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Information and meaning: foundations for an intersubjective account

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Abstract. *Information is fundamental to the discipline of information systems, yet there is little agreement about even this basic concept. Traditionally, information has been seen as 'processed data,' while more recently soft, interpretive approaches have taken information to be 'data plus meaning.' This paper provides a coherent and consistent analysis of data, information, meaning and their interrelations. It is particularly concerned with the semantic and pragmatic dimensions of information, and integrates the work of Maturana and Habermas into a framework provided by Dretske's theory of semantic information. The results show that meaning is generated from the information carried by signs. Information is objective, but inaccessible to humans, who exist exclusively in a world of meaning. Meaning is intersubjective — that is, based on shared agreement and understanding — rather than purely subjective. Information, and information processing systems, exist within the wider context of meaning or sense-making and the IS discipline needs take account of this.*

Keywords: autopoiesis, critical theory, information, information systems, information theory, meaning, pragmatics, semantics, semiotics.

INTRODUCTION

Information systems presumably could not exist without information, yet there is little agreement within the IS discipline over the nature of information itself. As Dretske (1981) and Lewis (1991) point out, few books concerning information systems actually define information clearly. There are, in fact, two competing views expressed within the literature, but there is little by way of rigorous discussion or debate about them. Lewis's (1991) survey of 39 introductory IS texts reveals the most common, traditional view of information, *where it was defined at all*, was data that had been processed in some way to make it useful for decision makers. Philosophically, this view generally involves an implicit assumption that data is objective, that is, it has an existence and structure in itself, independent of an observer; and that information (processed data) can be objectively defined relative to a particular task or decision. An alternative view argues for the

subjective nature of information — the idea that different observers will generate different information from the same data since they have differing values, beliefs, and expectations (Lewis, 1993). Checkland formulates this view as '*information equals data plus meaning.*' That is, by attributing meaning to data, we create information (Checkland and Scholes 1990, p. 303).

This paper argues that both views have significant weaknesses and that it is vital for the IS discipline to develop an effective and consistent concept of information and the related but distinct terms *data* and *meaning*. It will be argued in the paper that *meaning is created from the information carried by signs*. The consequences are that information is objective, but ultimately inaccessible to humans, who exclusively inhabit a world of meaning. Meaning is essentially *intersubjective* — that is, it is based on a shared consensual understanding. The implication is that information is only a part of what we understand by IS and that attention needs to be focused on the *meaning systems* within which *information systems* reside.

FOUNDATIONS FOR SEMANTIC INFORMATION

To study the nature of information, it is useful to use Stamper's (1973, 1985, 1987) framework based on semiotics (Morris, 1938) — the study of *signs* — since information must ultimately be carried by or exist through signs. Stamper does not provide a formal definition of the word 'sign' but illustrates it by examples. It is meant very broadly to be anything that signifies, or stands for, or can be seen to stand for, something else. A typology of different types of signs and symbols will be presented later. Stamper's framework distinguishes four levels of interest[1]:

1 *Empirics.* The study of sign transmission and the statistical properties of the repeated use of signs. This area is concerned with what might be termed communication engineering.
2 *Syntactics.* The study of structures or systems of signs and their properties without regard to their meaning or use. This area covers linguistics, the study of formal languages, logic, and so on.
3 *Semantics.* The study of the *meaning* of signs. This area covers the relationship between signifier and signified, between the sign and what it may represent.
4 *Pragmatic.* The study of the actual use of signs and systems of signs covering the relations between signs and behaviour.

For practical IS development, empirics and syntactics are necessary, but it is the semantic and pragmatic aspects of information, where signs gain meaning and are used, that is crucial. For example, suppose that an IS displays the message that the costs of closing down a coal mine are £30 000 000. What information is carried by or contained in this message (sign)? What meaning may this have for a particular person who comes across it? What information may they gain from it? What is the relationship between information and meaning? How, by whom, and under what circumstances was it generated? In what way might it be used? These are the type

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[1] Recently stamper (1991) has extended his framework to include the physical world and the social world as the bottom and top levels, respectively.

of semantic and pragmatic questions that must be addressed by an adequate conceptualization of information.

In considering such questions, two particular theoretical perspectives will be employed. First, at the semantic level, Maturana and Varela's (Maturana, 1975, 1978, 1988; Maturana and Varela, 1980, 1987) theories of cognition, based on their underlying concept of autopoiesis, provide a consistent and coherent biological explanation for cognition and language. They show that perception and cognition are inevitably subject (i.e. person) dependent, but that language is *intersubjective* — based on common experience and implicit agreement[2]. Secondly, at the pragmatic level, the work of Habermas (1979, pp. 1–68; 1984, pp. 273–338) on what he calls 'universal pragmatics' aims to formalize the analysis of language in use — that is, active *utterances* seeking understanding and agreement rather than abstract sentences or propositions[3].

A REVIEW OF THEORIES OF SEMANTIC INFORMATION

Both the objectivist and the subjectivist views of information have weaknesses. The main problem with the idea of objective or absolute information is that it assumes both that objective information exists and that it produces a similar effect on all those who receive it. Against this assumption, Lewis (1993) shows how conventional data analysis methods involve a large element of subjectivity. Moreover, Maturana's analysis of cognition and the nervous system shows that no sign, symbol or sentence determines its own effect on a receiver — it can never do more than *trigger* (or not trigger) particular changes in the structure of the body and nervous system.

> If the dynamics of states of the nervous system is (sic) determined by its structure, and this structure also determines what constitutes a perturbation for the nervous system, the description of the interactions of the nervous system in terms of information exchange, as if the environment were to specify the state that the nervous system adopts, is merely metaphorical. In fact, the notion of information is valid only in the descriptive domain as an expression of the cognitive uncertainty of the observer, and does not represent any component actually operant in any mechanistic phenomenon of instructive interactions in the physical space. (Maturana 1975, p. 17)

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[2] For explanation and discussion of autopoiesis see Mingers (1989, 1990, 1991, 1995a). These ideas have also been explored in the context of information systems by Winograd & Flores (1986), Winograd (1987), Harnden & Mullery (1991), Stephens & Wood (1991), and Kensing & Winograd (1991).

