
Chapter 14

Inadvertent pathologies of communication in human systems

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Introduction

From its inception, cybernetics has been concerned with errors in complex systems of control and communication (Wiener, 1948). If there were no errors, there would be no need for control by negative feedback. There would be no reporting of discrepancies between goals set and outcomes attained, because there would be no discrepancies. There would only be control of the feedforward type. The successful attainment of goals would be communicated in order for the pursuit of further goals to be set in motion. A system with no error-correcting feedback would be something like a fireworks display. A set of operations acting serially or in parallel would trigger off other operations.

Usually the systems we encounter, both natural and artificial, are more complex than this. My concern in this paper is with human systems, systems where humans are working together in the pursuit of shared goals. In such systems, errors do arise. There are discrepancies between the outcomes and the goals set. There may be successful communications about these discrepancies, such that errors are corrected and the goals are successfully attained, but there may not.

In a complex sociotechnical organization, which is what many of us are part of much of the time, the human operator receives informative signals of many different types from many different parts of the organization. Typically many of the procedures for effective control and communication are proceduralized as tasks that may be carried out by automata, by machines or by humans acting as machines. Indeed, it is increasingly the case these days that operations that have been proceduralized are carried out by machines. The human operator may play only a small part in such systems. However, there are many cases where, even if operations have been proceduralized, human operators do play a key part in the system of control and communication. In other cases, where there is an element of discretion in deciding on what operations should be carried out, the role of the human operator is critically important. Indeed, the set of permissible operations may be open ended in some way and not fully defined beforehand.

This paper discusses the inadvertent pathologies of communication that may arise when both sender and receiver are human operators.

First, a distinction has to be made between advertent and inadvertent pathologies. In the former, the human operator is deliberately pathological in some way. He or she is pursuing another agenda, a set of goals that are different from those in the organization as currently defined. These may be acts of sabotage or subversion within an organization or they may be Machiavellian political manoeuvres in pursuit of power. I am restricting my attention to inadvertent pathologies, those that are not deliberate, since there are limitations on what may be covered in a short paper. However, much of what is said is relevant to all forms of pathology. If the steps that are outlined as being appropriate for the elimination or minimizing of inadvertent pathologies of communication are followed, then it will also be the case that there will be an increased probability that other forms of pathology are detected and may be eliminated or minimized.

With regard to inadvertent pathology, clearly the occurrence of errors is not meant. As noted at the outset, errors are to be expected. However, the occurrence of errors may go undetected or may be wrongly classified as the wrong type of error. In this case, we have a higher order type of error. If there are errors about how we deal with errors, there may also be errors about how we deal with the way we deal with errors. It is these higher order types of error that are being referred to as pathologies of human communication. In the following sections, beginning with a brief general discussion of what is seen as the particular contribution of sociocybernetics, the underlying theoretical model is detailed, drawing chiefly on the classic work on the pragmatics of human communication of Bateson (1972) and Watzlawick *et al.* (1968), Laing *et al.*'s (1966) work on interpersonal perception and conversation theory, particularly as developed by Pask (1975, 1976).

In a later section, empirical studies are described to illustrate how the theoretical model may be applied. Initially, in planning this paper, I had hoped to report on a current project in progress. Unfortunately, the project I had hoped to initiate in my host institution was not implemented. There is some irony here. An independent body which had been invited by the institution to appraise the quality of its "investments in people" has reported that there are important deficiencies in the quality of communication at the level of middle management. Unfortunately, this was the level at which I was submitting my proposals to investigate specific pathologies of communication.

Sociocybernetics

A major aim of cybernetics is for it to serve as a unifying transdiscipline. As a psychologist and social scientist, its attraction for me is that it brings order and unity to a set of disciplines that otherwise tend to be pursued as relatively closed specialisms: biology, individual psychology, social psychology, sociology and social anthropology are examples.

The concern of cybernetics with social systems was noted at the outset (Von Foerster *et al.*, 1953; Wiener, 1954). In the late 1960s and 1970s, there were several related developments, which gave a fresh impetus to these concerns,

and which have become known as “the beginning of the new cybernetics”. Among these developments were Von Foerster’s articulation of a distinction between first- and second-order cybernetics, a cybernetics of observed systems and a cybernetics of observing systems, where a major goal of the latter is to explain the observer to himself (Von Foerster *et al.*, 1974). Explicitly second-order theories of the observer were formulated, not only in Von Foerster’s own work (Von Foerster, 1982), but also in the work of Gunther (1971), Maturana (1987), Maturana and Varela (1980), and Pask (1969, 1975, 1976, 1979, 1980).

