Information is Provisional

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1. Introduction

General systems theorists have described matter, energy and information as fundamental categories in the contemporary world (Umpleby, 2007), somewhat similar to the way that the ancient world identified fundamental elements such as air, earth, fire and water. The utility of this categorisation is illustrated by consideration of an artefact such as a smart-phone, where the size and weight are concerned with matter; the battery life with energy; and essentially everything else with information. ‘Everything else’ includes the communication services of the phone – the conversations of the user, the multimedia, music and video – but also the design of the phone, the choice of shape and colour schemes, for example. The tripartite categorisation is not restricted to manufactured artefacts, however, since the categories are equally valuable in understanding natural objects, including biological entities such as plants and animals.

Matter and energy are in many ways uncontentious, but information is more problematic. This paper presents a new way of understanding information based on a diagrammatic convention, that, it is claimed, provides significant insights into the nature of information, and explores some features of information including the fact that it is always provisional.

Section 2 introduces a framework for understanding information including a textual description of information and the new diagrammatic convention. Section 3 applies this framework to some examples of situations involving information in widely-different contexts. Section 4 discusses some of the implications of the provisionality of information, and Section 5 is the conclusion.

The ideas in this paper develop (though in some cases depart from) material in Chapman (2011), and some of the topics have been explored from time to time in the author’s blog (www.intropy.co.uk).

2. Understanding Information

Our understanding of matter and energy is uncontentious, but that does not mean it is easy to say what they are. *The Feynman Lectures on Physics* say of energy, for example:

> [I]n physics today, we have no knowledge of what energy *is*. […] However, there are formulas for calculating some numerical quantity, and when we add it all together we get “28” – always the same number. (Feynman, Leighton and Sands, 1963, p. 4-2. Emphasis in the original.)

The necessary mathematical calculations on energy (and matter) can be done, but our ease with them as concepts also stems from familiarity with them over many years, and a recognition that they are concepts grounded in science. Both matter and energy have scientific usage, coupled with derived or metaphorical usage linked to the scientific meaning (“it is a very energetic story”; “a weighty argument”).

Information is different. Information has many metaphorical uses, and it is important in widely different contexts and disciplines (though, as Von Baeyer, 2003, p10, observes it is not even in

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the index of *The Feynman Lectures on Physics*), but it is not clear whether it is grounded in any of them. Paolo Rocchi (2011) enumerated 25 distinct theories of information, and within some disciplines and tightly constrained contexts, the theories are unproblematic. There has been work towards a unified theory of information (UTI) in recent years (Hofkirchner, 2013) and plenty of popular writing about information (such as von Baeyer, 2003, Wright, 2007, Floridi, 2010, Gleick, 2011), but there is not as yet an understanding of information in the way parallel to that of energy and matter.

Claude Shannon's landmark paper (Shannon, 1948, reproduced in Shannon and Weaver, 1949) is a potential candidate for the grounding of information, because it explores a clearly-defined mathematical quantity of great practical utility in the design and analysis of communication systems – it is the foundation of the discipline referred to as information theory. Some authors interested in a wider understanding of information, however, dismiss Shannon's work[2] as of no relevance, partly because, in his 1948 paper, Shannon himself, after setting up the model of a system for communicating messages, stated that:

> Frequently the messages have meaning; that is they refer to or are correlated according to some system with certain physical or conceptual entities. These semantic aspects of communication are irrelevant to the engineering problem. (Shannon, 1948)

Donald Mackay, however, observed:

> The trouble here appears to be largely due to a confusion of the concept of information with that of *information-content* – the confusion of the *thing* with the *measure* of the thing. Communication engineers have not developed a concept of information at all. They have developed a theory dealing explicitly with only one particular feature or aspect of messages 'carrying' information – their unexpectedness or surprise value. (Mackay, 1953, also published as Chapter 6 of Mackay, 1969. Emphasis in original)

Perhaps the most widespread description of what the thing (information) *is*, can be summarised by the expression 'meaningful data'. Luciano Floridi formalises the idea of meaningful data in the GDI: General Definition of Information (Floridi, 2011, p84):

> σ is an instance of semantic information if and only if σ consists of data, the data are well-formed, and the well-formed data are meaningful

Other authors qualify the meaningful data further by time and space (Holwell, 2011, p72):

> data plus meaning in a particular context at a particular time

In both of these the information 'is' the data with certain conditions ('well-formed', 'meaningful', 'in a context', 'at a time'), but an alternative is to focus on the event, the generation of meaning, and Suhail Malik (2005) suggests that:

> Information is […] a situated event, an event that generates meaning in a system or for an organisation

Based on Malik's wording, we take as a working description of information:

> a situated event that generates meaning

This begs the question as to the meaning of 'meaning'.

Arguably, all the significant philosophical questions about information hinge on 'meaning'. As noted above, Shannon believed that his work could be isolated from meaning but it was nevertheless the catalyst for numerous strands of research into the semantic aspects of information. The work of Donald Mackay has already been mentioned, and more recently Fred

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[2] I am using Shannon as shorthand for a particular strand of information theory, though there are naturally many other important contributors to the field. Shannon, in his 1948 paper, cites Nyquist 1924, 1928 and Hartley 1928.