[3] Habermas's work on critical theory and a communicative theory of social action has already provided a number of ideas for conceptualizing information systems. For example, language as action, speech act, and intersubjectivity (Goldkuhl & Lyytinen, 1982); rational reconstruction, language games, and conversation (Goldkuhl & Lyytinen, 1984); typology of social action, and knowledge-constitutive interests (Lyytinen & Klein, 1985; Lentitinen & Lyytinen, 1986); critical social theory, knowledge-constitutive interests Ngwenyama, 1991) and typology of social action (Lyytinen, Klein & Hirschheim, 1991)

Thus, nothing is intrinsically informative for an individual, and no interaction is inherently instructive.

Turning to the opposite subjectivist view, Checkland's claim is that information is entirely subjective. A particular item of data must be interpreted by someone through their particular structure of meaning to yield information for that person. There are several problems with this formulation. Firstly, the terms and their relationships are not defined precisely and clearly. Thus, what precisely are *data*, *meaning* and *information*, and how exactly do *meaning* and *data* interact to produce *information*? Secondly, information is conceptualized as a purely *individual* construction, thereby ignoring the intersubjective and socially structured dimensions of language. Thirdly, it goes against everyday usages of the term 'information'. For example, books and train timetables could not be said to contain any information except for when they were being read, at which time the information provided would differ between individual readers. Nor could machines process information, or information systems contain information if this were the case.

These two approaches are not the only theories of information. Within the literature of philosophy, sociology, and particularly the cognate discipline of information *science*, there is a considerable range of approaches, most stemming in some way from Shannon and Weaver's (1949) theory of information communication. As part of this research a comprehensive evaluation of these information theories has been undertaken (Mingers, 1995b). Each theory was analysed in terms of four criteria: (1) the generality of the conception, that is, the extent to which they provide comprehensive and coherent accounts of both information and meaning; (2) the adequacy of their concepts for use as a fundamental base for information systems in both theory and practice; (3) their degree of fit with relevant theoretical and philosophical knowledge in other disciplines; and (4) the extent to which they correspond to common-sense usage of the terms 'information' and 'meaning'. The main result of this assessment is that Dretske's (1981) analysis of information and meaning is the most successful in terms of these criteria, and forms a base from which to develop theories of information at the semantic and pragmatic levels.

THE NATURE OF INFORMATION

In the analysis that follows, a realist ontological stance is taken. That is, it is accepted that there is a physical world consisting of structures and events that are related in a causal way, and that these events causally affect human beings. However, this view does not imply epistemological objectivism, i.e. that our knowledge and beliefs about the world can be independent of ourselves as observers. A defence of this view, based particularly on Bhaskar's (1978, 1979, 1986, 1989) formulation of *critical realism*, can be found in Mingers (1984, 1990, 1992).

Following Bateson (1970, 1973), that which are most elementary are *differences*. If some area of the world were completely uniform, it could have no effects at all. It is differences that are transmitted endlessly around the physical medium. Differences in the surface of an object become differences in wavelength of light, leading to differences in the retinal neurones, which become different patterns of neural activity, which in turn become differences in body posture,

and so on. For Bateson (1973, p. 286), information is a *difference that makes a difference*, which can be interpreted as one that generates an event, a sign, a symbol, or an utterance (the differences between these will be categorized below). More precisely, Dretske (1983) suggests that such events are not, in themselves, information but that they *carry* information (a definition of semantic information will be given below) about particular states of affairs in the world. A single event carries information, as Hartley (1928) and Shannon and Weaver (1949) saw, because it reveals a reduction in the possibilities of what might have happened. With the toss of a dice or the input of a particular data item into an IS, a number of possibilities are reduced to one. The *amount* of information carried or generated by the event reflects the reduction in possibilities brought about. The more likely the event, the fewer possibilities it eliminates, the less information it carries. Note, the information that is available is *independent of any observer.* Indeed, the event might not *be* observed — it may never move from the domain of the *actual* to the domain of the *empirical* (Bhaskar, 1978) — yet it still carries this information waiting to be tapped. Nevertheless, prior knowledge of the situation affects the amount of information received by a particular observer (see below). The *average* amount of information can be measured, using formulae similar to Shannon's (Shannon and Weaver, 1949), both for individual events and for sets of possible events.

Of more significance from a semantic, communicational point of view, is *what* the information is, and how it is *transmitted* from a source to a receiver. Considering first transmission, we must assume some causal link exists between the source and the receiver otherwise no information can be transmitted. The degree of correspondence between the two may vary from complete to zero. In general, the source will have a number of possible states, as will the receiver. These states will have differing probabilities of occurrence. The amount of information that can be carried is calculated for both source and receiver. The question is how much of the information at the receiver is caused by the source? If there is complete transmission, it means that every state of the source is linked with every state of the receiver and vice versa. In practice this situation is unlikely. The receiver will be affected by things other than the source (noise), and not all of the information from the source will affect the receiver (equivocation).

These situations can be seen in Figure 1 where S1–S3 are the possible states of the source, and R1–R4 are the possible states of the receiver. S1 is associated with (i.e. can cause) R1, R2, and R3. Knowing that S1 occurs does not tell us which R will occur, although knowing R1, R2, or R3 does tell us that S1 has happened. This case represents *noise* — some factor other than the source must determine which of R1, R2, or R3 occurs. In probability terms, the conditional probability $Pr(R1|S1) < 1$. On the other hand, S2 and S3 can both cause R4. Knowledge of R4 does not carry the information that S3 happened, only that either S3 or S4 did. This case represents *equivocation* — an output may result from a variety of causes. The conditional probability $Pr(S3|R4) < 1$. Thus the *amount* of information that can be transmitted from a source to a receiver depends on the causal relations between them. Independent events can transmit no information, but a causally linked event carries information about its cause. Instruments (e.g. thermometers) are good examples. They are designed specifically to have some causal relationship to a particular state of affairs. Assuming it is working properly, a particular thermometer reading carries information about the surrounding temperature.