Maturana’s theory of autopoiesis (Maturana and Varela, 1980), beginning with a description of the organization of the living system, goes on to give an account of the emergence of social systems, in which language and symbolic communication appear as “ coordinations of coordinations of coordinations”. “Languaging”, to use Maturana’s preferred term, co-ordinates the mutual adaptations of adapting organisms.

In Pask’s (1975, 1976) conversation theory, the higher order co-ordinating functions of language are given systemic status in their own right. Pask distinguishes self-referring, self-reproducing totalities distinct from the biological or mechanical. He calls them “psychological individuals”, P-individuals. P-Individuals are conceptual systems that are embodied and executed as processes in mechanical or biological systems (Pask’s general term is M-individuals). However, M- and P-individuals are not necessarily in one-to-one correspondence. One M-individual (brain, body and extensions) may house several Ps as distinct, situated perspectives; one P-individual may be housed, distributively, in several M-individuals. The model of communication outlined in the next section draws heavily on Pask’s work, although it has not been possible to make this fully explicit within the constraints of a terse presentation.

The new cybernetics addresses problems of self-reference and reflexivity, traditional concerns within sociology. Arguably, the approaches developed by cyberneticians are more clearly grounded, deploying, as they do, formal theories of self-reproduction and self-reference (Löfgren, 1968; Spencer-Brown, 1969). All reflexive theorizing runs into epistemological limits. In second-order cybernetics, these are made quite explicit. As Spencer-Brown (1969) notes, “the form of indication cannot be indicated”. Von Foerster (1993), in a discussion of the connotative and descriptive functions of language, notes, somewhat teasingly, “Language is magic ... We need language to talk about language”. Pask was fond of saying, “life is ineluctable, and ineffable”. As early as 1969 he said that the existence of limits is “not a source of despair”, rather it is “an indication ... of the fascinating potential of our discipline” (Pask, 1969).

Sociocybernetics applies both first- and second-order cybernetic concepts to the understanding of complex human systems: organizations, cultures, societies (Geyer, 1995). In the next section, a second-order cybernetic model is presented: a model of observers in communication, who, if they choose, may communicate about their communication in order to minimize pathologies.

A model of human communication

Human communication is two way; it is dialogical; it is conversational in form (Pask, 1975, 1976). Watzlawick *et al.* (1968), building on the work of Bateson (1972) and others, propose a set of axioms for the pragmatics of human communication. Strictly, their propositions are not axioms, since they are not independent, rather they are maxims. They are as follows:

- (1) One cannot not communicate.
- (2) One cannot not metacommunicate.
- (3) Communication may be analogical or digital.
- (4) Communication is punctuated differently by sender or receiver.
- (5) Communication may be symmetrical or complementary.

Maxim 1 captures the insight from information theory that the message not sent is also informative.

Maxim 2 is very much a Gregory Bateson insight; as well as explicit “messages about messages”, there is always a context which is tacitly metacommunicative about messages happening in it.

In maxim 3, analogical means continuous, as in facial expression or other bodily gesture. Digital refers to communication using spoken or written language or other symbol system. Human languages are doubly digitized, there being discrete units of sound, phonemes, and discrete units of meaning, morphemes. It is perhaps also worth noting here that human languages also serve as logical calculae, since they include some form of the logical operators, and, or, not.

With maxim 4, Watzlawick *et al.* (1968) are referring to the different ways in which the sender and recipient of a message may interpret the meaning of that message. The classic examples they give are from family therapy: the husband’s interpretation of his wife’s communication as “the nagging that leads him to drink”, and the wife’s interpretation of the husband’s communication as “the drinking that leads her to have to nag”. At the time of writing, Watzlawick *et al.* were not familiar with the work of Laing *et al.* (1966) which had just been published (see below).

Maxim 5 is a particular case of punctuation, in which sender and receiver interpret themselves as occupying particular roles. Of course, there may or may not be agreement about who is in which role. Symmetrical exchanges are peer to peer. Complementary exchanges are based on perceived differences of status and power: master/servant, parent/child.

