Information in Organisations: rethinking the autopoietic account

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1. The Theory of Autopoiesis

I begin with a summary of the theory of autopoiesis, which is a condensed version of an account in an earlier paper (Beeson, 2001). That paper also presents an earlier version of part of the argument in the current chapter.

Maturana and Varela's (1980, 1987) theory of autopoiesis defines living systems as autopoietic (self producing) systems. The theory gives a comprehensive and economic account of living beings from the simplest unicellular organisms ('first-order unities') to the most complex multicellular organisms ('second-order unities'). It extends, more tentatively, beyond organisms towards social systems ('third-order unities'). Social or business organisations are then examples of third-order unities.

An autopoietic system exists as a network of relations and processes which continuously produce the components which realise that network as a concrete unity. For a class of unities of the same type (eg, human beings), the organisation of an autopoietic system can be described as a set of relations in abstract terms. The structure of an individual being - the components and relations that actually constitute a particular unity - is then one realisation of that organisation. The same organisation is realised in different structures.

Autopoietic systems are organisationally (or operationally) closed. The behaviour of the system is not specified nor controlled by its environment but by its own structure, which specifies how the system will behave under all circumstances. The system is structure-determined. Systems however are is not disconnected from their environments, but in fact in constant interaction with them, in an ongoing process that Maturana and Varela call 'structural coupling' (1987, p. 75). System and environment (which will include other systems) act as mutual sources of perturbation for one another. The changes in a living being which result from its interaction with its environment are *triggered* by a disturbing agent in the environment, not *determined* by it. It is always the structure of the disturbed system (the living being) that determines the changes. There can therefore be no 'instructive interactions' by means of which something outside the system determines its behaviour.

It is the organisational closure of living systems that produces their autonomy and their individuality. Each individual has its own autonomous ontogeny (its own separate development and history), which is neither controlled by its environment, nor determined by its class or species. This same closure dictates that there cannot be any inputs or outputs of a system including information) that, for the system, have independent, objective reality outside it.

Over time, provided there are no destructive interactions between the system and the environment in which it realises itself, the system will appear *to an observer* to adapt to its environment. What is in fact happening, though, is a process of 'structural drift' occurring as the system responds to successive perturbations in the environment according to its structure at each moment. Though it might seem as if the system's behaviour is controlled by the environment, this is a feature of the observation, not of the operational reality.

What in the generalisation of their argument Maturana and Varela (1987, p. 181) call 'third-order' couplings and unities arise as the natural result of the congruence between the respective ontogenic drifts of higher organisms of the same species. A third-order unity - a 'social system' of animals or people - itself displays autopoietic organisation to the extent that the network of participating individual organisms co-produce it through their reciprocal structural coupling. The reciprocal coordination mutually triggered among the members of a social unity, they call *communication* (1987, p. 193). So defined, communication is an aspect of social behaviour, emerging out of structural coupling and drift in social groups, and not a separate or distinct mechanism suddenly appearing in evolutionary development.

Communication is then the basic behaviour from which language (or 'languaging') emerges. Human linguistic behaviour is a domain of reciprocal ontogenic structural coupling which human beings establish and maintain together. Although from an external perspective an observer may be able to describe words as designators of objects or situations in the world, the operational reality of our use of language with one another reflects a structural coupling in which words are 'ontogenically established coordinations of behaviour' (Maturana and Varela 1987, p. 208).

Just as Maturana and Varela put communication before language, so they suggest that mind and consciousness, far from being prior to language, arise out of it. As they phrase it, 'language is a condition *sine qua non* for the experience of what we call mind' (1987, p. 231). Reversing the Cartesian *cogito ergo sum*, they place thinking, in the sense of conscious thought, at the end of a chain which starts with autopoiesis, then proceeds through structural coupling, communication, and language. By putting being before thinking, the theory of autopoiesis offers an approach to communication that has existential and ontological, rather than epistemological, foundations.

2. Difficulties with information

A disturbing consequence of the theory of autopoiesis, for information scientists and theorists, for systems thinkers, and more generally for organisation theorists, is the rejection of the notion of information and related notions of message and communication, representation, input and output, feedback, control and regulation. These are at the heart of the systems model of organisation, central to organisation theory in general, and key concepts in computing and engineering science.