States of the source   States of the receiver
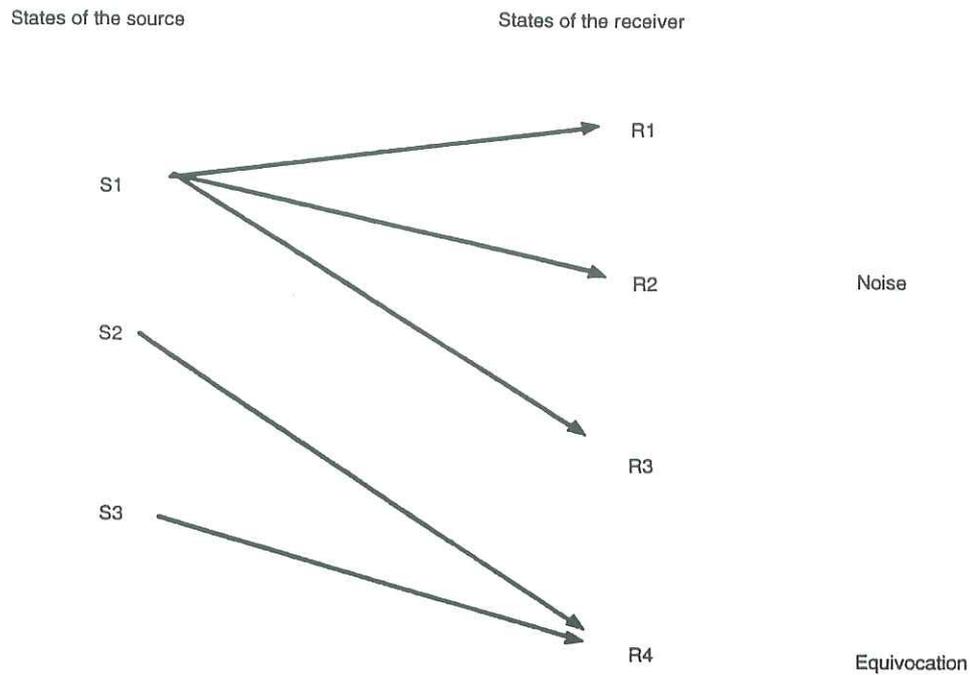
Figure 1. Relations between source and receiver.

Turning to *what* information is conveyed, Dretske argues that the *content* of the information carried by a sign is that which is causally implied by the occurrence of the sign. That is, what must be the case given that the sign or event has occurred. This formulation provides a definition of information — *information is the propositional content of a sign*[4]. Thus, a sign carries information about the particular states of affairs that are implied by the occurrence of that sign. There are a number of consequences of this definition:

1 Information is an objective commodity. It exists whether or not there are people to observe or extract it, and it can be stored and transmitted by artefacts, e.g. books, newspapers, TV sets and computers. Information is distinct from the sign (which must ultimately be physically embodied) that it is carried by since the information has causal effects in its own right. The knock on the door causes someone to open it not because of its physical sound but because it carries the information that someone is there knocking.

2 However, the amount of information available to a particular person depends on their prior knowledge — in particular, their prior knowledge of the possible states of the source. The message that the winner of a horse race was a grey carries more information for someone who

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[4] More formally, Dretske (1981, P65) puts this as:

A signal r carries the information that s is F and if and only if the conditional propability that s is F, given r (and k), is 1 (but given k alone, less than 1)

Where r is a signal: s is F means that some particular state of affairs, F obtains; and k is any prior knowledge of the observer about the possible states of affairs — this may well be zero.

knows there was only one grey than for someone who does not, since it enables the actual horse to be identified. Conversely, no information is available for someone who already knew the winner. Equally, a book written in a foreign language or a message in code carries information, but only for those knowing the language or code.

This relativity of available information does not contradict the argument that information in general is objective and independent of the observer. It is equivalent to two observers looking at the same object from different angles — they see things differently because of their different positions but the object is nevertheless independent of them.

3 If a sign carries the information that a particular state of affairs obtains, it also carries all the information that is implied by that state of affairs (Dretske uses the term 'nested in'). These consequences or necessary conditions could be analytic (that is, follow by definition), or nomic (that is, based on general scientific laws). A further possibility (in addition to Dretske's two) are consequences following from the logic of a social situation (for example, the rules and conventions surrounding the use of credit cards). Analytic consequences are those that follow from the definition of the event or entity. For instance, the information that something is square also carries the specific information that it has four equal sides and that its angles are right-angles, as well as the more general information that it is a square and not a triangle. Nomic consequences are those that follow because of natural laws. For example, if water is boiling, its temperature must be 100°C at sea level. Consequences from the logic of the situation relate to social meanings and practices. For example, a sign saying 'no credit cards' implies cash or a cheque will be required.

To summarize, physical signs carry and transmit information about their causes and the consequences of their causes. This information is transmitted regardless of their observation by anyone. For instance, a TV set turned on in an empty room is still transmitting the information that it has received from a long chain of transmitters going back in both time and space. Moreover, signs carry all the nested information implied by the particular states of affairs that they convey.

A TYPOLOGY OF SIGNS

Before discussing the relationship between *information* and *meaning*, it is important to clarify some terms. First, it is useful to have terms other than 'information' and 'meaning' themselves to use in a discussion about meaning. Second, there are various terms such as 'sign', 'signal', 'symbol,' and 'data' whose meanings tend to overlap. Figure 2 shows a typology that addresses both these concerns[5].

At the first level, (a), we have an *event* with its cause. It is not observed (or noticed) but it still carries (and possibly transmits) information. For example, wet marks on the ground caused by rain.

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[5] This typology is based on previous ones such as Morris (1938) and Buhler (1982, original 1934).

(a)

Cause ◄─────── Event

(b)

Signification ◄─────── Sign/Signal ─────► Import

Generator	A (direct) trace	Implications
bear	bear print	get away
person	knock on door	'the postman'
children	toys left out	kids were here

(c)

Connotation
↓

Signification ◄─────── Symbol ─────► Import

Indirect link - consensual
map symbols
toilet sign
numbers

(d)

Connotation
↓

Signification ◄─────── Utterance ─────► Import

↑
Intent

Intentions of the sign producer

Figure 2. A typology of signifiers.

