary interactions). World and mechanism are also incorrelate (the forms that interaction takes are independent of its content).

- There is a channel of communication between the subjects.

- The interactional processes in the system (composed of a number of subjects) are analysed as a succession of dyadic interactions.

- Interactions involving the exchange of a single bit of in formation are regarded as being elementary.

For more exhaustive treatment of the theoretical basis ofthe EPM and of its heuristic capacity, see [25,26].

3.3 Single bit of information exchange model

Given two subjects A and B, an elementary interaction of A with B can be expressed as a triplet

$$<X_A,X_B,X'_A> \quad \text{xith} \quad X_A, X_B, X'_A \in \{0,1\}$$

where X'_A is the final value of a certain proposition whose initial value was X_A, following comparison with the value X_B assigned to this proposition by B. Of course, this describes the situation from A's point of view.

A sufficiently long succession of triplets can provide the values of A's *coordinates:*

$$U_1 = n<0,0,1>/(n<0,0,0>+n<0,0,1>)$$

$$U_2 = n<0,1,1>/(n<0,1,0>+n<0,1,1>)$$

$$U_3 = n<1,0,1>/(n<1,0,0>+n<1,0,1>)$$

$$U_4 = n<1,1,1>/(n<1,1,0>+n<1,1,1>)$$

where $n<X_A,X_B,X_A>$ represents a statistical measurement of each of the triplets observed in the course of the conversation.

In other words, the U_{Ai} coordinates are interpretable as the probability that, starting from the four possible initial states (Table 1), the final state of subject A will be equal to 1.

$$U_{Ai} = \text{Probability}(X_A=i,\ X_B=j \rightarrow X'_A=1) \quad \text{with } i,j \in \{0,1\}$$

X_A X_B	$P(X'_A=1)$
0 0	U_{A1}
0 1	U_{A2}
1 0	U_{A3}
1 1	U_{A4}

Tabella 1

In the case of a deterministic automaton whose behaviour is entirely independent of content, the $U_i \in \{0,1\}$'s and Table 1 represent the set of Boolean fnctions in two variables.

The truth table for these functions can be represented in a natural manner by a binary oriented tree diagram [27]. For example, by applying the EPM to the base conversation pattern set out by Winograd and Flores [4], one obtains Fig.1

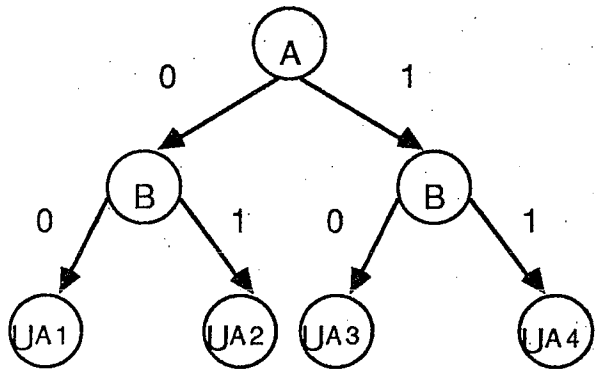


Figure 1

where the conversation ends up, with respect to one of the two subjects, in a sequence of triplets of binary values corresponding to all the possible three-value combinations. Thus:

A proposes	(1)
B accepts	(1)
A closes with satisfaction	(1)
A proposes	(1)
B accepts	(1)
A dissatisfied does not close	(0)
A reformulates his/her proposal	(1)
B refuses	(0)
A gives up	(0)

In this way the subject modifies his/her world by using a mechanism comprising only one of these functions. For subject A we have:

$$X'_A = F_A(X_A, X_B) \qquad \text{with } F_A \in \{F_0, F_1, \ldots, F_{15}\}$$

However, if we make the more realisitic hypothesis that there exists a distribution of the respective probabilities of the 16 functions that is sufficiently stationary to be observable, given an adequate number of elementary interactions, we can calculate the frequency with which the subject uses each of the 16 functions. Thus we have:

$$F_A = \{\langle a_i, f_i \rangle;\ i=0,\ldots,15\}$$

where a_i is the probability of using function f_i. In this way interacting subjects are considered as being probabilistic autonoma described in terms of the 16 Boolean functions.

The mechanism or relational pattern of a subject is therefore represented by a vector of 16 probabilities corresponding to the probability of each of the Boolean functions being used and corresponds to a point internal to a hypercube with the 16 Boolean functions as its vertices (Fig. 2).