Maturana and Varela write (1980, p.90): 'Notions such as coding and transmission of information do not enter in the realisation of a concrete autopoietic system because they do not refer to actual processes in it. The notion of coding is a cognitive notion which represents the interactions of the observer, not a phenomenon in the observed domain. The same applies to the notion of regulation.'

They reject the idea that the organism, via its nervous system, builds an internal representation of the world outside (1980, p. 129). While the common view is that an organism inputs information from the environment that it then uses to build a representation of the world, they argue that organism and nervous system operate with structural determination, which mean that the structure of the environment can only trigger changes in the organism, not specify them. It may look to an observer as if the organism's behaviour arises from an internal representation of the environment, but in fact it is the structural state of the nervous system at each moment that determines how any changes in the environment can perturb it. The idea of the nervous system picking up information from the environment and modelling a world from it, and the idea of the brain as an information processing device, are misconceptions, only useful for talking among ourselves about how the brain and nervous system appear to work, and no kind of scientific explanation of how in fact they do work.

And they reject the idea of information being transmitted in communication (1980, p. 196). Communication, according to them, occurs whenever there is behavioural coordination in a situation of structural coupling. But this is not the same as information passing along a pipe and determining behaviour at the far end. As they point out in ordinary language, saying does not automatically produce listening. Communication is to be understood not in terms of transmitted information, but in terms of what happens to the person who hears. There can be, as they say, no instructive interactions.

In his preface to Maturana and Varela's first book (1980, p.69), Stafford Beer, prominent cybernetician and proponent of the idea of the viable system, acknowledges that he had previously thought that 'the whole story' of the viable system was grounded in information, codes, messages and mappings. But he is persuaded by the argument of autopoiesis, and concludes that the authors must be right: 'Nature is not about codes; we observers invent the codes in order to codify what nature is about.'

The theory of autopoiesis thus poses immediate challenges to organisation theory. Core concepts of organisational science, and of systems theory, are rejected or transformed. The idea that organisational systems are driven by models or representations, and by the transmission of information, is challenged, as is the idea that behaviour can be controlled through instructive interaction. These are constructions by an observer, who is explaining a sequence of actions from an external perspective. The effective operational reality is one of autonomous individuals engaging in structure-determined behaviour, coupling, and drift.

However, there does remain a question of whether 'third-order unities', including organisational systems, are in fact autopoietic systems. The generalisation of Maturana and Varela's theory from biological to social systems is problematic (for them as well as others). An observer may see a third order unity as autopoietic on the grounds that its realisation depends on the autopoiesis of the (second-order) unities which integrate it. But it could be argued that, unless the third-order system is itself defined by relations between components which in turn produce the relations, it is not truly an autopoietic system. To see an organisation as a third-order unity, we would have to understand it as in some sense producing and maintaining its own components (which include human beings) and the relations between them.

Two ways then present themselves for trying to deal with the problems that the theory of autopoiesis poses for organisational theory in relation to information, representation, communication and related concepts. One is to try to recast the notion of information in a different way, which accepts the criticism from autopoiesis that information cannot have an objective external reality for organisms which are structure-determined, and develops instead an idea of information as something which may trigger (but not determine) a response. The other is to escape or ward off the strictures of autopoietic theory by denying that it applies to organisations in a precise sense, or by reorienting the theory to deal with higher level systems directly, instead of with organisms. If organisations are not autopoietic in the same sense as organisms, it could be that information and communication can assume an objective role in organisations even if they cannot for organisms. A third way of handling the autopoietic analysis of organisations is to treat it as a metaphorical or imaginative account, rather than an empirical or scientific one. The rest of this chapter will be devoted mainly to the first of these approaches, starting in the next section. A sketch of the other two approaches will be given in the remainder of the present section.

Kickert (1993) is one author who sees autopoiesis as useful as source of ideas for stimulating thinking about organisations and opening up new possibilities of action. Reviewing the relevance of the theory of autopoiesis in the field of public administration, he concludes: '…The possibilities of a strict conversion of the autopoiesis model into a valid model that can be used in the administrative sciences are limited. The usefulness of the model does not seem to lie in strict adherence to the original and literal translation, but rather in its power as a source of creative lateral thinking.'

