

Developing a Communication-Oriented Ontology
for
Using Computer Modeling in Negotiation

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Abstract

Computers have been used as tools to facilitate complex negotiations and to resolve disputes that arise in that context. These past efforts have been limited by a view of both negotiation and of computers arising out of our pervasive technical rationality paradigm. This paper, an initial inquiry into a new ontology for design, suggests an alternative model for negotiation and disputes based on an interpretive, communicative model that points to a richer set of possibilities for computers than merely the provision of information to the parties involved. In particular, the concepts of communicative rationality, developed primarily by Habermas, point to specific functions for computers in assisting the parties in establishing claims in rational domains beyond the positivist domain of technical rationality.

Introduction

This paper examines three key distinctions suggested in the title of the paper – negotiation, communication, and computer modeling, in the context of developing such models to support complex negotiations such as may be encountered in international dealings or the resolution of conflicts over environmental matters. Typically in such settings, one finds many parties involved in discussions of a complex technical subject with significant economic, political, and scientific consequences from the set of actions being negotiated. Frequently there is a substantial uncertainty in terms of the consequences of the potential agreement that is the focus of the discussions. In recent years, global environmental concerns over the disappearance of stratospheric ozone or the problems of the greenhouse effect and global warming have captured the policy stage among nations. Closer to home, our own U.S. Superfund program, the national effort to clean up old chemical waste disposal sites, has become bogged down over complex litigation by the many parties involved on a single site. One often finds the lawyers representing tens to hundreds of companies, their insurers, state and federal agencies, and the neighbors in intense, highly adversarial litigation aimed at sorting out responsibilities for project costs that now amount to many millions and at selecting the proper technical approach to employ.

The history of such discussions points to few successes as a measured by the emergence of agreement among the parties that are implemented voluntarily according to the terms of the agreement, or are accepted without protracted subsequent negotiations to revise the terms. In environmental disputes, litigation in the courts attests to the inability of the parties to come to any sort of mutual understanding and agreement. The process has become very protracted and expensive, and increasingly requires the use of experts to provide detailed information on the complex technical aspects of the subject at hand. Where there is little sound empirical basis for the arguments introduced by the experts, the disagreements spread beyond those of the principal parties to arguments between their respective experts.

Computers have been used in such cases to supplement the roles of experts in pointing to the potential outcomes of terms and conditions being weighed by the negotiating parties, and to suggest alternative options for settlement. My colleagues at MIT are working on the development of such models, based initially on a successful application in the Law of the Sea Negotiations some years ago. The primary purpose of the early models was to enrich the technical understanding of the players and to offer insight into alternatives that had not been

previously been available to the negotiating team. This application of computers follows from the basic conception of computers as information-providing tools and from a theory of negotiation that is fundamentally one where the parties seek to maximize some objective function. While such a model of the use of computers in negotiations is certainly a very powerful one, it may not conform to the fullness of the actions that are occurring during a complex negotiation, and thereby, be limited in its effectiveness in assisting the parties towards reaching agreement and action, the primary goal of bona fide negotiation.

With this introduction, let me proceed to define the key distinctions on which I will build an ontology of computer-supported negotiation. First what is negotiation? One classic definition of negotiation is given by Walton and McKersie (1965, p. 3) as: "Social negotiation is the deliberate interaction of two or more complex social units which are trying to define or redefine the terms of their interdependence." This is a very broad and powerful base for thinking about negotiations, but lacks one feature, that the interaction between the units is linguistic and takes the form of a complex conversation involving a series of speech acts. Negotiation is often considered in the context of conflicts, as a means of resolving the conflict through a voluntary agreement by the parties involved to a future course of action.

I would argue that negotiation is a much more pervasive process and is the basic conversation by which interacting individuals or social units act in general. The key in this last sentence is the word, "act." Social interactions are just that, conversations among people out of which some action occurs. Winograd and Flores (1986, Ch. 5) have developed a model of a prototypical conversation for action based on speech act theory. This model was used as the basis for a commercial computer software package, The Coordinator™, to support the coordination of action in organizations and the achievement of high levels of productivity.