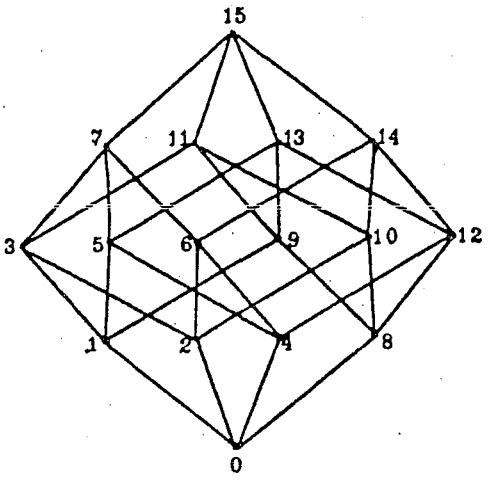


Figure 2: Boolean Algebra B_{16}.

The model thus acquires considerable descriptive power, given that that probabilistic vector makes it possible to handle an extremely wide range of kinds of behaviour.

The values of the a_i's can be obtained from those of the u_i "coordinates" on the hypothesis of the principle of maximum information [28,26,25]. But the core of the model is the law of the changing of mechanisms or "relational patterns". According to this law, a subject will modify his/her mechanism by using the same law with which he/she changes the world [25,12]. Hence we have:

$$F'_A = F_A(F_A, F_B)$$

The possible results of these meta-changes are given in Table 2. This is also known as the Paradoxes Table [25] because there is interference between different logical levels (world and mechanism) [12,29].

F_A / F_B	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	0	2	3	0	0	6	7	7	6	15	15	3	2	15	15
1	0	1	2	3	1	1	7	7	6	7	14	15	3	3	15	15
2	0	0	0	3	2	2	4	7	5	4	13	15	3	2	13	15
3	0	1	0	3	3	3	5	7	4	5	12	15	3	3	13	15
4	0	0	2	3	0	4	2	7	3	2	11	11	3	6	11	15
5	0	1	2	3	1	5	3	7	2	3	10	11	3	7	11	15
6	0	0	0	3	2	6	0	7	1	0	9	11	3	6	9	15
7	0	1	0	3	3	7	1	7	0	1	8	11	3	7	9	15
8	0	0	2	3	8	8	14	15	7	14	7	15	3	10	7	15
9	0	1	2	3	9	9	15	15	6	15	6	15	3	11	7	15
10	0	0	0	3	10	10	12	15	5	12	5	15	3	10	5	15
11	0	1	0	3	11	11	13	15	4	13	4	15	3	11	5	15
12	0	0	2	3	8	12	10	15	3	10	3	11	3	14	3	15
13	0	1	2	3	9	13	11	15	2	11	2	11	3	15	3	15
14	0	0	0	3	10	14	8	15	1	8	1	11	3	14	1	15
15	0	1	0	3	11	15	9	15	0	9	0	11	3	15	1	15

Table 2: Table of Paradoxes [25]

3.4 Experimentation already conducted

3.4.1 Psychiatry

Various relational tests [25,30] have been developed to measure the parameters of the model (coordinates and probabilities of the functions).
The experimental applications of the model that have been made so far are as follows:
In clinical psychiatry a significant difference has been found between the relational patterns of "normal" and "pathological" subjects [25] The EPM has also been widely applied in clinical practice [31]: a family therapy group at the Psychiatric Clinic of the University of Bari has used it in therapy for more than ten years. Also to report are a transversal research study of a significant sample of young people aged between 6 and 18 [32] and a study based on the hypothesis of modifications caused by the administering of drugs [33]. Both these research studies have confirmed the model's prediction of an evolution in a subject's interactional pattern during his/her physical ageing process (research into evolution), and the predicted change consequent on the administration of drugs - which came to assume the role of "virtual subjects", has been found. Further, a computer simulation procedure has been developed which sheds light on the conditions leading to the development of a stable normal pattern of interaction [30,18].