Morgan (1997, ch. 8), in his well known volume on organisational metaphors, discusses autopoiesis under the broader heading of flux and transformation. He notes three main features of Maturana and Varela's theory of living systems: autonomy, circularity, and self-reference. He suggests that organisations, from an autopoietic perspective, can be seen as attempting to turn their environments into extensions of their own identity. This implies a focus on establishing and projecting the organisation's identity and on shaping relations with the environment in the organisation's favour. He thinks this could produce narcissistic, egocentric, aggressive organisations. While such a characterisation of an organisation might resonate with some members, it also seems to be a misreading of autopoietic theory. Operational closure precludes an organisation's taking over its environment (or vice versa). Autopoiesis suggests a subtler analysis in terms of structural coupling. The danger of taking such ideas as autopoiesis metaphorically is that they may be taken on in a cosmetic or superficial fashion. Autopoiesis could for example be promoted as a doctrine of self-aggrandisement or survival of the fittest, or used to explain why organisational learning can never work. But this would be to distort the original theory.

More positively, a loose or informal application of autopoietic ideas might help us understand why patterns of organisational behaviour sometimes seem to reproduce themselves in a manner which is conservative and hard to change, or why individuals and groups can be resilient sometimes in adverse circumstances. We can call on ideas from autopoiesis to support actions in favour of individual autonomy or of a gradualist approach to change.

Luhmann's development of the theory of autopoiesis in *Social Systems* (1995) is not a metaphorical account but a thorough and ambitious reworking of the theory. He reshapes the central ideas of autopoiesis to produce a new focus on social systems as continuous self-referential productions. He drops the premise that social systems are living systems, so severing social systems from their biological foundations. Faced with the question of how social systems can be said to produce the people that compose them, Luhmann's answer is that the basic elements of social systems are not people but *communications*. Communication is no longer seen, as in Maturana and Varela, as an aspect of behavioural coordination, but as the central subject matter. The focus on *living* or *being* is replaced by a focus on *meaning* and its achievement. Although he describes consciousness and the formation of social systems as evolutionarily co-emergent, Luhmann separates psychic from social systems, in order to establish the autonomy of the latter. He is able thereby to reject the idea of the social as derived from a realm of intersubjectivity, as well as the idea of communication as an interaction between subjects or a transmission between consciousnesses, and can concentrate instead on the social system as an autonomous (organisationally closed) system of communications.

Luhmann's theory, and in particular his analysis of communication as a synthesis of information, utterance, and understanding, restores information to a central place in organisational theory, but at the cost of deleting the human subject. The existential and ontological aspects of the original autopoietic account of living organisms are left undeveloped as Luhmann opts for a thoroughly epistemological treatment of social systems. An extensive new theory of social systems with its roots in autopoiesis is delivered, but the founding idea of the self-producing organism is not at the centre of it. Information returns to the centre of the stage, and since it has been theoretically separated from the beings that use it, there is no urgency to consider whether the original rejection of information in autopoietic theory has any substance to it.

Luhmann's autopoietic theory looks better aligned with mainstream organisational and systems thinking than does the biological version. His approach fits well with theories of organisation which focus on rules, flows and structures more than on individual consciousness or cooperative action. Luhmann's theory is radical in its rewriting of sociology and of autopoiesis, but, as an abstract systems theory, is less foreign to organisational theorists than Maturana and Varela's precursor.

Both the metaphorical and social systems approaches to autopoiesis outlined here, in different ways and for different reasons, avoid confronting the conceptual difficulties surrounding the notion of information in the original theory. In the following section, we will return to the idea of information, especially in the organisational context, and try to develop an understanding of information which meets the reservations expressed in the original biological account of autopoiesis. The standard message model of communication or information will be presented first, and then critiqued from the perspective of pragmatics. Pragmatics offers a different angle from autopoiesis, but it will be seen that the reservations about the standard model of information in the two perspectives are compatible.