At the second level, (b), the event has become a *sign* or *signal* (using these terms synonymously) for someone (or something, e.g. an animal). The event is seen, not for itself, but for what it is a trace of, what it points to. The sign *signifies* something, or rather, it signifies *that* some event has occurred — it has significance. It also has implications for the receiver, what I shall call its *import*. For example, a particular print in the ground signifies that a bear was there and has the import for someone that they should get away.

What distinguishes *signs* from *symbols*, (c), is that a sign has a direct (causal or part/whole) relationship to what it signifies, but symbols have only an indirect one. The paw print is physically caused or produced by a bear and could not have been otherwise, whereas symbols rely on an agreed set of rules governing their use — a system of *connotation*. For instance, blue on a map signifies water not because it was caused by water but because of the accepted rules of map-making. There are many types of symbolic system, e.g. icons, colours and shapes, gestures, numbers, and language. Symbols only work for the community of people who share the connotation system.

Finally, in (d), we have an utterance, which is some combination of signs or symbols produced at a particular time with some *intent*. Typically an utterance will involve speech or writing, but it could be a gesture (either symbolic, e.g. a referee blowing a whistle, or a non-symbolic sign such as holding up an empty glass to request more drink), or it could be input into an information system. Utterances may also have unintentional aspects (e.g. body language) that act as signs.

A number of points can be clarified with this typology:

1 Signs/signals, symbols, and utterances will carry information about states of affairs in the world — what they signify. With signs/signals the link is direct, but with symbols and utterances it

is indirect, relying on an agreed background. The latter, therefore, only function for a particular community of observers.

2 The distinction between *data* and *information* is clear. Data is a collection of signs brought together because they are considered relevant to some purposeful activity. Each sign, or item of data, carries some information. In the information systems domain, data will usually be symbolic (numeric, linguistic, or graphic) utterances, produced in the system for a particular purpose.

3 Foreshadowing the next section on information and *meaning*, we can distinguish two different usages of the term 'meaning,' and distinguish them both from 'information.' There is, firstly, the idea of a system of meaning — the publicly available meanings within a language that enable sentences to be meaningful, i.e. that which actors draw upon, and reproduce (Giddens, 1979), in their linguistic interactions. Secondly, is the specific meaning that a listener gains from a particular utterance, and indeed that a speaker intends. Within the typology, the former is the system of *connotation*, while the latter is the *intent* and *import*. Both are distinct from the information carried by the utterance, that is, its *signification*.

INFORMATION AND MEANING

We have seen that events, and signs generated by these events, carry information that is objective — independent of observers and interpreters. The question now is, how is this information related to meaning (import) — the particular meanings that observers derive from the signs? The aim is to clarify that relationship by showing how objective information makes possible non-objective meaning.

This task will be accomplished using two related distinctions: *analogue* and *digital*, and *difference* and *distinction*. The physical world (in which all signs and signals are ultimately embodied) is essentially analogue (Wilden 1977) consisting of continuous rather than discrete effects, such as heat, light and sound. It is a continuum of differences transforming and being transformed, rich in information. Digital, on the other hand, is discrete — it is yes/no, on/off, a distinction (Spencer-Brown 1969) rather than a difference. Analogue is full of information, yet it is ambiguous and imprecise. The digital is precise and well bounded, but it carries only limited amounts of information.

Meaning as a digitalization of the analogue

Dretske's argument is that the transformation of information into meaning involves a *digitalization of the analogue*. Consider the example of a photograph of an old man sitting in a chair. The photo contains a vast amount of information in analogue form. The linguistic description given carries only *some* of the information *in digital form* (Dretske, 1981, p. 136). Much information in the picture is not conveyed. That which is conveyed is that which is stated plus the information nested in it, i.e. what follows analytically or nomically from the description. What is not conveyed is generally more specific information. In this example the man's appearance, his clothes, the type of chair, the background and so on. Signals can carry both analogue and digital information. The information

that is carried digitally by a signal is the most specific information that is available. In the verbal description, the most specific information about the chair was just that it was a chair. However, in the picture, we could see what type of chair, how big, what colour, and so on. Thus, the information that it is a chair is digital in the sentence, but analogue in the picture.

Inevitably when analogue information is digitalized, a loss of information occurs. The digital signal carries less information than the analogue. The manifold differences are reduced to a single distinction, and information that is irrelevant to the distinction is pruned away. Effectively, a process of generalization occurs — a number of different states all produce the same final signal. All that matters for someone who wants to sit down is that it is a chair, not what type. Note that digital information is not necessarily linguistic — for example, a simple thermostat digitalizes temperature.

Dretske argues that our perception and experiences are analogue, while cognition and meaning are progressive digitalizations of this experience. For instance, light from a complex visual scene (analogue) triggers differences in the retina that remain largely analogue. These, in turn, through the very active process of perception involving all the senses, become *seen as* particular things — trees, houses, people. Already some digitalization has occurred. Our attention picks out particular aspects of the scene. Eventually a linguistic signals, such as 'the apples are ripe,' is generated, by which time a full digitalization into meaning has occurred. The same thing happens with internal experiences. Toothache is a strong analogue experience but, by the time we have digitalized it into a sentence, almost none of the analogue information, the feeling, remains.

This explanation reveals the relationship between information and meaning (import) — objective *information* is converted into (inter)-subjective *meaning* through a process of digitalization. It fits well with Maturana's (1975) argument, outlined above, that information can only trigger subject-dependent structural changes. It cannot determine its effects on a receiver. At every stage the receiver's knowledge, intentions, and context determine what counts as information and what particular aspects of the available analogue information are digitalized. Meaning and information are clearly distinct. A message may carry information but have no meaning for a particular person who does not understand the language since they are unable to digitalize. Conversely, a message may have meaning but carry no information. The statement 'I have toothache' is meaningful but carries no information if it is not true. Finally, while information must always be true, the meaning or belief we generate from information may be false — we may be mistaken.

To formalize the difference, a sign or utterance impinges on the sensory system. Its information is carried in analogue form. The nervous system strips away much of the detail to focus on a particular level. The result is the *semantic content of the information structure* — that information, *and only that information*, held in digital form (Dretske, 1981, p. 177). The qualification is important, as we shall see shortly, for distinguishing between digitalization carried out in a meaningful, intentional way by humans from digitalization carried out by machines (such as cameras, thermostats, and computers). A further characteristic of the semantic content is that it must have some effect or action within the receiver, even if only internally. This semantic content is the meaning (import) generated from the available information.