3.4.2 Social Psychology, Linguistics, Economics

Because the EPM lays stress on relationships, it can be applied to Social Psychology, and it is of particular importance for the study of phenomena such as leadership, marketing, opinion polling, changes in attitudes and the resolving of conflicts [30]. A good correlation has been found between the model's parameters and the results of personality tests that consider relational aspects to be important (Cattel's 16-PF), while there is no correlation in the case of situational or intelligence tests [30]. Another preliminary research study has revealed a correlation between pragamatic distance, defined in agreement theory [12], and the "traditional" parameters measured in bargaining situations [34].
The model has also been used in linguistic studies measuring dominance in families undergoing therapy [35]. Syntactic structural analysis of discourse has been flanked by analysis of non-verbal indicators such as the taking and completion of conversational

turns, the length of such turns, the duration and frequency of pauses, the cognitive manoeuvres adopted.

4. A possible application of the EPM

The 16 functions of the EPM can be interpreted as elementary behaviour patterns of subjects, and the Table of Paradoxes enables prediction of the direction that a change in subjects' relational style will take (Table 3 shows an interpretation of the 16 functions).

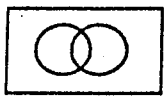
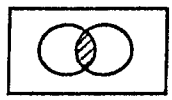
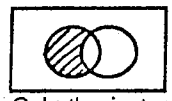
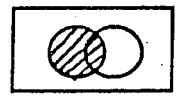
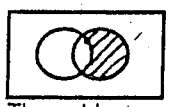
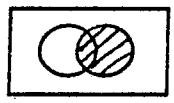
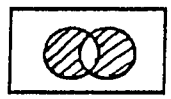
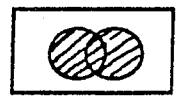
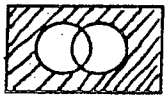
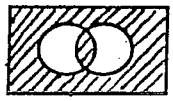
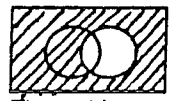
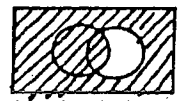
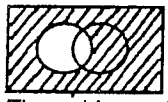
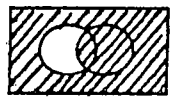
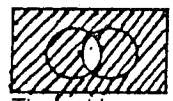
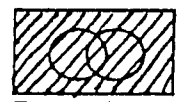
 F_0	 F_1	 F_2	 F_3
No proposals, not even those which are shared with the other will be accepted. The subject is unable to estabilish any relationship.	Only the proposals shared by the subject are accepted	Only the instances of the subject himself which are not shared by the other remain after the interaction has taken place. He refuses any element of overlapping	All the instances of the subject remain unaltered by the interaction. Every element is maintained independently by the proposal of the other subject
 F_4	 F_5	 F_6	 F_7
The subject accepts the proposals of the other only if they are not his own. "You want to do that? Let's do it. But I'm not getting involved. It's your responsability"	The subject substitutes for his own instances those of the other. Like a person who says: "You can't do that, O.K. I'll do it with you"	The subject doesn't accept common elements. Has the tendency to make the other person accept his own proposals or he accepts the proposals of the other without sharing them	The subject is willing to accept the proposals of the other and wants his own to be accepted:"I have my world, you have your world, we can work together"
 F_8	 F_9	 F_{10}	 F_{11}
The subject loses his own proposals and refuses those of the other overlapping elements outside of the ring	As in F8, except that the shared proposals by the interacting subject are saved. In the empty space of F8 there is an intersecting point of encounter with the other	The subject systematically refuses the proposals of the other. In the process of doing so he can even refuse elements from his own world	In absolutly conserving his own point of view the subject uses elements from outside of the ring
 F_{12}	 F_{13}	 F_{14}	 F_{15}
The subject refuses his own world, independently from the proposals of the other. He could seem very complying in respect to the other, but he is hiding an F3	He totally accepts the other's proposals as well as elements outside of the ring of interaction	The subject avoids any point of interaction at the cost of accepting elements outside of his own world, will do anything, even things he doesn't want to do	The subject will accept any proposals even those not formulated. He says "Yes" to everything. His behavior (like F0) doesn't produce any information

Table 3: Interpretation of the elementary behaviours [82]

Referring to the example proposed by Winograd and Flores in Understanding Computers and Cognition [4] concerning an imaginary meeting called to decide whether to introduce a new computer system into an organization, we now present a possible interpretation based on the elementary pragmatic model.

Winograd and Flores define a theory of interaction according to a number of statements, certain of which we quote here:
a) You cannot avoid acting.
b) Yo cannot step back and reflect on your actions because there is not enough time during negotiation to organize an extensive strategy.
c) The effects of actions cannot be predicted.