The negotiations that are of interest in this paper and have been the subject of research by many scholars are particular in that they are not those that occur transparently in the everyday flow of action, but, rather, are entered into in the middle of some sort of conflict or disagreement or dispute. I prefer the use of dispute or disagreement over conflict, as in the latter case, the conversation among the players has often broken down completely such that no further linguistic interactions are occurring. In a conflict the interactions may devolve to coercive, physical force or other related actions, such as unilateral economic sanctions. This distinction is important because of the contextual differences between the conversations that go on in a dispute and those that occur in everyday activities. To an outside observer, the flow of conversation might look exactly the same, but to the parties inside the contexts are very different. One key difference in the negotiation process that takes place in the ordinary, everyday flow of action and that which takes place in a dispute is that the background of trust and mutual concerns that is present in our permanent institutions is missing in a dispute. The players do not agree on the actions to be taken, and do not trust one another, have doubts as to the sincerity of others in faithfully implementing the agreements that might transpire, or may see the others as coming into the process with inimical goals. The design of an effective computer system for assisting the negotiation process requires an understanding of these contextual differences and of the impact on the conversational interchange among the parties.

Disputes show up in every level of human interactions from arguments between family members, lovers, customers and the sellers of goods and service, governments, and aggrieved parties seeking remedy to their problems in the courts. We, in our everyday sense, tend to think about disputes over arguments over some thing - money, land, scenic outlook, or a reified version such as rights, freedom, and so on.

In this way of seeing the world, our approach to the resolution of these disputes is to seek somehow to allocate the thing over which we are arguing. Wars are one way to do this and have been the historic means by which powerful institutions like kings and states have settled their disputes. In circumstances of lesser belligerency, societies have used judges and other authoritarian means to decide in lieu of the disputant's ability to agree over the allocation of the things in question.

All of these means have one common element; they involve coercion to a larger or smaller extent, and, thus, require some sort of authoritative, powerful (in the everyday sense of power) institution in the background with the ability to force the parties to accept requests which they have no power to decline, with a consequent frittering away of dignity and other human concerns in the process. The increasing complexity of life in the modern world, coupled to our growing awareness of man's reliance on maintaining the supportive integrity of our

environment and of the destructive force of our coercive mechanisms, raise many questions about the efficacy (and, as always, the normative functions) of our traditional dispute- and conflict-resolving mechanisms.

Disputes are not fundamentally disagreements about the things in question, but are breakdowns in the linguistic dance between the parties that lead to a recurrent pattern of requests and subsequent declines. If these breakdowns persist, the communicative framework linking the parties often dissolves. When this happens, no means appear to be available to any of the parties other than taking coercive, often violent action, or appealing to another body to interpose its authority and might. Further, I argue that the disagreements relate, even in the case of real things like money or custody of a child, to additional underlying domains of concerns that are fundamental to being human. The objective, surficial claims are a proxy, a reified metaphor for these unmet underlying concerns.

I note that all disputes can be described in terms of a canonical series of linguistic acts (see Winograd and Flores, 1986), which I will describe below. If this is so, then, this model opens up some additional ways in which we, individually or through our social institutions, can intervene, in a non-coercive manner to shift the nature of that conversation toward reaching understanding by the parties in dispute and a settling of their claims with consequent coordinated, effective action. [It is interesting to note that the etymology of "negotiation" is something like to negate leisure or, conversely, to get back to business.] This kind of intervention in the negotiation process has been called mediation and is employed as an alternative means of dispute resolution in many venues. Mediation, as practiced today, lacks a sound, theoretical basis, and has had uneven results in the past. There is no disputing that some mediators are very effective in bringing disputants together, just as there are therapists with a magical reputation, but there is little agreement on what is going on during the process and what the mediator is doing.

In developing a model for the role of computers in negotiation, it is interesting to examine them as a sort of mediator intervening in the negotiations, providing similar kinds of functions, and so, it is important to examine further what mediators do in the negotiation or dispute-resolution process. The roles played by interveners in mediating – as opposed to adjudicating disputes – alter the conversational or linguistic context of the disputants, shifting the dynamics of their conversation from one with no possibilities for consensual, communicative action to one where such possibilities may arise. I note that this model only offers possibilities for understanding and action; it cannot guarantee action. I will discuss the role of mediators in general terms and note that the mediator can be human or, perhaps, even a computer, the specific focus of this paper.

An Ontology of Disputes

1. Speech Acts – the linguistic background

In the simplest terms a dispute arises when one party makes a request of another that is declined or where the first party determines that the actions taken (other than an outright declination) are not tendered in accordance with the promises of the other party. If, after repeated attempts to elicit a promise or remedy of a broken promise, the requester is prepared to or has taken take authoritative action, we can call the situation a conflict. The central acts in a dispute or conflict are, then, linguistic in nature, no matter what is the object in dispute. Requests are representatives of a broad class of speech acts, designed to produce action in their utterance. (Searle, 1979) Requests, in their basic form, ask someone to do something by a time certain. The most common request heard in our everyday world is "please..." We make requests, containing other background information, by using different utterances, for example, "I beg" has in the background our dire need for something and our powerlessness to get it. "I order" speaks of some background authority to dole out punishment if the request is not obeyed. And so on. Searle calls this class of utterances, Directives. (Searle, 1979) In making this kind of utterance, the speaker has determined that his or her world lacks something, and the directive is designed to produce some sort of action that will alter reality (the world) to align it with the speaker's intention.