3. The message model of communication

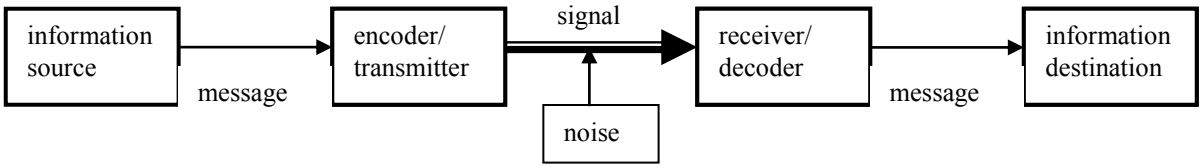

Figure 1: Communication as signal transmission

Figure 1 (derived from Fig. 1 in Shannon and Weaver 1949, p. 34) shows in schematic form the model of communication as a transmission of signals, which is the basis of the communication theory (or information theory) derived from Shannon's work on channel capacity and noise. The *source* generates a *message* (which consists of information) for communication to a (remote) *destination;* the message is operated upon ('encoded') by a *transmitter* in such a way as to make it suitable for transmission (as a *signal*) across a medium (channel). The signal is subject to distortion by *noise* in the environment, so that the received signal is in general not identical to the transmitted signal. The *receiver* operates upon the incoming signal so as to 'decode' it, if possible removing the errors introduced by noise and restoring the original message for the destination. Shannon's theories rely crucially on being able to measure the variety in the set of messages produced by the information source. This quantity - the entropy of the source - is calculated from the relative probabilities of selection of each of the possible constituents of a message: 'We can think of a discrete source as generating the message, symbol by symbol. It will choose successive symbols according to certain probabilities depending in general on preceding choices as well as the particular symbols in question.' (Shannon and Weaver 1949, pp. 39-40). This kind of process, in which a discrete sequence of symbols from a finite set is produced according to a set of probabilities is called a *stochastic* process. Shannon was able to show that, for such a discrete source, an efficient encoding scheme could be devised which achieved maximal utilisation of the channel. His fundamental result for a noiseless channel was that a channel capable of transmitting C bits per second could transmit symbols from a source with an entropy of H bits per symbol at an average rate no higher than C/H symbols per second. He also showed that, for any channel whose capacity was greater than the noise it was subjected to, an encoding scheme could be devised which would guarantee accurate delivery of messages.

Shannon's theories lie at the foundation of communication engineering. He - and his interpreter, Weaver - were at pains to point out that a specialised notion of 'information' was being used here, related not to any intention to convey meaning, but rather to variety in the message set and uncertainty in the source. Weaver postulated three levels of communication:

> '- Level A. How accurately can the symbols of communication be transmitted? (The technical problem.)
> - Level B. How precisely do the transmitted symbols convey the desired meaning? (The semantic problem.)
> - Level C. How effectively does the received meaning affect conduct in the desired way? (The effectiveness problem.)' (Shannon and Weaver 1949, p. 4).

Weaver acknowledged that Shannon's theories applied only to Level A, but then went on to claim that 'the theory of Level A is, at least to a significant degree, also a theory of Levels B and C' (Shannon and Weaver, p. 6). Ritchie (1991) believes this generalisation of Weaver's to be unfounded, and to be based at least in part on a confusion between two meanings of

uncertainty: the statistical uncertainty relating to the set of symbols which can be generated by the source, and the subjective or cognitive uncertainty of an observer about what particular message was sent in a noisy channel (pp. 53-55). Weaver's treatment of Levels B and C is in fact quite vague, and verges on the mystical. He wants the theory to be generalisable: '...the mathematical theory is exceedingly general in scope, fundamental in the problems it treats, and of classic simplicity and power in the results it reaches. ... [T]he theory is sufficiently imaginatively motivated so that it is dealing with the real inner core of the communication problem - with those basic relationships which hold in general, no matter what special form the actual case may take.' (Shannon and Weaver 1949, p. 25). And he is willing to restrict language behaviour to make the theory fit:

> 'This idea that a communication system ought to try to deal with all possible messages, and that the intelligent way to try is to base design on the statistical character of the source, is surely not without significance for communication in general. Language must be designed (or developed) with a view to the totality of things that man may wish to say; but not being able to accomplish everything, it too should do as well as possible as often as possible. That is to say, it too should deal with its task statistically.'
> (p. 27)

Misinterpretation of Shannon's theories thus appears to date back to the very beginning. The model of communication as signal transmission seems appealing and powerful, and remains influential. It seems attractive to extend the model from messages sent between devices so that it equally covers a conversational exchange between human speakers. It may be tempting to follow Weaver's suggestion and keep the basic technical model in all its essentials - simply adding levels of semantic and pragmatic source/destination, encoding/decoding, transmission/receipt and noise, and assuming that analogous mechanisms are at work at each level. But, in fact, the generalisation of the technical model to semantic and pragmatic levels must be contested, since it appears beset with flaws. Linguistic communication between people is not the same as, and not very like, signal transmission between machines. It is not a stochastic process.

The Shannon model persists in organisational theory and in management thinking even though it does not give an adequate representation of human communication. Shannon devised the model for signal transmission, but it has appeared to his interpreters to be capable of more general application. Because this possibility of generalisation also seems to accord rather strongly with ideas about the detachability of information from context and the desirability of controlled communication, Shannon's model has not been definitively curtailed. This is no doubt partly a political matter, but there are also theoretical and technical issues surrounding attempts to store information in databases and transmit it across networks.

4. Pragmatics and relevance

Akmajian et al. (1998, p. 65) list four problems with what they call the Message-Model (the Shannon model generalised to talk exchanges):

1. it identifies the message to be sent with the literal meaning of the words uttered;
2. it depicts the process of encoding the meaning into sounds as linear and sequential;
3. it depicts the decoding process from sounds into meaning as linear and sequential;
4. it depicts the hearer's recovery of the intended message as being identical with the decoding of the meaning of the sentence.

Problems 2 and 3 relate to perceptual and semantic aspects of communication, while 1 and 4 are more concerned with the intentions and uses in communication - i.e., pragmatic aspects.

Akmajian et al. show that the production and perception of utterances is not linear and sequential. Even at the phonological level, speakers do not simply produce, nor hearers perceive, a discrete string of phonemes. Rather, whole words, phrases and sentences are produced and perceived, in which successive sounds colour one another. (To give one of their examples, the sequence *-str-* in *construe* is articulated differently from the same sequence in *constrict*, because of the *following* vowel.) From the hearer's side, actual speech is experienced as a physically continuous stream of sound, from which the hearer derives individual sounds, words and sentences, not by a sequential process of signal extraction but by hearing the larger utterance as a whole. One hears what is said only by virtue of knowing the language and understanding the context of communication. At the grammatical level, sentences with the same surface structure may have different deep structures. Akmajian et al. give the example (p. 70): 'I saw the man with the telescope.'; that two different meanings are available (to both speaker and hearer) shows that the meaning of a sentence cannot in general be derived sequentially from the meaning of the individual words.

Proceeding to the pragmatic level (roughly equivalent to Weaver's Level C - 'effectiveness'), Akmajian et al. list six inadequacies of the Message-Model (pp. 75-78):

1. Expressions can be *ambiguous*. A hearer tries to resolve ambiguity by assuming the speaker's remarks to be appropriate to the context.
2. Messages can contain *references* to people, events or things not uniquely determined in the message itself. (Pronouns are an obvious example, but many expressions contain imprecise references.)
3. The Message-Model omits any account of the speaker's *communicative intention*, or the hearer's recognition of it.
4. People often speak *non-literally*; they do not mean what their words mean. Irony, sarcasm, and metaphor are common examples.
5. People often speak *indirectly*; they mean something beyond what their words mean. For instance, 'My car has a flat tyre.' may be given as a request for a repair when said to a mechanic, or as a reason for illegal parking when said to a policeman.
6. Communication may not always be the reason for speaking. We may simply be declaring something (that someone is married, fired, or innocent, for instance), or trying to impress, or deceive, or persuade. These acts can succeed whether communicative intentions are recognised or not.