Intentionality and meaning

The information that is held digitally is the most specific information about something and carries with it the more general information nested in the description. But this nested information — analytic, nomic, or situational — must be held in analogue form, since it is *less specific* than that held digitally. This information is not part of the *semantic* content of the signal. Although it is carried by the signal, it is not what is *meant* by the signal. For example, saying that a glass contains water carries implications such as its boiling point and its chemical constituents and properties, but these are not generally what is *meant by* such a statement. These are not part of the semantic content *unless they are relevant to the reason for the digitalization*. If there was a question 'can I drink this?' then the reply 'it is water' *does* have the semantic content that it is drinkable.

It is this aspect of intentionality — of bringing forward only specific semantic content — that distinguishes humans from information processing machines. Some machines transmit all or most information they receive (e.g. a television). Some digitalize it to a greater or lesser extent (e.g. a sensor in the road converts pressure differences into a count of cars passing, which is then fed to a computer). In all cases they transmit the information that they carry and all its consequences — they are not able to impose a higher-order intentional structure on it and lose some of the information. They have not been able to discriminate between the relevance of different aspects of the information.

Summary

Information is different from meaning. Information is an objective, although abstract, feature of the world in the same way as are physical objects and their properties. Information does not depend on knowledge, beliefs, or understandings in itself, although the information available for a particular person does. Meaning, however, is generated from information by interpreters through a process of digitalization that abstracts only some of the information available. Large quantities of information, generally in analogue form, are carried by physical media. Yet humans can never experience or interact with it in an unmediated way, it is literally untouchable. Humans are *always already* in a world of interpreted, digitalized meaning. In this sense, computers have access to all the information they process, they just never know that they do. They are genuinely information processors. Humans, on the other hand, cannot consciously process information, only meaning.

ANALYSIS OF SOME EXAMPLES

So far we have only considered the precise mechanism by which information triggers meaning — *how* meaning is generated, not *what* meaning is generated. We need now to bring in the semantic and pragmatic aspects of communication using the theories of Maturana and Habermas. This will be done initially by way of two examples that illustrate both the mechanisms outlined above and the link into semantics and pragmatics.

Example 1 — a non-linguistic sign

The first example is of a non-linguistic sign since language adds extra dimensions of complexity. Consider coming across a bear's footprint in the Canadian forests. What information does it carry? and what meaning might someone gain from it? The information it carries clearly relates to its own existence. The most likely cause is a wild bear, and the sign carries the further information implied by that — a bear is an animal, carnivorous, often hostile, and so on (analytic); as well as specific information such as size, weight, speed, and direction (nomic). Although a bear is most likely, it is not necessarily the case. One can imagine other, improbable, explanations — for example, a film being made, or a circus. In fact, the likelihood depends on the circumstances — wild bears are very *unlikely* in Hyde Park.

Nevertheless, all this information is carried by the print, even if it is never actually seen by anyone. If it is seen, however, it will trigger some meaning. Consider four different people. The first comes from the city, knows little about animals, and does not even recognize it as a bear print. They are able only to digitalize a very general meaning that it was made by some animal. The next person has come for a picnic with the family. They recognize it is a large bear and quite recent. They digitalize the meaning that the bear could be a danger to them and move away quickly. The third person is a hunter who can almost visualize the bear from the print and follows the tracks in eager anticipation. The final person is a technician from the film company who thinks the print is one of the fake ones they made, but unfortunately is mistaken, and is mauled by the bear.

What does this tell us? It shows the large amount and variety of information carried by the sign quite independently of its observation. It also shows how this information triggers specific meanings in people and how these differ substantially between people. Note that these meanings are not purely individual (subjective) but will be shared among different groups of people, living different *forms of life* (Wittgenstein, 1958, pp. 8–12), such as hunters or a film crew. Information is *potential meaning*. These meanings, in turn, lead to practical action in the world, generating new signs and signals of their own. The last case shows how the attribution of meaning can be mistaken. The sign was wrongly interpreted, and the resulting meaning was incorrect because of *equivocation* in the information.

Example 2 — a linguistic utterance

This example follows the first, except that instead of seeing the bear print, the receiver is *told* about it, as in 'I saw a bear track over there.' What information does this *linguistic* sign carry?

Once again, it carries information about its own existence — what has led this particular set of sounds to occur? Now, however, there are two different types of answer. One concerns the state of affairs that it describes — its *propositional* content. We could say that the fact there is a bear print (assuming the statement is true) has caused the statement. It therefore carries similar information to the previous example (although much less as it is digital). The actual cause of the statement, however, is the fact that it has been made by a particular person with particular intentions at a particular point in time. This points to the *illocutionary* or pragmatic content of the

statement — what it is trying to achieve. Thus, in contrast to the non-linguistic sign, the statement also carries information about its pragmatic dimensions. These can be analysed using Habermas's communicative validity claims (Habermas, 1979, 1984).

This situation is quite different from before, as illustrated in Figure 3. In the first example, the relationship between source and sign was direct — the bear caused the print. In the second, it is indirect. We can gain information about the described state of affairs if we assume that Habermas's four validity claims, *comprehensibility, truth, truthfulness*, and *rightness*, can be justified for this speech act (see Table 1). If we do make these assumptions, we gain some of the information that would have been available by seeing the print. But not all. The print itself is an analogue sign that carries a large amount of information. The statement is a digital sign that carries relatively little — it loses much of the richness. A better secondary sign might be a photograph which maintains much of the analogue information.

Information is now also available, however, about the speaker's pragmatic intentions and the validity claims underlying the utterance. What possible motives could there be for the statement? What type of speech act was it: answering a question? making a statement? ordering something? If the propositional content seems unlikely, we may question the validity claims underlying the communication — is the speaker mistaken about factual matters (*truth*)? Have we understood the utterance correctly (*comprehensibility*)? Is the speaker sincere (*truthfulness*)? Is the speaker assuming different social norms and rules than we are (*rightness*)? Note that I do not restrict the term 'speaker' to a single person. Rather, it can be seen as the ensemble of people, mechanisms, and procedures that lead to a particular sign being produced. In the case of data in an information system, it is not so much the person who types it in as the people and procedures that actually produce the data.