Dretske's "Knowledge and the Flow of Information" (1981) is of recognised importance. Other major early work on the semantic aspects of information include that associated with semiotics (see for example "On Human Communication" by Colin Cherry, 1957) and the body of work referred to as 'Semantic Information Theory' pioneered by Yehoshua Bar-Hillel and Rudolf Carnap (Bar-Hillel, 1964), which is briefly discussed below.

The need for interdisciplinary conversations to uncover meaning in information was recognised from the early days, and some of the most important insights into information come from interdisciplinary work. To take just two examples, the Macy Conferences on Cybernetics ran from 1946 to 1953 (Ramage, 2011), while Fritz Machlup and Una Mansfield brought together 41 contributors in "The Study of Information: Interdisciplinary Messages" (Machlup and Mansfield, 1983).

At the present time, of particular note is the work of the Unified Theory of Information Group (UTI) based in Vienna (http://www.uti.at/), the BITrum project (http://en.bitrum.unileon.es/) and the Foundations of Information Science initiative (http://infoscience-fis.unizar.es/).

Set within the context of the output from these groups and other individuals, the present paper is a modest offering. Nevertheless is hoped that the novel use of simple diagrams provides a new way of understanding which sheds light on the nature of information, contributes to understanding the meaning of meaning, and delivers practical insights into the nature of information events.

2.1 A Diagrammatic Representation of Information

As noted above, one of the directions taken by the early work exploring a wider understanding of the nature of information was towards the insights of semiotics (Cherry, 1957, see also Monk, 2011 and Chapman, 2011). In the field of semiotics, a diagrammatic representation in the form of a triangle has proved illuminating (Chandler, 2002). Different versions of semiotic triangles have been presented by different authors, and, while some authors may argue that one version or another is correct or incorrect/misleading, triangles generally provide a basis on which to hang semiotic insights.

A source for a representation of information is a diagrammatic convention sometimes used by engineers for layered communication architectures, where a trapezium represents the processing of data that is passed through a layer. Figure 1, for example, redraws Shannon's iconic diagram making use of trapeziums. A message is communicated by encoding at the transmitter, transmitting a signal, then decoding at the receiver. The change from Shannon's drawing introduces the metaphor of layers or levels. The language of communications has it that there is a virtual communication of the message between the source and destination, but that for the physical communication the message is conveyed by the layer below after encoding, and that the message is extracted from the physical signal by the decoder at the receiver.

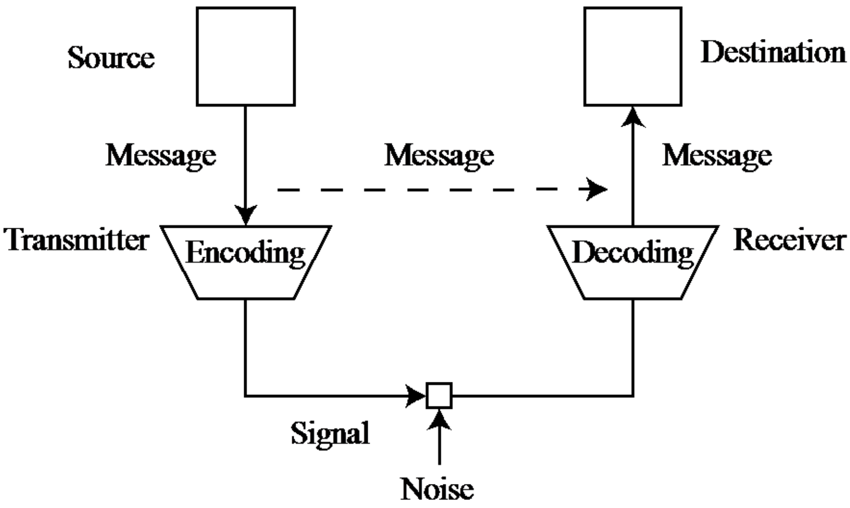

Figure 1 A redrawing of Shannon's model of a communication system

Engineers break down the processes needed for communication into multiple levels, so, for example, Figure 2 shows the coding divided into an ascii-coding level and a modulation level. Notice the use of the virtual communication (shown by the dashed lines), where the letter 'a' is communicated in what we might here call a 'text' level, sets of bits are communicated in a 'binary' level but the actual communication is the signal, which might be light in an optical fibre.