A manager, company director or similar is chairing the meeting. We shall describe his interaction with the group of participants as a series of binary interactions placing him in relation with one participant at a time. For the reader's convenience, we shall use the term "Mr Smith" instead of "the Smith group" and do likewise for every other group. Although for each subject, as the discourse topics vary and as the action unfolds, the mechanism articulates itself in the use of each of the 16 functions, the relation between a specific subject A with a particular partner may be characterized by the presence of certain dominant functions.

Mr Smith tries to oppose the computer via the strategy of keeping discussion focused on costs and by diverting it away from what the meeting is actually doing. He may be attributed a relational style of type F_{10} - that is, an allout oppositive style which leads to his systematic rejection of any proposal made by his opponent (in this case, the purchase of the computer).

Mr Wilson, who tries to ensure, computer or no compter, that he keeps control over scheduling policies, seems to use an F_7 relational style: he pushes his own proposals but at the same time accepts those of his interlocutor as well as joint proposals.

Mr Evans can provide the key to the situation by taking one side or the other. Those present focus his attention on the problem of personnel training, which is exclusively his province. At this point he can be assigned an F_0 relational style - i.e. a relational style that indicates his withdrawal from the realtion - or else an F_3 style showing that the properties (contents, elements) that existed in him prior to the interaction are still unaltered subsequent to it. Every element of his world is preserved regardless of the proposals made by the others.

Let us attribute a relational style to the chairman of the meeting. This style will be of use to us in describing his behaviour towards the participants in the meeting. The chairman could equally use an F_3 or an F_7 relational style.
But, alternatively, following the Table of Paradoxes (Table 2), he might decide that using the F_3 relational style would transform Mr Smith's relational style into F_{12}: one that indicates total acceptance of the other's world but also the rejection of both one's own world and of elements in common. Instead, he might see Mr Smith's relational style change from F_{10} to the highly cooperative F_7 function if he used an F_8 relational style (that is, by having his and the other's proposals defeated and by using only external elements). As for Mr Wilson , the most suitable style that he can adopt in order to keep (F_7) favourable towards the introduction of the computer could be equally either style F_3 or F_7, in that neither would change his previous relational style. In the case of behaviour identified as F_0 i.e. in the case of the impossibility of the relationship and of the non-acceptance of any proposal - the subject would not in any circumstance alter his behaviour of (autistic) withdrawal.

5. Conclusions and future directions for research

The model refers to and is interpretable in terms of generic, unambiguous communication. That is to say, in the elementary pragmatic formulation one assumes that subjects share the semantic of the information communicated; and that unambiguously associated with this information is a binary value (and subsequently its probability). When one specializes in particular forms of communication (electronic communication, language, other fields of application), the task becomes one of defining if and how the semantic is shared, if and how a binary or binarizable value can be associated with the information. For example, within the setting of a particular application, assuming that "silence = assent" or, recursively, that "silence = the delayed answer" may be contextual and non-absolute.

The next stage of experimentation requires a statistically significant number of interactions by individual system or element. Analysis of data under these conditions produces statistically valid results for the set of experiments; the validity of the individual experiment system or element - is to be verified specifically for every type of application. (This validity is still not guaranteed in its application to clinical psychiatry).

However, the situation seems to be better in electronic communication. Here the informational and classificational context is probably much more limited (one can expect more patterns that are more superifical and closer to a low number of vertices, rather than patterns internal to the hypercube).

Finally, the existence of significantly distinct classes of patterns needs to be verified. If it turns out that all patterns are more or less similar, one will have to conclude, in general, that the information to be gained from experiments is practically nil (because of the absence of parameters for comparison). If, instead, two or three classes emerge, analysis and action shold be relatively simple to interpret and accept scientifically.

In conclusion, one notes that: "The model has been constructed in order to describe not human subjects but subject systems.one may realistically maintain that human systems often evolve on the basis of decisions taken regardless of the contingent argument, but in order to command, to warn, to deter or simply to react. It also often happens that agreement or disagreement is not principally motivated by personal opinion, but by structural factors such as alignments and factions and, again, by the previous history of the relation, seen however more in terms of score than of rationality. In all these cases, probably, a purely pragmatic quantitative model is applicable in principle" [12].

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