These examples illustrate how signs carry propositional information and, in the case of utterances, illocutionary information as well. They also illustrate how meaning can be extracted
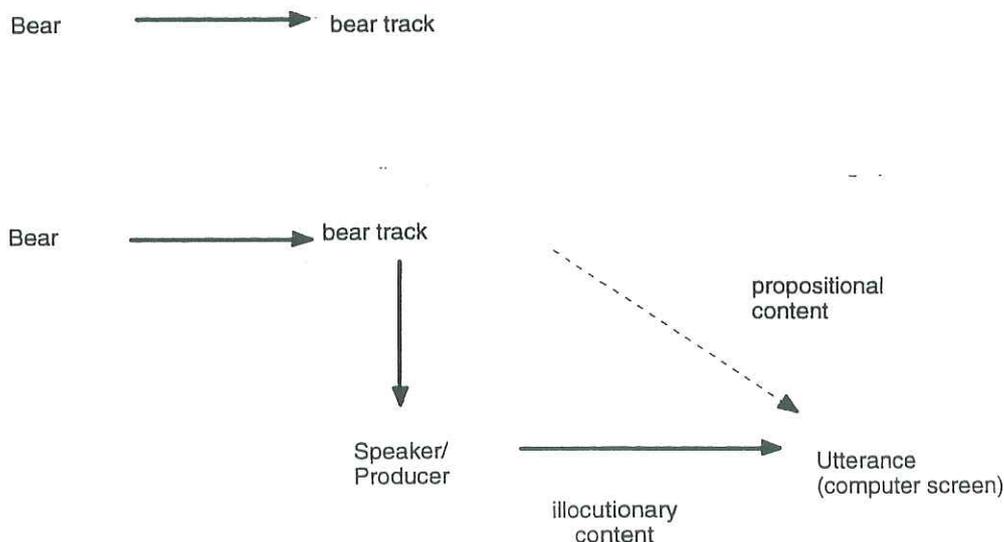
Figure 3. Direct signs vs. linguistic utterances.

Table 1. The Validity Claims of Communicative Action (after Habermas, 1984)

Validity claim	Reference world	Purpose	Type of speech act	Forms of argument
Truth	Objective world – that which obtains (external nature)	Presentation of knowledge	Constative – propositions – explanations – predictions	Theoretical discourse
Rightness (legitimacy)	Social world – normative relations and practices (society)	Establishment of social relations	Regulative – promises – orders – requests	Practical discourse
Truthfulness (sincerity)	Subjective world – private experience (inner nature)	Expression of self	Expressive – beliefs – intentions – desires	Therapeutic critique
Comprehensibility	Language	Understanding		Explicative discourse
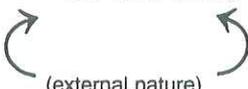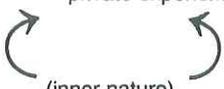
from the information and how meaning has both intersubjective (connotation) and subjective (import) dimensions. The next section analyses this process of meaning generation in more detail.

LEVELS OF MEANING

We have seen how meaning can be generated from information and leads on to action. The examples have shown that the initial perception of a sign, and comprehension of its meaning (connotation) if it is linguistic, quickly brings in context, knowledge, and intention to create the complex, individual meaning (import) for a particular person. There is, here, a continuum of meaning that ranges from initial, public, intersubjective meaning of the utterance to the private, individual, subjective implications for action for the receiver. We can distinguish, analytically, three different levels of meaning within this complex continuum. They apply to both linguistic and non-linguistic signs, although they are more revealing in the linguistic case. They are referred to as 1, 2 and 3. Initially, they shall be explained from the viewpoint of a receiver gaining meaning from signs (the focus of most of the paper so far). It is equally important, however, to look at the producers of signs and utterances, and the relations between their meanings and the signs produced (see Figure 4).
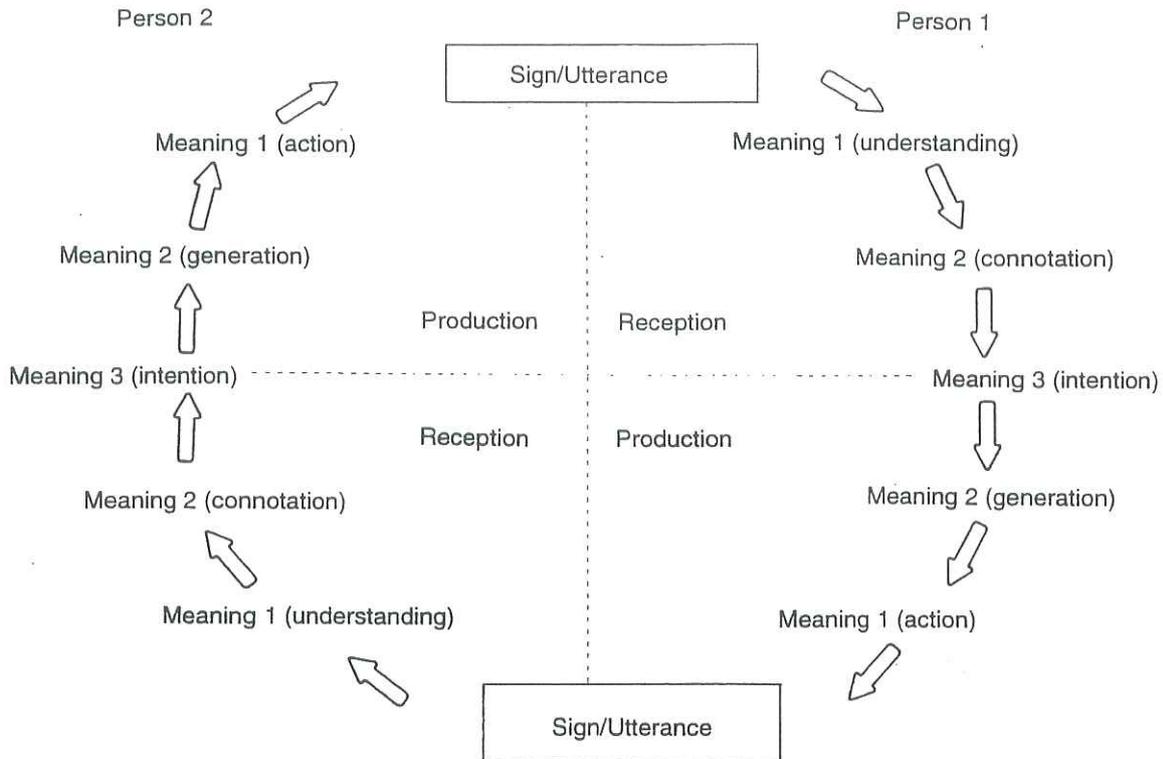
Figure 4. Levels of meaning.