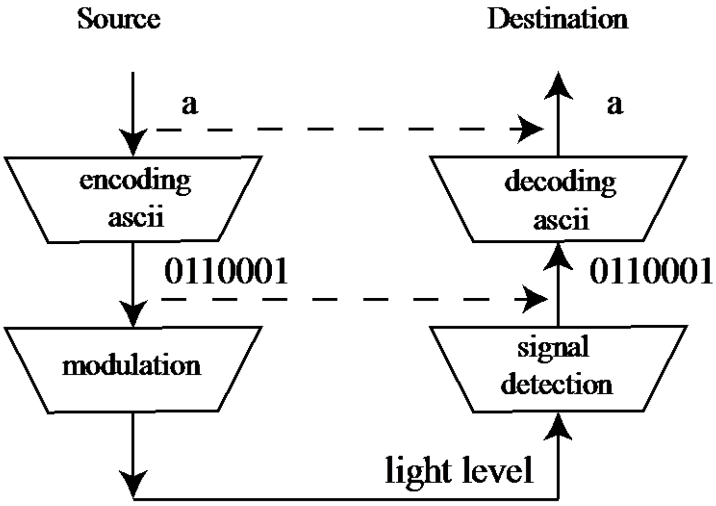

Figure 2. A communication system with two levels

Standardised sets of levels, such as the seven layers of the ISO's framework for Open Systems Interconnection (OSI, Bissell and Chapman, 1992), have been defined, and this is important for interworking, but more generally engineers use whatever levels are convenient for the task at hand.

In the present proposal, information is identified specifically with the trapeziums at the receiver. It is suggested that when, for example, the process of signal detection in Figure 2 identifies a received light level as a data '1', this may be described as the trapezium interpreting the 'meaning' of the signal (the 'data') to be '1'. Similarly, when the ascii decoding trapezium determines 0110001 to be the letter 'a', this can be described as an information event whereby the trapezium extracts the meaning (a letter 'a') from the data (0110001).

More generally, information events are represented by trapeziums which interpret data to generate meaning, as represented in Figure 3(a). Some other labelling used later in the paper appear in other parts of Figure 3, but for the moment notice Figure 3(b) which presents Gregory Bateson's description of information as a "difference that makes a difference" (Bateson, 1972).

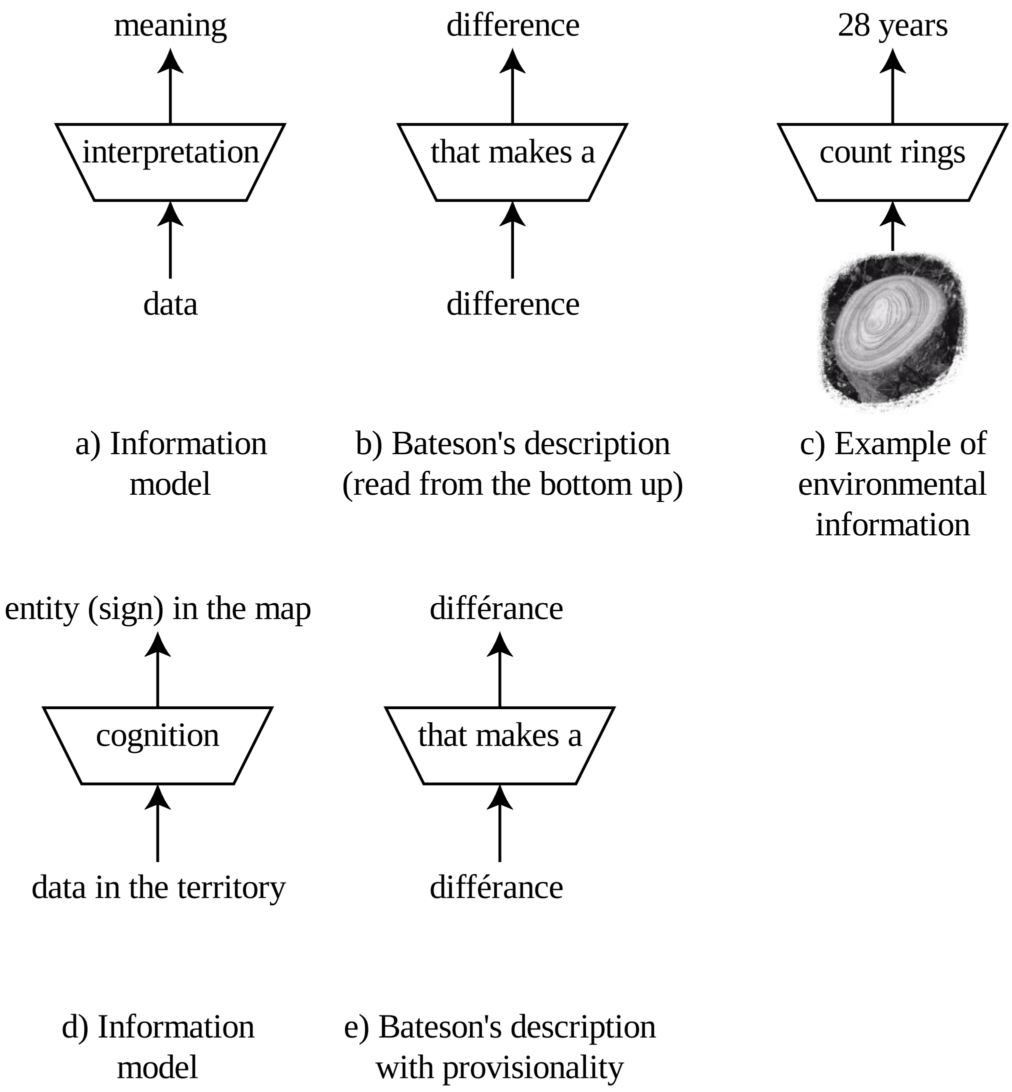

Figure 3. Diagrammatic representations of information

For communications engineers, the trapeziums and the layered architecture provide a means of dividing the communications problem into manageable segments. For the proposal in this paper, they provide a means of understanding the role and nature of information. Faced with any information problem, we represent it by a trapezium or a set of trapeziums at different levels and ask questions about the data, the meaning and the process of interpreting the data (the content of the trapezium).