With these preliminaries, we will look more closely at what happens when humans communicate. Laing *et al.*’s (1966) work was one of the first studies of interpersonal perception that clearly articulated the way in which human communication entails both sender and recipient having perspectives of each other’s perspectives, that is, metaperspectives. This requirement is imminent in G.H. Mead’s writings on the nature of a significant symbol, one which “arouses in the sender the same response as in the receiver” (Mead, 1934).

The following is Laing *et al.*'s (1966) construction for dyadic communication:

A(B(A(T)))	Level of Understanding or Not	B(A(B(T)))
A(B(T))	Level of Realisation or Not	B(A(T))
A(T)	Base Level (Agreement or Not)	B(T)

A and B are participants. T is the topic, proposition or object being contemplated or perceived.

Example configuration (see text):

Let A be a psychologist. Let B be a parent. Let T be "The problem is in the child".

A(T) = "no" (A thinks T is false), B(T) = "yes" (B thinks T is true).

A(B(T)) = "yes" (A realizes there is disagreement), B(A(T)) = "yes" (B fails to realize there is disagreement).

A(B(A(T))) = "yes" (A understands that B does not realize there is disagreement), B(A(B(T))) = "yes" (B falsely understands that A realizes there is agreement).

In developmental psychology, being able to compute such perspectives and metaperspectives is known as having "a theory of mind" (Whiten, 1991). Howard's (1971) theory of metagames has a similar structure for a two-person non-zero sum game, such as "prisoner's dilemma".

In the model of Laing (Laing *et al.*, 1966) for the dyad, there are two perspective levels above the base level. Howard's results show that, in general, if one is to represent all possible configurations of perspectives of perspectives for n persons, it is necessary to have n factorial levels above the base level. This fact is in itself a possible reason for error in human communication. We know from other work in cognitive psychology, there is a limit, equal to approximately five plus or minus two, on the number of "chunks" of information that a human operator may hold in mind at any one time (Miller, 1956). Signals containing more variety than this will tend to be condensed, "chunked". Notice that this also applies to the ways in which the human operator perceives his social world. In any particular communicative context, he or she will chunk the participants (senders and receivers) into subgroups or coalitions in order to be able to think about them at the same time. Of course, in many cases, participants may already be grouped. However, not all participants will see the same set of groupings being in operation. Each participant will have his or her own perception of what is the communicative context. It is his/her construct. In analysing possible pathologies of communication, it is necessary to recognize that we are dealing with what Gunther (1971) refers to as a "polycontextuality" and Maturana (1987) refers to as a "multiverse" (see also the classic analysis of the phenomenology of the social world made by Schutz (1972)).

The structure in Laing *et al.*'s (1966) model shows the set of perspectives and metaperspectives for two participants, A and B. In principle, the topic being discussed or the message being interpreted may be anything that can be pointed to or named. For example, the topic, "most beautiful motor car". Each participant has a perspective on the topic, a way of describing or explaining the topic. Each participant also has a perspective of the other's perspective. And finally, to give us the required number of levels in order to exhibit all forms of stability or conflict, each participant has a perspective of the other's perspective

of perspectives. In Laing *et al.*'s (1966) original terminology, there may be an agreement or not at the base level; at the second level, there may be realization or not that there is an agreement or not. And at the third level, there may be an understanding or not that there is realization or not about what is happening at the base level. Laing *et al.* (1966) point out that as long as at least one of the participants has a correct understanding of the pattern of perceptions and possible misperceptions, then the relationship may be a stable one. The participant with the correct understanding can adapt to the errors in the other participant's perceptions.

Using this model, we can see that there is a rich set of possibilities for the occurrence of errors and higher order errors. At each level, there are four possible patterns of match and mismatch. This gives four to the power three possible overall patterns, that is, 64. Fortunately, as previously noted, at the level of understanding or not, errors, that is, mismatches at the lower levels, may be compensated for. Of the 64 possible patterns, there are 48 where at least one of the participants understands what is going on. This leaves 16 where neither participant understands what is happening.