The converse of this is the class of Commissives – utterances that commit the speaker to take actions. "I promise to do something by a time certain," is the canonical form of

commissive. In thinking about disputes, the negative promise, I decline, is important. In essence a decline is a promise not to do something. In between there are many forms of commissives, such as agree, swear, guarantee, consent...

I will introduce another call of speech acts, called by Searle, Assertives, whose importance will become clear. Assertives are statements made to express in words a representation of the speaker's beliefs about the way the world is, that is, the reality appearing to the speaker. Assertives include "assertions," claims made about the state of the world that are, more or less, undeniable or, otherwise stated, that any [universal] observer sharing the same linguistic and historical/cultural context would agree with. "Assessments, predictions, estimates..." are also assertives, but have less agreement about their reality.

Next, Searle and others discuss a class of speech acts called, Declarations. Declarations are an important set of speech acts and have the effect of creating a new world or reality out of nothingness or on top of what already exists, merely in the utterance itself. Declarations are successful in doing this only when the speaker invokes some sort of extra-linguistic institution constituted so as to bring about the declared action. Exceptions to the institutional requirement are when we invoke the supernatural or name something. "I declare that something is so," is the canonical form of declaration. More familiarly, we say things like, you are guilty or are now married, fired, hired, etc.

Other authors, even Searle, have variations on this speech act taxonomy. The key in this paper is that a conflict can be dissected into a series of speech acts.

2. Breakdowns and the revealing of the world

A second important claim in this ontology of disputes arises out of a basic way in which we, as human beings, hold ourselves and the world. Our cultural norm in the West is a Cartesian, positivist paradigm in which we divide the world between an external, ahistorical reality and our human minds that, through our rational powers, recreate the world inside our brains. I will not enter into an extended philosophical argument about the correctness of this paradigm, but I will offer that there are alternative views about the how we are as human beings and create our reality. One of the alternate views is that espoused by Heidegger and others who suggest that, for the most part, the world is unavailable to us as human beings in that we act transparently and are unaware of our actions. We do things like talking and walking without thinking about them and without a set of rules we can explicate that form the theory on which we formulate our action. And while we are acting in this way, the world is concealed from us. In an alternative model based on biology, Maturana and Varela (1988) make a claim about the origin of language, cognition, and social interaction that are consistent with and support the arguments developed by Heidegger. Winograd and Flores (1986) refer extensively to this work in their critique about the prevailing theories of computer design and of future roles for computers.

During our everyday our transparency is frequently shattered and our actions are interrupted by something in the world. Heidegger calls this a disturbance or breakdown, and suggests that there are successive modes of disturbance which increasingly reveal the phenomena of the world. Such interruptions arise when the tools we are using fail to do the job we are involved in. The car has a flat on the way to work. These kinds of breakdowns are the ones we are most aware of; our days are filled with utterances of, "oh expletive deleted," a sure sign that a breakdown has occurred. Sometimes this kind of interruption has a positive connotation or an aesthetic experience. We may stop during a walk through the woods when we become aware that there is something special about the world around us to admire the beauty of the day. Interruptions also occur when we stop our actions purposefully to reflect on what has gone on or when we are being coached to learn some new practice.

When these breakdowns occur, we wake up to the world around us and usually, perhaps always, render some assessment of what is happening and may make some declaration at the same time. Then we move on to the next action. The next action we take, according to our sense of rationality, is dependent on the assessments, declarations, and new requests and promises made in the context of the breakdown that has occurred. I may, for example, in the case of a flat tire, assess that I can fix everything up by myself and get to the job of changing the tire, or that I cannot and will call a local garage for help or that I can't do anything in time to get to where I was going in time to satisfy my original intentions, and declare a new set of intentions

– that I will forego my original destination for the time being. And any other of a very large set of possibilities for action that arise in the assessments and declarations.