For example: is the interpretation a matter of *extracting* meaning from data, or of *creating* meaning from data? It is argued in the next section that the extraction of meaning from data may be associated with semantic information and the creation of meaning from data may be associated with environmental information.

2.2 Semantic and Environmental Information

Figures 1 and 2 illustrate communication, and the meaning (information) extracted from the data by the trapezium at the receiver has been communicated from the transmitter. Trapeziums can also be drawn to model situations that are not, or are not obviously, examples of communication, in which case it might be more appropriate to talk about meaning being created.

These two categories of meaning – meaning which has been communicated and meaning that is created – roughly coincide with Grice's (1957) distinction between non-natural and natural meaning respectively. In Floridi's map of information categories (Floridi, 2010 p. 20), the top-level distinction is between semantic information and environmental information, and it is proposed here that semantic information is identified with communicated non-natural meaning and environmental information is identified with created natural meaning. We can also make a link (Table 1) with the first two Cs of the triple C model: Cognition, Communication and Cooperation (Hofkirchner, 2013 pp 184-196).

TripleC process	**Grice's Meaning**	**Information Type**	**Information Event**
Communication	Non-natural	Semantic	Extraction
Cognition	Natural	Environmental	Creation

Table 1. Categories of information and meaning

The standard example of environmental information is the growth rings of a tree, which provides information about the age of the tree although they were not deliberately put there for that purpose: they are an integral feature of the annual growth of the tree. The observer of the rings, however, generates meaning from the observation, so we model the information-event as in Figure 3(c).

Rather than describing the environmental information event as the creation of meaning, it might be argued that the meaning is already 'out there' and therefore the event is that of discovering the meaning rather than creating it. The justification for describing it as creation rather than discovery is explained in Section 2.3 below.

These two categories, semantic and environmental information, appear at first to be distinct: information is either one or the other. If, however, we explore any one information event in depth we can find in it reasons for describing it as either of the two categories. All information may therefore be said to be both semantic and environmental.

All information is semantic

Salmon hatcheries in Alaska encode information in the bones of the fish's inner ear, by varying the water temperature during the development of the embryos.

> [A] kidney bean shaped bone in the salmon's inner ear, called an "otolith," is sensitive to water temperatures during embryonic development. When the temperature of the water running over the salmon eggs is raised by a few degrees, the developing otolith adds a darker layer of calcium to its surface. This is done repeatedly to the embryos. Later on when the adult fish return to spawn and are harvested, the otolith can be removed and cut in half to reveal a pattern of dark rings.
>
> By reading this "barcode", the hatchery can tell which batch the fish came from and how long it had been in the wild. (Glass, 2007)

As a thought experiment, imagine growing a tree in an enclosed environment and varying the microclimate over time in order or write a message into the growth rings. Wide and narrow rings could be created and used as a binary code, for example. Rather than environmental information, interpretation of the growth rings would now be semantic information. The only difference with ‘natural’ growth rings is the origin of the information which is the enclosed environment, so we might represent the information of the naturally-grown tree rings as in figure 4.

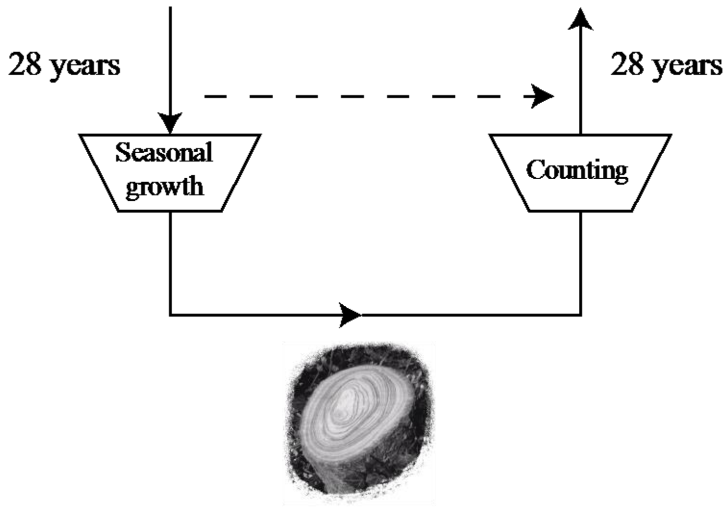

Figure 4. Tree rings as semantic information

There can be merit in considering all information to be semantic information since by seeking a semantic (communication) representation for even environmental information – any information – we are driven to uncover the origin of the meaning that has been created/extracted.

All information is environmental

All communication channels are unreliable – there is always noise in the channel. Also, how can we be certain that the decoding is correct? The receiver can never know for sure that he/she/it has correctly accessed the message of the sender, so in this sense the receiver is always creating meaning locally, and all information is environmental.