Generation of meaning from signs

Meaning 1 — understanding

The first level of meaning is that in which the receiver comes to understand the *primary* meaning of a sign or linguistic message. The observer *recognizes* the bear print as such, or understands the sentence as saying that there is a bear print. This is the level of understanding that can be expected from all competent speakers of a language — all those who share a particular language or symbol system. It corresponds to the semantic content outlined above — that is, the digitalized information without its analogue nesting. The main validity claim it involves is that of comprehensibility, although others may be involved.

It is not always easy or simple, however, to gain this understanding. Much work in ethnomethodology and hermeneutics show how difficult it can be to understand a particular utterance. Often a negotiation or interchange is necessary to establish it, especially when speakers are not straightforward or sincere, and employ irony or sarcasm to negate the surface meaning. If comprehensibility is a problem, it may reflect a lack of adequate *structural coupling* (Maturana, 1978) between speaker and receiver — the signs do not have common connotations — or it may call into question other validity claims, particularly sincerity.

Meaning 2 — connotation

This level brings in the complex of other meanings, beliefs, and implications that are associated with the primary meaning. For example, the knowledge and experience that the receiver has about bears. This level of meaning will not be primarily individual but will be differentiated between groups of people — for example, bear hunters, zoologists, and picnickers. Such people share forms of life with meanings that are unavailable to outsiders. This level of meaning extends the initial digitalization to include nested consequences known and available to the receiver.

This level is mainly concerned with the validity claims of truth and rightness. Is the propositional content of the sign actually correct? Does the state of affairs actually exist? Are its claims about social rules and roles acceptable?

Meaning 3 — intention

Meaning 3 is finally the individual meaning for a particular person and the implications of that meaning for action — what intentions will it lead them to have. Their own personal experiences, feelings and motivations at a particular time will be brought in and result in a particular activity, which may be simply remembering it for future use. This level of meaning is subjective rather than intersubjective.

At this level, sincerity will be a primary validity claim. Is the source truthful? Did the speaker mean what they said? Are they reliable? Questioning these implicit claims may lead the conclusion that the speaker was acting strategically rather than communicatively and thereby to appropriate action.

Production of signs from meaning

Here we are concerned with the obverse of meaning generation — that is, sign production. This is of much greater importance in the indirect symbolic systems such as human language where questions of truth and truthfulness arise. We can trace three similar stages from the intention of the speaker through the actual enactment of the sign or utterance. In terms of the analogue/digital distinction, production is the obverse of digitalization — a case of generating an analogue sign (i.e. an utterance or a gesture) from a digital meaning.

Meaning 1 — Intention

The first stage concerns the intention of the sender or producer of the sign. An intention to communicate might come about *de novo* or it might be in response to a previous utterance. Questions at this level concern the nature of the intention (for example communicative or strategic action), and its sincerity.

Meaning 2 — Generation

This level is concerned with converting an intention into a specific form that can then be

expressed through particular signs or utterances. There are a wide range of possibilities. At one extreme — say the cry of 'help' in response to danger — the transition from intention to action is almost instinctive and involves little work. On the other hand, to pick up an earlier example, estimating the cost of closing a mine will involve much research, a number of people, and theories, assumptions, calculations, and procedures. It will be a highly political process.

The generation stage always occurs within the context of particular forms of life and draws on social structures and constraints such as language, practices, skills, resources and power. The main validity claims are rightness, truth, and, in the case of strategic action, effectiveness.

Meaning 3 — Action

Finally, a comprehensible utterance or sign must be generated. This clearly implies competence in the semantic and syntactic rules of the language or sign system if the sign is to be understood. The process produces an analogue sign from a digital meaning, the obverse of digitalization. This is clear in the case of a gesture or picture but is equally so in linguistic interactions through, for example, tone of voice and body posture. Maturana (1988) describes a conversation as a meshing of language, emotion, and body. It is interesting to note that signs produced in a computer lack most of these analogue dimensions and communities of e-mail users often re-create their own stylized forms.

IMPLICATIONS FOR INFORMATION SYSTEMS

Consider, first, the example given in the introduction. What are the information and meanings associated with an IS recording the sign (data) that the cost of closing a mine is £30 000 000[6]? The *information* carried by this sign is independent of who may receive it and concerns the conditions of its production, both propositional and illocutionary. The information concerns *who* produced it, *why and how* it was produced, and its relationship to what it signifies. It raises validity claims concerning truthfulness (the sincerity of its producer(s)), rightness (its adherence to agreed norms and procedures), and truth (its assumptions about particular states of affairs). All depend on the design and operations of the particular information system.

The *meaning* of the sign is quite separate and depends on the receiver or interpreter. The level 1 meaning (understanding) simply involves comprehending the message or display. In an information system, it will depend on the users' familiarity with and understanding of the rules and conventions of the system. The level 2 meaning (connotation) involves relating this initial understanding to other knowledge and experience, including assessing the implications and consequences. Note that this will not be a wholly conscious process — it is part of the nervous system's digitalization of the analogue. It may lead to questioning the presumed validity claims

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[6] Note that this example has been deliberately chosen as something that is obviously contentious to make clear it is not suggested that the processes of producing and interpreting signs are clear and determinate. Rather, they are under-determined and are often contestable within wider social processes and power structures.

— are the assumptions made valid? Are the calculations and accounting conventions used acceptable? Are the espoused motives of the producers sincere? Finally, the level 3 meaning (intention) is reached. What actions will it lead to on the part of the interpreter?