The actions out of which breakdowns can arise are not limited to tangible, physical acts such as driving; they can be a series of linguistic or speech acts of the kinds that I have described above. In fact some kinds of speech acts will inevitably create breakdowns. Directives (requests) always interrupt what is going on; they are always made against a background of other actions, and thus invoke some sort of assessments in the listener. We will see that the subsequent response of the listener depends on his or her acceptance (positive assessment) of the validity of the speaker's speech act in three (or four) classes of claims. (Habermas, 1979) What is important is that Habermas and others claim we make assessments in more than the objective domain of technical rationality. This has consequences in terms of the models used to describe negotiation, mediation, and the role of experts and computers. If we limit the model to objective rationality alone, then the process depends only on assessing information, that is, data telling the players about states of the world. In examining the negotiation process in a richer communicative, additional possibilities for resolution of the disagreements emerges.

In complex, technical negotiations, the players often become preoccupied with the assessments of the consequences of the propositions under discussion. As requests are made and counteroffers presented, each party, in the subsequent breakdown, makes an assessment of the future consequences of the actions implicit in the proposition. When these outcomes are complex, the parties must rely on experts to inform them of the relevance and impact of the future expectations. Such assessments of the future state of the world will always be central to the negotiation process, but are not the only assessments that are made following each new offer or request.

3. Action and Rationality

Models of negotiation, either implicitly or explicitly, depend on some base of rationality to explain why the parties ultimately may agree on some set of terms and conditions. Only if there is some common, that is rational, understanding can the parties agree on the action being contemplated. The main body of theory for negotiations, for communication, and for computer design rests on a positivist view of technical rationality. The whole of the early economic theory of bargaining springs from a view of the rational, economic man (Schelling, 1960).

Rationality in this discussion has a broader connotation or practical sense and might be considered simply "what constitutes good reason for actions." (White, 1982, p. 9) In the positivist paradigm, only one form of rationality and action are consistent with the universal, ahistorical notion of reality. Actions are for strategic purposes by an individual. This form of rationality is basic to the prevailing theories of negotiation.

White, in his interpretative work on Habermas writes, that this form of action is,

the intentional, self-interested behavior of individuals in an objectivated world, that is, one in which objects and other individuals are related in terms of their possible manipulation. The rationality of action is correspondingly conceptualized as the efficient linking of actions-seen-as-means to the attainment of individual goals. (White, 1988, p.120)

This is the fundamental model on which all rational choice systems of thought and action are built, particularly economics and decision theory. Walton and McKersie (1965) establish a taxonomy for negotiation, in which the first category is "distributive bargaining" in which the parties attempt to maximize their own portion of a fixed pot of benefits. Even their next level, integrative bargaining, is strategic in this sense, except that the parties strive to expand the bundle of possibilities that they will allocate or agree upon.

Contextual rationality is a second model where rationality is thought of as "conformity...to norms." (P. Winch as referred to in White, 1988, p.12, fn. 8) As to this form of rationality, White says

Action is understood as norm-guided behavior and can be evaluated as being rational or irrational depending whether or not it conforms to beliefs and social norms in the

context in which it occurs. Thus, on the contextual account, what counts as rational action will vary with the social context. (White, 1988, p. 10)

Habermas, in a complex critique extending over many years and in several major works, develops a more encompassing form of rationality which he calls "communicative rationality", and deems the kinds of actions that flow out of it as "communicative action." I will appropriate, more or less, the ontological character of his theory. Habermas argues, as others have, that understanding based only on analytic, Cartesian claims is insufficient to explain how we act in general. Habermas noted that the two above forms of action and their underlying rationality are insufficient to explain and become a model for the coordination of everyday social interactions. He discusses a third mode, dramaturgical, in which an inner set of motivations or affects can be rationally associated with a subject's behavior. He then proceeds to claim

that ordinary language competence is now envisioned as giving actors the capacity to use this *entire* system of world relations and validity claims in a distinct fashion for the purpose of coordinating action. (White, 1988, p. 39)

White discusses this claim in an introductory section linking Habermas' basic sense of understanding as transcending the Cartesian view of knowing what the external world is all about, by tying understanding to communicative action.