There are echoes here of the work of semioticians on meaning in texts or other artefacts. Does the reader of a text access the sense of the writer? What is the relationship between the reaction of the observer of a work of art to the ideas of the artist? We will return to some of these questions in Section 3 below.

The distinction between semantic and environmental information therefore, may not be an inherent feature of the information event. Rather, it is a distinction between different ways of modelling/interpreting an information event, one of which may be more or less valuable in any given situation. To understand an information event both interpretations should be considered.

2.3 Maps, Territories and Levels of Abstraction

A central concept of Luciano Floridi’s philosophy of information is that of level of abstraction: LoA (Floridi, 2011). Floridi’s construction is worked out in rigorous detail, but we simply propose here that an LoA is like a map. A map is an abstraction of a territory, and we cannot comprehend a territory other than through a map (in the widest sense). There can be many different maps of the same territory, each of which represents different aspects of the territory by using a different abstraction. Famously, Harry Beck’s London Underground map (Garland 1994) is topologically accurate but geographically misleading. A geological map of London should be geographically accurate but would be of no use for planning a journey on the underground.

Information is the connection between the map and the territory: the process of abstraction (Figure 3(d)). Through the map the territory can be understood, so creation of the map is the creation of meaning from the territory.

A map has a scale (level). A small scale map may be created from a large scale map, so one level of abstraction may be created from a lower level of abstraction. Or, to put it another way, the 'territory' may itself be an abstraction.

Entities in one abstraction simply do not exist in another abstraction, even if they 'only' differ in level. A motorway on 1:25,000 road map is a different entity from a motorway on a 1:100,000 road map. Different abstractions are completely different worlds, and the only connection between one and another is through an information event. This is why environmental information is the creation of meaning rather than the discovery of meaning that is already out there: the meaning in one abstraction cannot exist in another abstraction. Environmental information is the creation of an entity in an abstraction using data from a different abstraction. Semantic information, on the other hand, is the extraction of information that originates in the same abstraction at a different location (or from a different time because the communication can be in time as well as space) but which has been communicated by another abstraction.

2.4 The Veridicality Thesis and the Provisionality of Information

According to the veridicality thesis of information, (semantic) information has to be true in order to be information. False information is simply not information. It is not appropriate to rehearse the proof here (a full and detailed account is presented in Floridi, 2011, Chapter 4), but a simple justification is that requiring information to be true resolves the "Bar-Hillel – Carnap paradox".

Bar-Hillel and Carnap worked on the information content of language building on ideas from Shannon. The information content of a sentence in their models is, as with the messages in Shannon's model, greater the less the probability of the sentence/message. So sentences saying that you have *not* won the lottery carry much less information than the sentence which says that you *have* won the lottery. This accords with intuition (there is more information in something unexpected than in something you thought was likely to be the case anyway), but it leads to the awkward observation that:

> [A] self-contradictory sentence, hence one which no ideal receiver would accept, is regarded as carrying with it the most inclusive information. (Bar-Hillel, 1964 p229)

That is to say, a sentence which *cannot* be true conveys the greatest information. The stipulation that information has to be true – that something that is not true is not information – side-steps the problem and resolves the paradox.

We argued earlier, however, that it is impossible ever to know whether information is true, so it would seem that we have another paradox: that we can never know whether we have information or not. Or, to express it differently, information is always provisional. That, however, is indeed our experience of many sorts of information in everyday life, and the claim here is simply that rather than being an occasional disappointment, that we are from time to time let down by finding we were misled, it is inherent in the nature of information. Information cannot be other than provisional.

In semiotics, the provisionality of signs is captured in the word 'différance', invented by Derrida (1967). Derrida was doing a number of things with this word, including addressing the relative roles of writing and speaking because the pronunciation of this new word, différance spelt with an 'a', is identical to the normal French word différence with an 'e' (which means in English difference), so the distinction is present in the writing but inaccessible in speech.

Of relevance here, however, is that différance draws together the two meanings of the French verb différer: to 'differ' and to 'defer'. Derrida was alluding to the fact that the meaning of any word – of any sign, of any concept – derives from how it differs from other words, signs concepts, but also that it is indefinitely deferred. That meaning is not there at the time, but developed in the future.

Merging with Bateson's phrase leads to a description of information that alludes to the provisionality of information (Figure 3(e)):

> the différance that makes a différance

3 Examples and Insights

The argument of this paper is that representing information by the trapezium provides a framework for an interdisciplinary understanding of the nature of information. In this section are a few examples of information events that illustrate some features of information that are uncovered by the formalisation used in this paper.

An email

The recipient of an email, Bob, sees the words on the computer screen:

> "Meeting arranged for 10.30 on 13th May in the main meeting room. Regards, Alice"

A representation of this event is shown in Figure 5. The information event for Bob is in the reading of the message: Bob extracts or creates meaning by reading what it says. Conventionally we'd say 'extracts', but, as discussed above, there are reasons why it might be appropriate to model the process as creating the meaning, and, as will be explored further below, the created meaning should be considered as provisional.