This example shows how the scheme developed in this paper distinguishes between the terms 'information,' 'meaning,' and 'data,' and explains how meaning is generated from the information carried by data. It places equal importance on the process of production of data and information from meaning.

The main implications (highlighted below) of this analysis for information systems are of a general and conceptual nature. It does not promise new methods or techniques for immediate use by practitioners; nor does it provide a new perspective for the discipline. Rather, the analysis is concerned with clarifying the concepts underlying the discipline of IS and providing a framework within which the different world views may be located and may work together more effectively.

Firstly, and most significantly, this paper provides a clear and consistent conceptualization of the basic concepts of the discipline of IS. In particular, distinctions are drawn between signs, symbols, and utterances on the one hand, and between data (a collection of signs relevant to a particular purpose), information, and meaning on the other. The actual distinction drawn between information and meaning has a number of advantages over other characterizations:

1 It corresponds to everyday usage of the terms — books, timetables, and computers *contain or process information*, and this information may *mean* different things to different people.

2 It also corresponds to usage in other disciplines. For example, the use of the term 'meaning' in the social sciences, and the idea of information processing in engineering and computer science.

3 The particular approach adopted here covers both the semantic and pragmatic characteristics of information. It integrates significant theoretical work by Habermas and Maturana, but still relates back to Shannon's information theory at the empirical level. This spectrum could be completed by an analysis of information at the syntactic level based, perhaps, on the idea of logical information developed by Bar-Hillel and Carnap (1952).

Secondly, this formulation avoids the unproductive dichotomies between hard and soft or objective and subjective perspectives in IS. It provides a place for each.— objective information and (inter) subjective meaning. More importantly, it proposes a mechanism that links the two. Namely, the role of the nervous system in converting objective, analogue information into intersubjective and then subjective digital meaning, and then back into activity. This explanation focuses attention on the role of the physical body in cognition, a topic that has been neglected but is now receiving widespread attention (Varela et al, 1991; Synnott, 1993; Beeson, 1994; Edelman, 1992; Mingers, 1995c).

Thirdly, a clear framework is provided for analysing both the subjective and intersubjective dimensions of meaning. Producing and understanding symbols and utterances is only possible through a variety of shared, publicly available backgrounds of practices and meanings. In this sense meaning is intersubjective. Yet information also has its particular importance for an individual leading to subjective meaning and action.

Finally, one of the main conclusions of the analysis presented in this paper is the distinction between information systems, traditionally conceived, and meaning systems.

Computers process (transmit and transform) signs (data) and the information which they carry. In itself, this information is quite meaningless until it connects to the wider meaning systems within which human beings operate. What we call information systems are really only a part of human meaning systems (see Fig. 5) in which signs and signals are continually produced and interpreted in an ongoing process of intersubjective communication. Information systems *as a discipline* needs to focus attention to the wider field of meaning systems if it is to make an effective contribution to human practice.
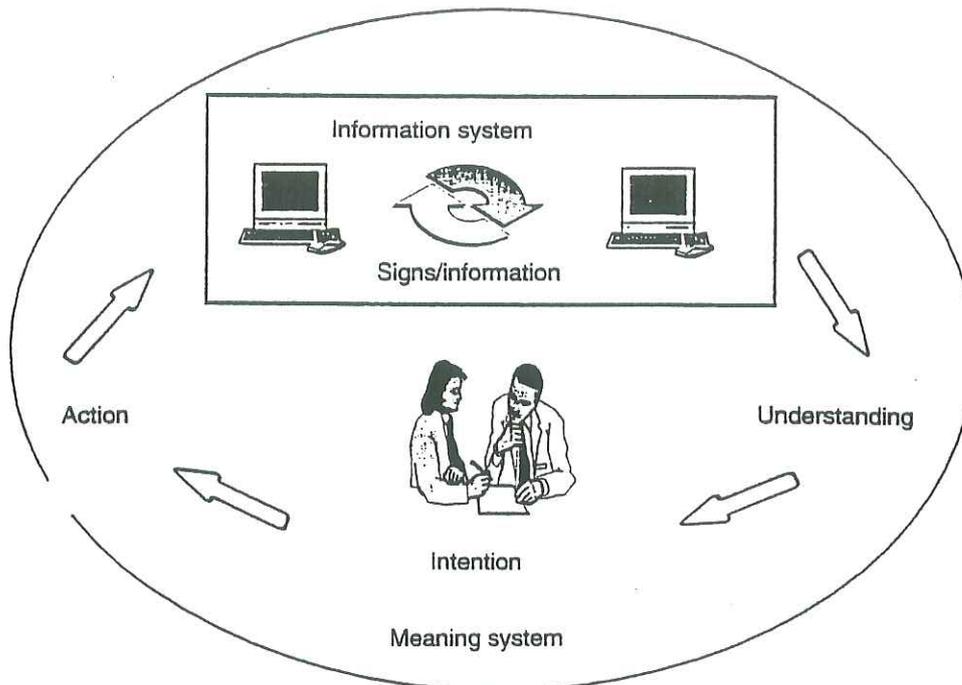

Figure 5. Information systems as part of meaning systems.

CONCLUSIONS

The aim of this paper has been to develop a clear conceptual framework for distinguishing between information and meaning and to analyse the relationship between the two. The main results are:

1 Information and meaning must be distinguished, but rather than meaning creating information, meaning *is generated from* information.

2 Signs carry objective information, but humans cannot access this — we always already exist within a domain of meaning. Meaning is expressed in and conditioned by language, which is intersubjective — that is, based on agreement and consensus.

3 The meaning that is generated from information, and that which generates further information, depends both on our linguistic forms of life and on our individual circumstances and intentions at the time.

4 *Information* systems exist, therefore, within the much larger domain of *meaning systems* or *sense systems* and it is only within this wider domain that information can have any import or significance.

5 This leads us to consider the semantic and pragmatic aspects of the production of signs and the generation of meaning and their relationship to the social context in which they occur.

This particular conceptualization allows us to make sense of the rather dichotomous nature of the discipline of information systems — hard, technically-oriented versus soft, people-oriented. It also links well with the established usages of 'information processing' within IS/IT and 'meaning' within the social sciences. Thus, it has the potential to provide a platform from which a more unified and effective discipline may spring.

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Biography

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