Akmajian et al. conclude their analysis of the Message-Model by declaring it inadequate to account for the full richness of normal human language use. They also suggest that, for a hearer to identify a speaker's communicative intentions, more than just a common language is required: 'A shared system of beliefs and inferences must be operating, which function in effect as communicative strategies.' (p. 78). They propose a model of their own to show how a hearer identifies a speaker's communicative intention (pp. 78-79). In this, the hearer must identify what the speaker has uttered, identify what that must be intended to mean in this context, and resolve any references. The hearer must then decide whether the utterance is to be taken literally or non-literally, and must finally identify if any indirect communication is intended. Communication is only complete when the hearer has accomplished all these steps. One could go further and suggest that communication can never be complete (even though it can be finished). Merleau-Ponty (1992, p.390) comments that language always outruns us, that there is always a surplus or excess of meaning beyond what has been said or heard.

The analysis by Akmajian et al. shows that, as a basis for spoken communication between people, the Message-Model, derived from Shannon's model of communication, is seriously flawed. Speaker and hearer in a human talk exchange do not operate as stochastic processes. They are not engaged in selecting symbols from a finite set of symbols on a basis of probability. Successful communication depends on a good deal more than the transmission and receipt of symbols or sounds - for instance, common language, shared context, resolution of references, resolution of ambiguities, identification and interpretation of non-literal meanings, communication of intention, and identification of indirect meanings.

Sperber and Wilson (1986, 1998) have further developed the pragmatic analysis of communication by building on Grice's theory of *implicature* (Grice, 1975). Grice draws a critical distinction between what is *said* by a speaker and what is *implied.* What is *said* is closely related to the conventional meaning of the words uttered, and can be worked out from an understanding of the language. What is *implied* is sometimes also derivable from the words uttered and their conventional meanings, but more generally, in a conversation, implications derive not from the words, but rather from the working out of understandings between the participants in the course of their exchanges. He pictures conversation as a *cooperative* venture.

Sperber and Wilson give an account of inferential communication derived from Grice's, but founded on the central notion that to communicate is to claim someone's intention, and hence to imply that the information communicated is *relevant* (Sperber and Wilson 1998, p. 82). Communication is achieved when a speaker produces ostensive stimuli which provide evidence to the audience from which the speaker's informative intention can be inferred (p. 91). They proceed towards a definition of relevance in which - other things being equal - an assumption with greater contextual effects is more relevant than one with smaller effects, and an assumption requiring a smaller processing effort is more relevant than one requiring a larger effort (p. 96). The principle of relevance is simply this: that a hearer treats it as axiomatic that the speaker has done his best to be maximally relevant (p. 361).

> 'In interpreting an utterance the hearer uses this principle as a guide, on the one hand towards correct disambiguation and assignment of reference, and on the other in deciding whether additional premises are needed [i.e., for indirect implications], and if so, what they are, or whether a figurative interpretation was intended.' (Wilson and Sperber 1998, p. 361)

Sperber and Wilson do not propose that their version of an inferential model of communication should be elevated into a general theory of communication (p. 91). They even leave a limited role for the message model (which they call the 'code model'): they suggest that a hearer recovers the linguistic meaning of an utterance by a form of decoding, but then applies inferential processes to recognise the speaker's intentions (p. 82).

This pragmatic analysis of communication goes a long way towards defusing the arguments levelled against information in the theory of autopoiesis. In this analysis, information is no longer seen (as in the message model) as existing objectively and externally to those using it. The emphasis instead, as Maturana and Varela would wish, is on how a hearer responds to a communication, and how members of a community use language to coordinate their behaviour.

5. Autopoiesis and ontology

Dell (1985), in his illuminating comparison of the work of Maturana and Bateson, remarks that ontology is "the road not taken" in Bateson's thinking and suggests that the biological ontology delineated in Maturana's work could provide a sound foundation for the social and behavioural sciences.