Before going on to consider how, as researchers, we may work with this variety, it is perhaps worth spending a little more time reflecting on what may be the topic of communication, the conversation between the participants. As noted, the topic may be anything that can be indicated by naming, pointing, or signalling in some manner. It could be a proposition about a particular state of affairs. For example, when working as an educational psychologist (Scott, 1987), I frequently came across parents, teachers and care workers who fully accepted the proposition that "the problem is in the child". As a psychologist using a systems perspective, I could not agree with this proposition. For me, so-called problem behaviours were specific to a context (see Laing *et al.*'s (1966) dyadic construction model above). However, by being aware of this disagreement at base level in our interaction, it was usually possible to work constructively with the other in the interaction and to work towards changing his or her point of view.

Other examples are that the topic might be a memo or other message, a rule, or statement of policy, all of which might be given different interpretations by the participants in the overall conversation which is the organization (Pask, 1979). However, notice also that the conversation, the interaction itself, may be the topic. Conversations may be self-referential (see Lucy, 1993). This is typical of interactions in which the form of the encounter is still being negotiated, as well as its content. Is this a friendly encounter or not? Are we meeting as peers, or are we differentiated as master or servant? Can we assess the quality of our communication? Can we in fact use a Laing *et al.* (1966) type analysis and avoid possible inadvertent pathologies in our communication?

I am persuaded that the short answer to this question is very much in the affirmative. Yes, such analyses can be carried out in organizations, and yes, the outcomes can be used to improve the quality of communication. However, there

are snags and pitfalls, not least at the initial stage of persuading participants that such an analysis is possible and worthwhile.

Empirical studies of pathologies of communication

Before saying something about the events which led up to my not having a current project to describe, I would like to make some retrospective comments about two empirical studies in which I participated some years ago and also to make additional reference to my experience of working as an educational psychologist in a UK local authority.

My first contacts with pathologies of communications in large organizations and with action research methodologies were in the 1960s at Brunel University, UK, where I was an undergraduate student of psychology. The Brunel psychology course was a sandwich course and I spent two fruitful six-month periods working and researching in two large institutions; a fabrics manufacturing factory and a large children's hospital in south London. Although the projects I worked on were reported in detail to my supervisors, the work described was not written up for publication, except in summary ways, so, although the events described took place some years ago, they are still, to some extent, newsworthy.

The project in the fabrics factory was carried out under the supervision of Professor Elliot Jaques of Brunel University. In his own work on large industrial organizations, Jaques had, in several publications (see, for example, Jaques and Brown, 1963), argued for the need to have well defined roles as a pre-requisite for effective communication. To avoid overlap or ambiguity, all roles should have demarcated discretionary boundaries, for the exercise of decision making, and clearly defined duties and responsibilities, as far as this is possible in the real world of day-to-day production, management and trouble shooting.

Most of my time in the fabrics factory was spent working on the factory floor, for which I was paid a weekly wage. As a student of organizational psychology, I was invited to play the part of participant observer and to observe the culture of the factory floor, much as an anthropologist studies the culture of a pre-industrial society. This I did. I got to know several informants and found out much that was interesting.

I made a particular study of how the workers on the factory floor interpreted and responded to the incentive bonus scheme that operated throughout the factory. I discovered that, as far as I could tell, and without exception, every single worker in every single department of the factory regarded the operation of the incentive bonus scheme with cynicism and was engaged in some sort of fiddle. In departments, where there was group working and group bonuses, rather than individual working and individual bonuses, the fiddling was done collaboratively as a group project. Where the bonus scheme was applied to individuals, tips regarding effective fiddles were shared among the workers and newcomers, like myself, were quickly initiated into the necessary procedures that ensured that, with the minimum effort, one obtained the maximum return from the incentive bonus scheme.

In retrospect, it is clear that the culture of fiddling within the workforce was symptomatic of serious pathologies of communication between the management of the factory and its workforce. Before leaving the factory as a place of employment, I broached the topic of fiddling with the manager of the large department in which I had spent my time as an employee. He agreed that incentive bonus schemes could, if not well managed, tempt workers to engage in fiddles. However, he was quite confident that in the case of his own department such fiddling was not a problem. As evidence for this, he cited the fact that, in all his years as manager of the department, there had only been two isolated incidents where workers had been found to be fiddling their time sheets. In telling me this, the manager in question gave the impression that he was quite sincere in his description of what was happening in his department. It is, of course, quite possible that he knew what was going on but chose to turn a blind eye in order not to disturb the status quo or cause unnecessary problems for himself with the organization's board of directors. I wrote a report appraising the effectiveness of the incentive bonus scheme that was used in the factory. It was decided not to circulate this beyond the confines of the psychology department at Brunel University (Scott, 1965).