Everything that is done to get the message to him is gathered together in a single layer below that of Bob, but we can think of the processes that turn the signal arriving at Bob's computer into the displayed message as another information event. The displayed text is the meaning extracted/created from the received signal. (Computer and communication engineers would typically break this lower layer down into several separate layers, including the TCP and IP layers of the internet.)

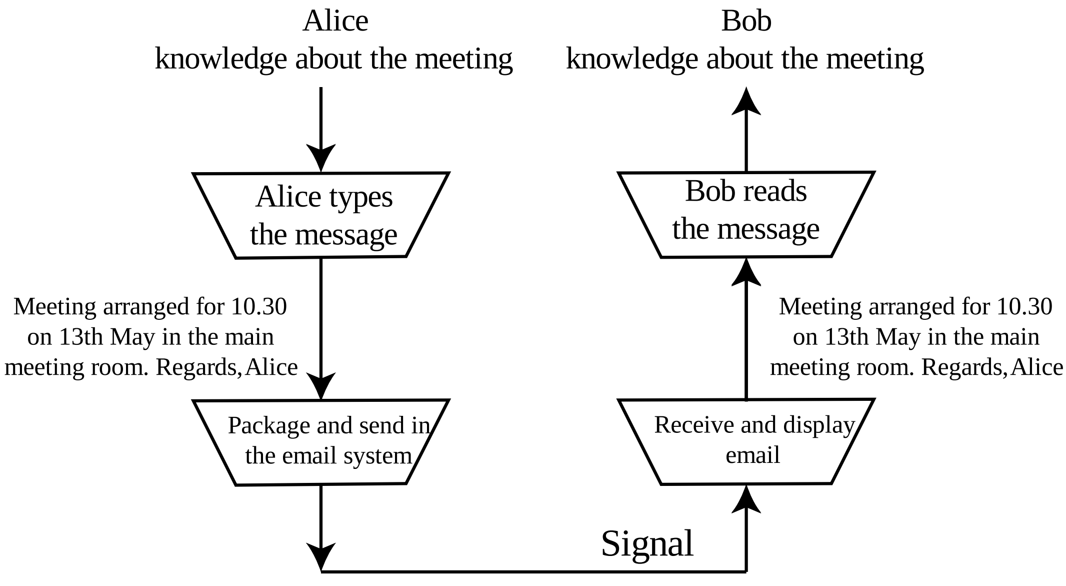

Figure 5. The information in an email

Notice how much contextual knowledge was required by Bob to extract the meaning. He needs to know, for example, which main meeting room is being referred to, which year the meeting is in (13th May 2013? 2014?), he needs to have some idea what the meeting is about. This shared context is sometimes referred to as exformation (Lefrere, 2011), and is part of the work of the trapezium.

The same is true of the trapezium that displays the message on the computer screen. Bob's computer needs contextual knowledge in order to be able to extract the meaning from the signal. It needs, for example, to 'know about' ascii code and about the format of emails.

Possible mistakes in the extraction of the meaning, and therefore the provisionality of the information, can be identified at both levels. Alice could have made a mistake in typing her message, Bob could be wrong about the location of the meeting room (maybe the one he thinks is the 'main' meeting room is different from the one Alice thinks it is), or there could have been errors in the layer below that have made the message display incorrectly (the 13 could be wrong in the date). Although error control algorithms make it unlikely that the content of the displayed email text is incorrect (it is more likely that the email is simply not received), it is still always possible. The particular random noise in the signal, or some problem with the software in one of the computers, could in principle result in the message displaying 14th May rather than 13th May, for example.

A school report

There was a time when school reports consisted of a few handwritten sentences, whereas the reports received by parents today can be substantial documents: a printed booklet with paragraphs of 50-100 words on each subject. At face value, parents reading today's reports are getting much more information.

These reports however are frequently put together with the aid of specialised software that reduces the workload on the teacher. Using software such as The Report King (http://www.happymongoose.co.uk/), all that a teacher needs to do is input the name of the pupils and their grades for each subject, selected from a pre-defined set such as: *h* for higher achiever, *m* for average to more able achiever, *l* for average to less able achiever and sen for students with special educational needs. The software then writes the whole report, drawing on the statements contained in the National Curriculum for England.

Figure 6 is a simple representation of the written report, and it would be possible to use the same diagram for the computer-generated report, replacing 'writes report' in the left-hand trapezium with 'report produced on the computer', but that would miss an important feature of the computer-generated reports. All that the teacher contributes to the process is contained in the selection of the grades, and Figure 7 shows a different way that the diagram could be drawn. It would in principle be possible for Figure 7 to represent the way the reports are delivered to parents: the parents could have a copy of the Report King software on their own computer, then all that the school needs to send out for the report would be the grades, and the parents' computer generates the report.