As commented earlier, Luhmann's significant reworking of autopoiesis followed an epistemological rather than an ontological route. Ontology is the branch of philosophy concerned with what things exist in the world. In Maturana and Varela's theory, the most fundamental behaviour (comments Dell) is to exist, and the most fundamental knowledge is to know how to exist. In autopoietic theory, the world is populated by (structure-determined) living organisms. Dell explains the significance of Maturana's ontology thus:

> '*Structure-determined living systems automatically become organised into interactional systems.* Whenever two or more structurally plastic living systems interact they will begin to co-evolve a closed pattern of interaction. They will form a system. When a system is understood in terms of structural coupling, it can be seen that there is no need to explain the system's organisation in terms of homeostasis, systemic rules, or control hierarchies. … The system arises naturally from the way its structurally plastic components fit together. Such a system results from, and *is*, the structural coupling of its components.'
> (Dell 1985, pp. 13-14)

The theory of autopoiesis, in its original form, is fundamentally ontological in character. It is concerned with the existence of living organisms, how structure-determined unities continue to exist by producing themselves, and how they interact with one another. The emphasis is on what it is to exist, and to live, and what it is to be engaged in interaction (as distinct from observing interaction). When this perspective is applied to information, and its use in organisations, the focus is not on the information as such, existing independently, perhaps stored in a document in a database, but on the exchange of information in interaction. This was also the emphasis in the pragmatic analysis of information and communication presented in the previous section. The critical point is that, in the interaction between two parties, each party is producing itself; it is influencing, but not producing, the other. There are no instructive interactions, and there are no fixed or final meanings in any of the messages.

Gibson's theory of information pickup (1986, ch. 14), appears at first glance to have a contradictory view of information to that in the theory of autopoiesis, because it maintains that information is present in the world, and is picked up by organisms. But his notion of information is more fundamental and more radical than that attacked by Maturana and Varela or assumed in our previous discussion of communication and relevance. In his theory, individuals acquire information not from communication or instruction, but from perceiving the world:

> ''... picking up information is not to be thought as a case of communicating. The world does not speak to the observer. ... Words and pictures convey information, carry it, or transmit it, but the information in the sea of energy around each of us, luminous or mechanical or chemical energy, is not conveyed. It is simply there. The assumption that information can be transmitted and the assumption that it can be stored are appropriate for the [mathematical] theory of communication, not for the theory of perception.'
> (Gibson 1986, p. 242)

In Gibson's theory, information is picked up through 'perceptual systems' (not the senses as ordinarily understood) from the environment. He is concerned, not with the perception of forms, colours, time, motion or other abstractions in a laboratory setting, but with the perceiver's experiencing of places, events, substances and objects in an eventful world. The perceiver is also aware of being in the world. Gibson portrays perception as a psychosomatic *act.* A perceptual system is *active.* It consists of organs located in a moving body, not receptors. A perceptual system does not merely receive stimuli,

but *obtains* information, actively. We live in a sea of energy, and experience it not as a sequence, but as a flux. Perception involves the concurrent registering, not only of self as well as of environment, but of change as well as persistence in that flux. Information is always available, and individuals are always actively seeking it:

> 'A perceiver can keep on noticing facts about the world she lives in to the end of her life without ever reaching a limit. There is no threshold for information comparable to a stimulus threshold. Information is not lost to the environment when gained by the individual; it is not conserved like energy.' (p. 243)

Gibson's theory of information and information pickup recasts information ontologically, relocating information in the world and re-presenting the world to us as the information we perceive, through living in it. It offers an approach to information compatible, I suggest, with the theory of autopoiesis, and indeed seems capable of providing an explanation of the notions of plasticity and structural drift central to the autopoietic account. The idea of organisational closure clearly does not mean that organisms are condemned to repeating a fixed behavioural repertoire, since they are able to change as they interact with their environment. Information pickup, as an active engagement with the world, must be part of behavioural variation in the organism.

6. Information in organisations

The theory of autopoiesis can be combined with the inferential model of communication, and the theory of information pickup, to give an approach to information in organisations that emphasises action, interaction and attention rather than storage and transmission. In this approach, human beings are regarded as active and attentive in their pursuit of information. Information is obtained by them continuously as they move through their environment or as they interpret the implications and resonances of what is communicated to them. They are constantly interacting with one another, always on the lookout for information, and always oriented towards working out its relevance.