During the latter period of time spent in the factory, with the agreement of senior management, Marilyn Kelly (a fellow student) and I carried out a study of the patterns of communication that prevailed in the packing department of the factory (Scott and Kelly, 1965).

The most regularly occurring patterns concerned the flow of orders for the department. In brief, orders, in the form of messages on paper, entered the department and these were processed in turn by staff in the storage, cutting, packing, and despatch sections of the department. If the processing of the order was successful, a bolt of cloth or other product was despatched for delivery to a client and other messages on other pieces of paper sent to their appropriate destinations, such as the accounts department. Using standard methods for recording the flow of goods and information, we noted several inefficiencies in the system of communication for the department. The more obvious ones involved a particular foreman who was responsible for the day-to-day operation of the department. We noted that, not only did all pieces of paper entering or leaving the department have to cross his desk, but also that frequently, as the pieces of paper moved from section to section within the department, they would find themselves back on the foreman's desk for relatively long periods of time. In our analysis, these journeys and delays in the orders were unnecessary. We reported our findings to the senior management who agreed that we had identified some inefficiencies that could be rectified. They were not happy, however, about the implied criticism of the foreman.

In retrospect, I can see that not only did we identify some inefficiencies in procedures for processing orders, but we also encountered pathologies in communication among the participants in the department, particularly concerning their perceptions of the foreman's role and the way in which he implemented it. Senior management considered the foreman to be particularly

meticulous and thorough. He was someone who could be trusted to be keeping a very close eye on what was happening in his department. In contrast, the workers in the department, in particular those with supervisory responsibilities in the different sections, perceived him to be a niggling source of interference that prevented them from getting on with their jobs in an efficient manner.

Both the studies described above identified pathologies of communication. The next study, that I shall briefly describe, not only identified pathologies, but also actively sought to correct them. This study was part of the Hospital Internal Communications Project, Project Director, Professor Reg Revans (Revans, 1972).

Revans is one of the pioneers of action research methodologies in which participants carry out research in their own organizations. Revans calls this approach to organizational change “action learning” (Revans, 1980; see also the related work of Harri-Augstein and Thomas, 1991). The basic idea of Revans’ project was that senior staff from ten London hospitals should carry out projects studying the organization of the hospitals in which they themselves worked. Before carrying out their investigations, the senior staff in question were given an intensive crash course in social science research methodology, that lasted for up to three weeks. Revans’ hope was that senior staff would be encouraged to look at their organizations with fresh eyes and become far more sophisticated in understanding how they functioned.

The larger project was only a partial success. Not all senior staff stayed the course and successfully carried out investigations of their own organization. The usual plea, after having being trained as social scientists, was that they were far too busy. To offset this sort of renegeing on the original deal, Revans’ core team of researchers was augmented by research assistants whose job it was to assist the senior staff in their investigations, by doing the data gathering legwork. I was assigned to one of those hospitals in that role.

The investigation I helped carry through was a study of the patterns of communication associated with one particular ward in a large children’s hospital (Scott, 1966). In a period of six months, I carried out observational studies: sitting in the ward and observing all the comings and goings that linked the ward to the larger institutional setting. I also carried out a series of in-depth interviews with relevant participants in the overall pattern of communications. For example, there were nine or so service departments with which the ward staff interacted: kitchens, porters, pathology laboratories, and so on. The key feature of my study was that the sequence of interviews became iterative. Having established one participants’ perception of the role that their department played, with detailed comments and criticisms, I returned at a later date for further interviews, armed with information that I had gathered from interviews with other participants. In retrospect, although I did not articulate it in those terms at the time, I can see that I was investigating participants’ perspectives and metaperspectives, that is, I was employing a model similar to that presented above and was developing a methodology for identifying and correcting pathologies of communication.

I quickly established that there were many pathologies in the patterns of communication, clear misperceptions by participants of others' perspectives and metaperspectives. I found myself in the role of facilitator and go-between. It was possible to actively correct some pathologies in the course of my investigations, using the iterative interviewing technique. Other interventions involved setting up face-to-face meetings between participants. This required the consent of senior staff, to whom I had to present a clear, non-judgemental picture of my data. Later evaluation indicated that my study had been one of the more successful components in Revans' larger project (Wieland and Leigh, 1971).