When a speaker orients himself towards understanding - that is, engages in communicative action - his speech acts must raise, and he must be accountable for three rationality or 'validity claims' [*Geltungansprüche*]: truth, normative legitimacy and truthfulness/authenticity. Only if the speaker is able to convince his hearers that his claims are rational and thus worthy of recognition can there develop a "rationally motivated agreement" [*Einverständnis*] or consensus on how to coordinate future actions. (White, 1988, p. 28)

Now I have to shift back for a moment to the normative character in Habermas' theory. He is particularly concerned with the conditions under which action shows up in a consensual, cooperative, non-coercive manner, that is, how language can function as "a medium of unhindered understanding." (Habermas, 1981, pp. 94-5, 285-6)

Within this model, actors are conceived of as seeking an understanding in regard to some practical situation confronting them, in order to coordinate their actions consensually. Reaching an understanding requires 'a cooperative process of interpretation aimed at attaining intersubjectively recognized definitions of situations.'... one must assume a more complex competence on the part of actors than is postulated in other models of action. Within the communicative model, actors are envisioned to relate simultaneously to *all three* of the aforementioned worlds (objective, social, and subjective). Moreover, they can relate to them *reflectively* in the sense that they have the competence to differentiate the three types of relations and select one or the other as the most appropriate for interpreting a given situation and working out an agreement on a common definition of it. Thus, the three modes of world relations together constitute a 'commonly imputed system of coordinates,' which actors have at their mutual disposal to aid them in understanding one another.

Actors within the communicative model are not only accorded the competence to dispose reflectively over the three world-relations, but also the competence to assess the rationality or irrationality of one another's actions according to all three of the respective sets of criteria (truth/success; normative legitimacy; and truthfulness/authenticity) which are implied by the different possible world-relations. (White, 1988, p. 39)

4. Disputes as recurrent linguistic breakdowns

It should be clear, even with the above sparse and curtailed discussion of Habermas' argument, to visualize the conditions under which the unhindered flow of speech, including the claims and counter claims, could lead to understanding and agreement and subsequent consensual action. But we know that disputes over just such claims are the subject of much historical writing and take the center stage in our contemporary consciousness. Partly that arises because, as Heidegger says, the world is only revealed in breakdowns. Linguistic breakdowns are a common form of failures to coordinate action transparently. I will argue that all disputes have their origins in linguistic breakdowns, which if not remedied, will often turn into coercive, unilateral actions involving force of one kind or another.

Before turning to disputes, let me return a more common form of social conversation, which I have called negotiation. I note that negotiation is a term of art in many arenas of dispute resolution, and often has a formal sense. As noted earlier in the paper, I am using the term more broadly; others have referred to social talk as the general kind of conversation people engage in in many forms of social activity. (Giddens, 1984) Negotiations, in this broad sense, are nothing more than an extended series of speech acts, initiated with a request from one person to another. The request may be responded to with a simple promise, followed by the actions inherent in the promise. With those actions and the requestor's implicit or explicit declaration that the conditions sought in the request have been satisfied, the negotiation is complete.

More frequently, the events do not unfold in such a simple manner. The party to whom the request is made, often asks for more information to validate the claims made or implied in the request, and may make a counter-offer, promising to do something related to, but not quite the same as that originally requested. This dance may go on for some extended period of time as is the case in most international treaty negotiations, or in labor contract talks. In these complex negotiations, the parties involved may employ agents to negotiate for them, for example, lawyers in labor and other business negotiations. These negotiations may become quite complex, as the parties actually involved in the linguistic dance are not the "official" parties, thus the need to have treaties, negotiated by agents of governments, ratified by the official authoritative bodies.

The speech acts that form the explicit dance of negotiation tell only part of the story. As noted earlier, directives (requests) are a special form of speech acts which have the distinctive character of inevitably producing a breakdown and thereby raising assessments to the surface or at last to some level of cognitive activity. Habermas goes beyond the general ontological sense of seeing the world revealed in a specific way, through the raising up and establishing of the three specific sets of validity claims. (Habermas, 1979) These claims show up as assessments (examples of the assertive class of speech acts) made by the listener as part of the general competence we all acquire as natural language speakers. Each of us, as a listener, assesses the validity of the claims made by the speaker in the several domains of rationality. When someone makes a request, for example, when a parent asks her child to put on his or her galoshes before leaving for school, the listener will assess the request according to the three classes of claims:

1. Truth - In this case, the child might assess whether or not it is raining or likely to rain. This assessment relates to the objective reality context out of which the request has come. Failing to accept that claim, the child might balk at doing the requested action, requiring coercion if the parent was insistent. This family of claims deals with objective rationality; the effective choice of means to some end otherwise specified. Such a truth claim is always at the base of grounding for a request; in it are buried the requester's normative intentions. It is a set of assessments pertaining to the future that would show up as a consequence of taking the actions proposed. In our Cartesian world, all claims collapse into this domain.
2. Truthfulness or sincerity - Here the child would question the parent's sincerity in making the request. One might expect that in most cases of this direct kind of request between familiar parties that this claim is accepted without much argument. But in some situations of family breakdown with a history of making specious requests, the child might doubt the sincerity of the request. In the more general social situation,

this claim is more naturally questioned, often in association with offers or promises made in response to requests, and may be completely absent in extended conflicts where one or more of the parties has an identity of broken promises in the past. The absence of validity of truthfulness is often expressed as, "I do not trust you." Or, in many cases, the respondent does not explicate this assessment. I suspect that many social conflicts which appear rooted in claims over the contextual truth are more fundamentally failures to establish claims in the truthfulness domain. Habermas claims that this domain belongs to the subjective or dramaturgical dimension of rationality. It is connected with the inner set of intentions and cognitive states of the party or parties who are expected to be the actors in the pending step in the conflicted conversation.

3. Legitimacy - Here the child would ask whether the parent is acting out of concerns for his or her health or out of some other disconnected motivation, serving only the parent. It is from this class of validity claims that much conflict arises. Legitimacy is related to the normative or intersubjective dimension of rationality. The most evident assessment in observations of conflicts appears in arguments over the fairness of the requests. Often, the parties can be heard to say that the others are playing with a different set of rules.

Occasionally a fourth class, that of comprehensibility, is added to the three discussed above. This claim is fundamental; I cannot enter into a conversation leading to action if I cannot understand the language itself, or the conventional use that the speaker is using. Comprehensibility also may enter into complex technical arguments where the parties speak in jargon and technical distinctions. This is an important aspect of conflict around social decisions involving complex technical issues, such as the siting of hazardous waste facilities or of determining strategies for cleaning up Superfund sites. The arguments used by one of the parties may not be comprehensible to another. In the case of arguments around the riskiness of a proposed action (a request to accept something potentially dangerous), the parties may be speaking in two sets of mutually foreign languages, but all the time believing they are comprehensible to each other.

Disputes, as constituted by recurrent patterns of breakdowns in the negotiating process, may arise in the course of such extended conversations. In such extended conversations the other party or parties can agree or not with the latest request, depending on their assessments in the several validity domains. When the assessments are negative, that is, that one or more of the validity claims is not satisfied, the other party or parties will decline or possibly make some counter-offer, often in the form of a request for further information, or an offer to take action under some variant of the original request. This process will be repeated until

1. some agreement appears, that is, the parties have reached an understanding, such that the requested set of actions are promised,
2. the parties break off the conversation,
3. the parties appeal to an authority for adjudication, or
4. some sort of unilateral action is taken.

The latter three actions in the above list constitute a conflict. It is interesting to note that this stage of conflict is generally signaled by another form of speech act, a declaration, for example - I declare war, I'll see you in court, or may you burn in hell. It is important to recognize that the ultimate breakdown in communication comes out of the failure to establish one or more of the validity claims through the on-going dialogue.

In either case, if the unfulfilled request remains valid and consensual agreement is still sought, for example, during a truce or armistice in a belligerent action, then some means of re-initiating the conversation is essential, and some means for introducing a new set of claims and assessments is needed; otherwise the conversation is bound to revert to the original ineffective dialogue, doomed to turn into two disconnected monologues.

The several stages or types of negotiations suggested by Walton and McKersie (1965) are consistent with this ontology. Distributed bargaining involves only the acceptance of claims in the category of objective truth and results in strategic behavior by all of the parties. Integrative bargaining couples such claims with an atmosphere of trust in order to set up a

speculative context in which the parties can create and explore possibilities that were not available at the start of the bargaining. Their third category, attitudinal structuring, recognizes a broader interpersonal set of relationships and may involve both the domains of truthfulness and legitimacy. The latter category, intraorganizational bargaining, extends their arguments to a second level of negotiations among players in the organizations represented by negotiators at the main bargaining table.

These four levels of negotiation conform to two separate distinctions of communication. The prevailing definition of communication is the transmission of information, which is fundamentally context-free, between a transmitter (speaker) and receptor (listener). In this paradigm, computers are limited to a role of informing the claims in the single domain of objective reality, that is, truth in the above set of categories. For this role, computers can provide data, per se, simulate the "real" world through various kinds of models, or substitute for human expertise through some form of artificial intelligence. Winograd and Flores (1986) argue that computers cannot become fully intelligent because human actions are determined by our biological structure as Maturana argues, not by a Cartesian, representational model of a rational, cognitive mind, and, as yet, we have not been able to mimic that structure in a machine. But they do accept that computers can play important roles in a bounded sense of rationality. This is an important function for computers in negotiations, but may be an impoverished view of their potential roles.