The lacunae and ambiguities always present in the exchange of messages in organisational settings create the conditions in which information problems are bound to occur. The expansion of information systems across organisational boundaries, because it attentuates the connections between communicating partners still further, will inevitably make matters worse. The solution cannot be found in formal information or computer systems, however far extended, and however much enhanced by the introduction of intelligent agents and similar software assistants to track and prompt our data usage. Such 'active' information systems will help people marshal their data, but the derivation of meaning will perforce remain a human prerogative.

In the familiar designs and expectations of current information systems, there is no assumption that (nor any attempt to make) information always available, or always relevant. Information is rather - under a rationale of efficiency or control - confined and limited within reporting cycles, hierarchical regimes of disclosure, and predefined accesses or queries. The question of relevance does not come up, for two reasons: the meaning and implication of any item is presumed to be fully contained within the item itself (which in turn assumes a common context for originator and recipient of the information); and whatever interpretation is made should in any case be the standard one laid down in operating procedures. The ability of individuals to find new information and make new interpretations is thus obstructed, often on purpose. The expressive range of language is severely curtailed by confining information within prearranged formats and conventional meanings; the entire figurative dimension, for instance, is sacrificed in the reduction of information to records and recipes. Information gets lost as interaction and coupling are blocked in the mire of procedure and hierarchy.

Were managers and designers to recognise that individuals naturally and inevitably interpret information and seek relevance in it (however obscure it is made), they could then design systems which exploited this capability and encouraged interpretation. For example, structured information sources could be expanded (either within the system or in supplementary documentation) to include explanations or commentaries on data items and algorithms or decision routines. This would recognise and exploit the fact that individuals are predisposed to try to make sense of the information that confronts them. If, further, the author or agent currently responsible for each data item and routine were to be made known to users, the possibility would be opened of a conversation between originator and user which could deepen relevance, refocus attention, and perhaps suggest different or additional uses of information. Taking up Sperber and Wilson's suggestion that relevance can be plotted on a continuum, we can imagine an information analysis of an organisation which concentrated less on the formal structure of items, and more on the contextual effects and interpretive effort associated with each item. Sperber and Wilson have commented that a full account of how people understand one another's utterances - especially, but not only, figurative ones - requires a theory of rhetoric, which is to say a theory of argument and persuasion.

If we are to make sense of and more effectively use the information abundantly available in our organisations, we need to be able to judge what is relevant, to make convincing interpretations, and to persuade others of its import. This is so because meaning is not to be found in the symbols, and not in the databases nor the diagrams, but is constructed by us as we engage with the world and in the spaces of conversation which stretch between us.

7. Conclusion

The rejection of the notion of information, as ordinarily understood, in the theory of autopoiesis, presents problems to theories of organisation rooted in ideas of information, control, system and communication.. But the rejection seems well founded if the idea of a self-producing organism is taken seriously. There are various ways of trying to resolve the issue. We can say that autopoiesis cannot be extended to 'third-order unities' (societies and organisations), so that its strictures are irrelevant, even if the autopoietic account can be useful metaphorically. Luhmann's solution is to work out a full-blown autopoietic account of social systems in which the self-producing entities are not individual human beings but communications. This is elegant, but discards autopoiesis's biological foundation and so breaks the connection with living in the world. A re-working of ideas of information and communication using theories from pragmatics takes us closer to the autopoietic view by switching focus from stored information and instructive interaction towards a cooperative search for meaning and relevance. Such an approach, however, remains epistemologically focused (on how knowledge is exchanged), while (as Dell suggests) autopoiesis is oriented ontologically (towards existing and what exists). A more radical reworking of the idea of information taken from Gibson's perceptual theory has therefore been suggested as more compatible with autopoiesis. In terms of the design and interpretation of organisations and organisational systems, an autopoietic account, coupled with a pragmatic approach to communication and a Gibsonian treatment of information pickup, would shift focus (and effort) away from information storage, control and abstraction towards richer forms of interaction and awareness. While the message of organisational closure from autopoiesis has been taken to mean that individuals and organisations have limited capacity for change (so perhaps need to be forced), the positive conclusion from the theory is that individuals and organisations are autonomous, not finally determinable nor controllable, and so are open, even within their structural constraints, to inexhaustible possibilities.

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