By the 1980s, in my work as an educational psychologist, the iterative process of investigating participants' perspectives within a larger nexus of communications, became part of my daily working methodology (Scott, 1987). I applied it to increase my understanding of communication problems within particular institutions, such as schools or particular support services, also within families and within the larger collective that was the local authority and the designated community that it was commissioned to serve. By bringing participants together at key moments, it was possible to combine the action research methodologies with the more dramatic interventions of family therapy (Hoffman, 1981).

I will briefly describe the study that never was. Recently, while carrying out survey research for a large, higher education institution, I conceived the idea of carrying out an action research study of how relevant and useful were the regular surveys of the student population carried out by the survey department. There is a well-established literature on institutional research and the problems of ensuring that administrators and managers pay attention to the findings of that research (see, for example, Gilmour, 1977). Further, it was on public record that there were problems of that kind in the institution in question.

Unfortunately, my proposals were blocked by a more senior academic with managerial responsibilities. He was quite confident that he knew what the problems were. He did not believe that the research that I was proposing would add to his knowledge of the situation or would help to improve things. He added that, in any case, there was an outside body assessing the institution as a whole for its quality as an "investor in people" and that this assessment included studies of internal communication of the kind I was proposing and there was no need for duplication. I did point out that what I was proposing was intended to be much more focused than any general appraisal, but this qualification fell on deaf ears.

Ironically, the outside body did indeed carry out its assessment of the institution but did not grant it "investor in people" status. It reported that there were serious deficiencies, particularly at the level of middle management. The chief pathology noted is a classic in studies of management styles. This is where the majority of communicational exchanges are in the form of "top down" commanding. In higher educational institutions, the majority of managerial posts are occupied by academics with no explicit background or

training in management. Typically, they construe their roles as being primarily about giving orders to other people about what should be done and checking to see if those things have or have not been done. What is frequently lacking is any sense of the nurturing and furthering aspects of the managerial role: the need to listen to people and to bring out the best in them.

On reading these findings of the outside body, I noted with only mild satisfaction that in the period of 18 months or so, in which my particular academic manager had been in post, not once had he initiated any meeting with me. All our exchanges about my work, including my proposals for research, took place at my request.

Concluding comments

The constructivist epistemology of second-order cybernetics (Von Foerster *et al.*, 1974) tells us that pathologies of communication occur not just because participants have different perceptions of the real, but that participants inhabit different realities. To use Gunther's (1971) term referred to earlier, we are dealing with the ontology of a polycontexture whose dimensionality increases in a combinatorially explosive manner as the number of participants making up the polycontexture is increased. As we have seen, much of this variety is generated by the need to take into account the perspectives and metaperspectives of the participants. As argued, in empirical work in complex social organizations, an action learning approach may be fruitfully used to minimize the occurrence of pathologies in communication. Using such an approach, the form and quality of communication itself becomes a topic to be communicated about. Critically, at some stage, key participants may need to meet face to face. As Revans (1972) notes, "such encounters may be difficult and painful". This is to be expected in a therapeutic process that confronts ways of behaving in which participants very often have a large emotional investment. Some encounters need to be prepared for with great care. Ground rules and agenda may have to be established well beforehand to allow time for negotiation and reflection.

Essentially, what we are considering is a hermeneutics of observers and their interpretations, in which concepts of ethical responsibility and normative pragmatics may have to be spelt out (see Habermas, 1990). Once participants have accepted a set of ground rules, it still may be the case that their belief systems, their perspectives and metaperspectives, have to be unpacked and explicitly laid out. Gaps and illogicalities in conceptualization may have to be attended to.

As developed at length by Gordon Pask in his cybernetic theory of conversations, the psychological individuals that participate in conversation may be distributed over many brains and bodies. Cultures may converse as well as persons. Our understanding of what it would mean for conflicting participants to "sit down and calculate" has come a long way since Leibniz speculated about a universal language. Thanks to Gordon Pask and others, we have better understandings and better support tools to help us resolve social

conflicts, and at this late stage of the twentieth century, perhaps all that is lacking is the will and, to some extent, the art to put them into practice.

I suspect that a key step in any handling of social conflicts is that of persuading participants that their perceptions of a reality are in fact interpretations. Here, indeed, is a role for the magical arts of the cybernetician (Pask, 1980).

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