Maturana and Varela (1988), arguing from a biological point of view, imply that communication is a linguistic interchange among individuals with the intention of achieving mutually coordinated action. They note that

Our discussion has led us to conclude that, biologically, there is no "transmitted information" in communication...

This conclusion is surprising only if we insist on not questioning the latest metaphor for communication...According to this metaphor of the tube, communication is something generated at a certain point. It is carried by a conduit (or tube) and is delivered at the other end. Hence there is a *something* that is communicated, and what is communicated is an integral part of travels in the tube. Thus, we usually speak of the "information" contained in a picture, an object, or, more evidently, the printed word.

According to our analysis, this metaphor is basically false. It presupposes a unity that is not determined structurally, where interactions are instructive, as though what happens to a system in an interaction is determined by the perturbing agent and not by its structural dynamics. It is evident, however, even in daily life, that such is not the case with communication: each person says what he says or hears what he hears according to his own structural determination: saying does not ensure listening. From the perspective of an observer, there is always ambiguity in a communicative interaction. The phenomenon of communication depends on not what is transmitted, but on what happens to the person who receives it. And this is a very different matter from "transmitting information."

Communication, in this sense, is consistent with Habermas' claims that action and understanding depend on context and on the establishment of validity claims (grounding) in a broad set of communicative rational domains.

When the parties are unable to handle the social talk by themselves, they may turn to a negotiator to act in their behalf, and, in the case of conflict, may turn to an extra-linguistic authority to intervene and force a settlement of the claims. It is important to distinguish between "pure" negotiations between the parties making claims and counterclaims, and "mediated negotiations (see below)," where some measure of responsibility to speak for and to the parties has been delegated by them to various kinds of third parties.

The use of experts is another device employed by negotiators to enrich their knowledge of the objective impact of the issues at hand. When the issues being argued involve complex economic or phenomenological outcomes, such as the distribution of costs among nations or the time it will take to increase the global temperature by five degrees, the negotiating parties generally will not be able to assess the impact of the latest set of offers and must call on experts. In the distributive bargaining, typically each party employs its own experts in a strategic

exercise to come to the "best" guess of the future, that is, the future that provides the greatest gain for their interests. Computers can be used to supplement or complement the provision of information to ground the claims of the parties, but may not achieve their full potential if used only as sources of information by each party individually.

Mediative Intervention in Disputes

If left to their own, a team of negotiators in a complex dispute or even in a relatively simple dispute is frequently unable to resolve the conflicts that arise during the conversation, that is, the interchange of speech acts. Short of the ultimate coercive, authoritative remedies of forceful action or use of a court to resolve their disagreements, the negotiators may employ a mediative agent. I am defining such an agent more broadly than the usual definition of mediator to indicate that there are several ways in which third-parties may be brought into the negotiation process. There are several classes of mediative intervention which are important to distinguish:

1. Delegation to a negotiator—here the parties employ third parties to speak for them, to make promises and requests, and to respond to questions for information (a special form of request). The use of negotiators will necessarily distort the communications between the parties because the communications will be carried out in the negotiator's context which will be different from that of the parties. The negotiator and the principal parties being represented may share a common background in the domain of objective rationality, but only rarely in the other domains. Often lawyers are employed by the parties who have little sense of how to handle a complex series of claims or who are in or are close to being in conflict, that is their communications have broken down recurrently. But the use of lawyers or other agents may distort the communicative context in other ways. The linguistic dance in negotiations being carried out in shadow of the law or of some other authority may be distorted by the presence of that authority.
2. Delegation, assignment to, or arrogation by an authoritative arbiter—These are cases where the issues are taken out of the hands of the parties and brought before a third party acting as as an arbiter or judge, or cases where one party, tiring of the ineffective talk takes forceful action to settle the claims. The negotiation can be brought to a close, even without the agreement of the parties, that is, without satisfying all of the validity claims. In these cases, the party or parties with unsatisfied claims may continue to harbor unfulfilled requests, leading to the possibility of breakdowns in the future.
3. Use of a "mediator"—A mediator in this sense intervenes only in the linguistic context surrounding the on-going negotiation between the parties. The rest of this paper describes functions of such agents in complex negotiations and conflicts. In some cases, mediators will be used by mutual consent of the parties; in others, mediators are forced upon the parties by an authority, such as court-ordered mediation in many family law matters. Although the mediator's role may appear similar in both cases, the authority in the background may affect the parties listening, in the same way as in negotiations in the shadow of the law.