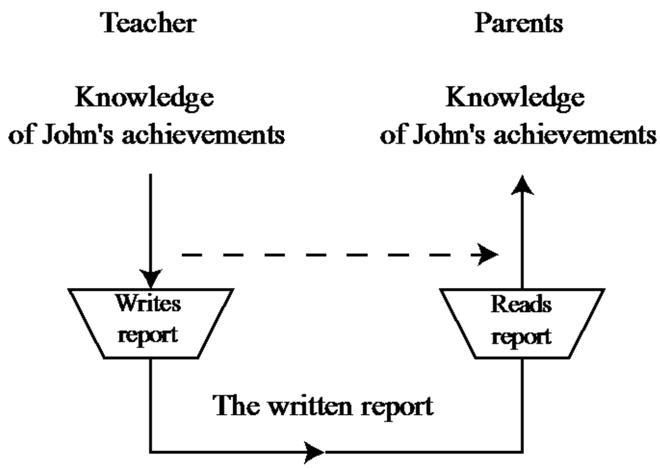

Figure 6. A hand-written school report

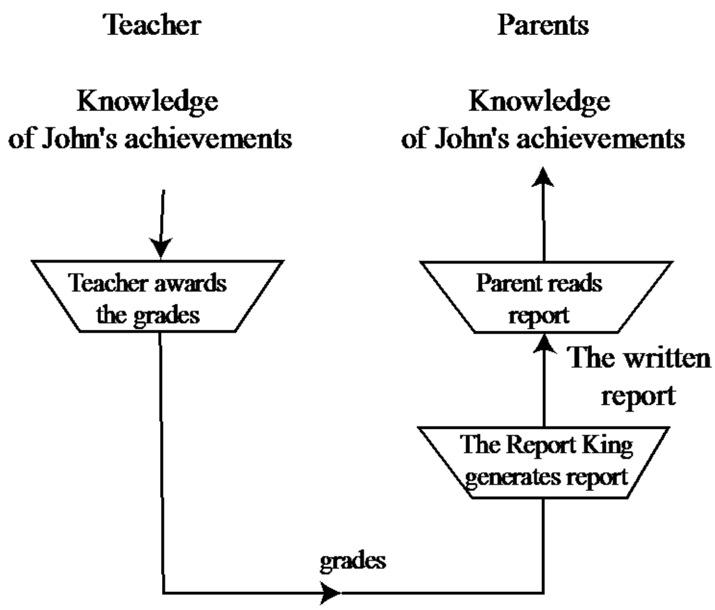

Figure 7. A computer-generated school report

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The asymmetry between the source and the destination in this diagram is evidence of a problem, and it can be seen that there is doubt about the origin of the meaning that The Report King extracts/creates from the data (the grades). The Report King is making use of very substantial exformation, including details of the National Curriculum for England. Maybe the resulting report is valuable data for the parents, but it has not come entirely from the teacher in the way that a handwritten report would have done.

This is discussed in more detail on the author's blog (in posts labelled 'Schools'): http://www.intropy.co.uk/search/label/schools

Biosemiotics: The peacock's tail

Søren Brier has developed a comprehensive and detailed thesis of cybersemiotics, drawing together (bio)semiotics and information theory (see for example Brier 2003).

The discussion here is by comparison trivial, but is nevertheless useful to present as part of the overall diagrammatic presentation.

Consider for example a peacock that wants to communicate the message that he is strong, healthy and ready to breed, so fans out his remarkable tail. A peahen sees the tail and extracts from what she sees that the peacock is strong, healthy and ready to breed (Figure 8).

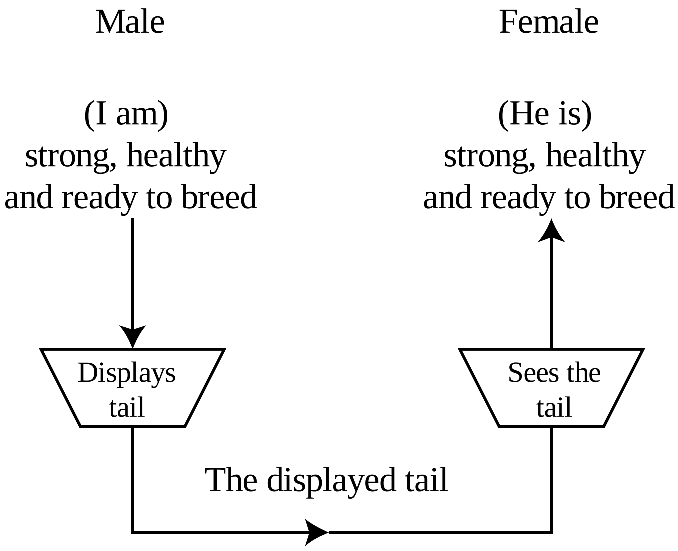

Figure 8. The information in a peacock's tail

On another occasion the peacock may fan out his tail for some entirely different reason, or maybe, despite having a fine tail, he is not as healthy as he appears. The peahen may be wrong in her interpretation.

Similarly with humans. A man, for example, may read a woman's behaviour and clothes as sexual invitation, but this is the meaning he creates from what he sees. It may not be the message that the woman intended, and the man should recognise that his interpretation is provisional.