The first category is taken for granted in this paper, that is, that the interested parties have already selected negotiators to act on their behalf. The second category is not discussed in depth as the conversation is taken out of the hands of the parties, except for responding to specific requests for information by the arbitrator. The last category, intervention by a "mediator," is more interesting in that it offers an opportunity for design of the negotiation process along all the communicative dimensions.

A mediator is defined here as an agent that intervenes in the dialogue in a dispute in a way to cause the conversation to proceed by:

1. suggesting other possibilities to the disputants for the framing of the requests and counter-offers, such that the new set is consistent with the existing context of the claims.
2. changing of the conversation to permit the questioned claims to be validated, thus allowing the action to proceed to the next step in the dance of the disputants.

With respect to the first item, computers can be used to simulate the outcome of current possibilities or to create new ones through models that have some sort of design capability built into the program. In very complex situations, a computer may be capable of producing such possibilities in an rapid, interactive mode, exceeding the competence of human experts. It would be important, in the development and application of such systems to get the parties to agree, a priori, on the validity of the models and the parameter set to be employed. The model in this application need not be terribly precise as in the case to be discussed below of models to establish truth claims, but only be sufficient reasonable to suggest a new possibility set to the participants in the negotiation. This role for computers corresponds to one model for human mediators, the active model, in which the mediator plays a substantive role beyond the more traditional facilitative mode.

In the more traditional mode, the mediator is facilitative and is restricted to establishing the conversation among the players. Mediation is then an intervention in a conversation with the object to alter the status of the sets of validity claims held by the various parties. This can involve one or more of the categories of claims. Mediators can then:

1. make the party's conversation comprehensible,
2. bring about new evidence as to the contextual truth conditions surrounding the arguments,
3. create a means to demonstrate sincerity, i.e., build trust among the parties, and
4. assist in establishing the legitimacy (fairness) claims.

The primary roles played by mediators, it appears to me, is in the first two domains - comprehensibility and truth. In complicated scientific disputes, the notion of joint fact-finding fits the second item. Risk communication has been designed to aid in the comprehensibility of the information provided in satisfying the truth claim. A role that a mediator would play in the legitimacy claim might be in establishing the rules and institutional structure that frame the conversation, for example, in creating a whole new way of reaching a consensus in setting regulatory standards. It is less clear to me how and where mediation fits into the sincerity claim class, other than perhaps to provide some sort of pilot, non-threatening exercise than would convince the parties of the underlying sincerity of those in question.

We commonly think of mediators as human beings, interposing themselves in a conversation, but there is no reason not to examine other agents for this role, particularly computers. But it is important to look at computers as more than an information providing device. Winograd and Flores (1986) argue that even the prevailing attempts to develop artificial intelligence in computers are bound by our technical rational ontology. A challenge to designers of computers as support tools in negotiations is to consider the computer as a tool in facilitating the conversation that is occurring, primarily as a communicative device, but with a notion of communication that is consistent with the Habermasian model.

Computers should be able to enhance comprehensibility by the use of graphical presentations and data summaries that parties unfamiliar with the underlying technical distinctions could more easily comprehend. By modeling or simulating phenomena in the objective world, computers could help establish validity claims in the domain of truth. By using such interactive models in which the parameters of the models were set cooperatively and jointly by the parties, computers might enhance the establishment of claim in the fairness category. Joint fact-finding with expert teams developing models based on a set of hypotheses and parameters established by agreement of the parties prior to the calculation of outcomes

has been used in resolving environmental disputes. (Konkel, 1987) Mediative functions for computers in the sincerity area are not clear at this point, but perhaps some sort of games that could test the party's truthfulness would move a deadlocked conversation off-center. Simulations and games have been used by mediators prior to or within dispute-resolving processes to change the attitudes of the parties. These simple notions are presented to indicate that computers could play various mediative roles, spelled out by the communicative rationality and action hypotheses of Habermas and others.

At the same time, one countervailing possibility associated with the use of computers emerges. If computers are used by one party alone and they are perceived to permit that party to gain an advantageous position concerning the truth domain, then their use might exacerbate the conflict by escalating an already invalid position in the domain of legitimacy or fairness.

In concluding this initial inquiry into this area, I note that efforts toward conflict resolution and mediation are in themselves normative based on the belief that cooperative, consensual agreements are a step towards the emancipatory, unhindered communication and action that Habermas [and others] takes as a more or less universal moral end. Computers could play an important role towards this end, but moreso if they are viewed in an ontology that departs from the traditional realm of technical rationality.

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