DNA

A more subtle example from biosemiotics is the genetic information of DNA. Although it is a gross simplification of the biology, suppose there is a segment of DNA that codes for the construction of an eye. The eye is the meaning of the DNA, but (in the sense used in this paper) this is a semantic information event rather than an environmental information event. If it were environmental information we would be faced with the problem posed by William Paley (1803) of finding a watch lying on the ground, apparently a lucky outcome of chance.

Semantic information, however, requires a source, the transmitter of the information, but what is that source in this case? There are three aspects of the source: where and what it is; the process of encoding (the content of the trapezium); and the entity that is encoded by the trapezium.

The entity being encoded is 'eyesight'. Creationist would identify God as the source, and, depending on how sympathetic to science they are, might allow the process of encoding to be evolution or else envisage some sort of direct hands-on design. We, on the other hand, would look for an explanation that does not require God at all and the suggestion here is that the source is the abstract concept of 'a competitive advantage of being able to see', while the process is evolution by natural selection (Figure 9).

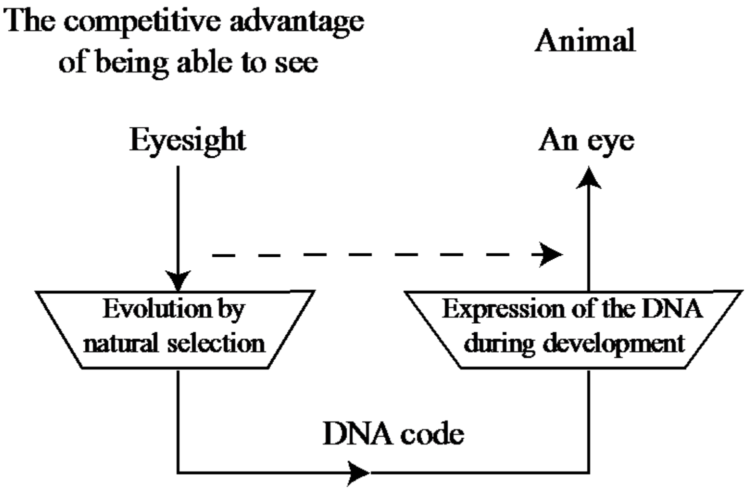

Figure 9. The information in DNA

Identity: Race and Gender

Alice thinks about Bob and decides that he is a white man. This is an information event deriving meaning from data associated with Bob, but what is the data? Is meaning being extracted or created? What is the exformation used by the trapezium? Who decides whether the categories 'white' and 'man' are meaningful anyway? (Or we might say, how did they become permitted objects in the abstraction, and how are they defined and used?)

Alice later learns that Bob was brought up as a man but considers herself a woman. Also, it turns out that Bob's parents were from Kenya and when asked to complete equal-opportunities monitoring forms she always puts down 'black African'.

Identity, like all information, is always provisional.

4 The Provisionality of Reality

The provisionality of information from an email, from a school report, or even a person's gender might not seem so very significant. We know that we can get things wrong and change our understanding. However, the idea that information is inherently, always and unavoidably, provisional, might have more profound and unsettling consequences.

The current popular perception (in western developed nations at least) of the nature of reality is based upon a materialist (physicalist) paradigm: that the physical, matter, is the ultimate reality, and information is a poor relation (Clayton, 2010). This existential hierarchy derives from the authority of science, especially physics, in developed societies.

In recent years, however, there has been an increasing recognition of the reality of information in science (Von Baeyer, 2003). The Oxford physicist Vlatko Vedral (2010) expresses it using Landauer's "information is physical" (Landauer, 1991), and John Wheeler famously coined the slogan "It from Bit", suggesting that matter ('it') owes its existence to information ("bits") (Davies and Gregersen 2010 p59).

Anton Zeilinger (1999), furthermore, proposed that constructing a foundational principle around information could provide a simple and intuitively clear basis for the interpretation of quantum mechanics. He argued that quantum mechanics is missing this level of understanding: "an analysis of what the theory implies for our general view of the world ("Weltbild") […] questions as to the meaning of the theory in a deeper sense."

Without attempting to explore the physics in detail, we observe that if information is the foundation of our model of reality, then we should expect reality to behave in accordance with the nature of information. If information is provisional, so, too, is reality.

5 Conclusions

A framework for understanding the nature of information based around a diagrammatic convention drawn from communications theory has been proposed. It makes use of the description of information as:

> a situated event that generates meaning

where the generation of meaning can either be by extraction or creation, depending on whether it is semantic or environmental information. Any one information event should, however, be modelled as both environmental or semantic because different insights come from each.

Within the framework the concept of meaning corresponds to the identification of an entity within an abstraction. This allows meaning to be identified in a wide range of contexts, which may or may not involve people.

Modelling information as semantic leads to the need to find the source at the other end of an assumed communication channel, potentially uncovering significant insights into the nature of the information, as was illustrated with the examples of school reports and of the evolution of eyesight.

Modelling information as environmental emphasises the provisionality of all information, which was shown to have significance in the examples of emails, human identity, and the peacock's tail.

As increasing numbers of diverse disciplines find information to be fundamental to their understanding, so the nature of information becomes an ever more pressing concern. If information is inherently provisional, this has important consequences for many different fields.

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