



Cardiff School of Social Sciences

Paper: 101

Codes, Signs and the Explicit



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Note: This is a working paper in the full sense of the word. It is a draft that may be completely misplaced and certainly invites the comments and corrections of anyone willing to read it. I am aware that there is a vast literature on semiotics that is not much referred to here (eg the terms `digital' and `analogue' as used here are roughly equivalent to Saussure's `symbol' and `icon') and would welcome comments from those who know the corpus. But I am not so much interested in scholarly infelicities or, say, the political dimensions of interpretation, as any substantive mistakes I have made in terms of the aims of this paper and would be able to correct by going back to the literature, or any important ways in which I could push the argument forward that could be found there. The object of the paper is to sort out the claim made by Polanyi which appears in the second epigraph below. Please send comments to CollinsH@cf.acuk

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... it shows great folly ... to suppose that one can transmit or acquire clear and certain knowledge of an art through the medium of writing, or that written words can do more than remind the reader of what he already knows on any given subject. ... The fact is, Phaedrus, that writing involves a similar disadvantage to painting. The productions of painting look like living beings, but if you ask questions they maintain a solemn silence. The same holds true of written words; you might suppose that they understand what they are saying, but if you ask them what they mean by anything they simply return the same answer over and over again. Besides, once a thing is committed to writing it circulates equally among those who understand the subject and those who have no business with it; a writing cannot distinguish between suitable and unsuitable readers. And if it is ill-treated or unfairly abused it always needs its parent to come to its rescue; it is quite incapable of defending or helping itself. (Socrates according to Plato at page 275 in Hamilton 1973) [Hamilton, W., (1973) Plato, The Phaedrus, translated by Walter Hamilton,(1973), Harmondsworth: Penguin]

Now we see *tacit knowledge* opposed to *explicit knowledge*; but these two are not sharply divided. While tacit knowledge can be possessed by itself, explicit knowledge must rely on being tacitly understood and applied. Hence all knowledge is *either tacit or rooted in tacit knowledge*. A *wholly explicit knowledge is unthinkable*. (Michael Polanyi, "The Logic of Tacit Inference," *Knowing and Being: Essays by Michael Polanyi*, ed. Marjorie Grene, University of Chicago Press, 1969, p.144.)

The confusing grammar of tacit and explicit and a new vocabulary.

One reason for the stumbles and falls that come with the analysis tacit knowledge is that the 'parts of speech' are used inconsistently and confusingly in the discourse. The Chamber's Dictionary defines 'tacit' as: 'unspoken' or 'understood or implied without being expressed directly.' But Polanyi, as shown in the chapter epigraph, talked of can and cannot: 'we can know more than we can tell.' In the dictionary definition 'tacit' is descriptive – tacit knowledge, then, is knowledge that is not explicit -- but in Polanyi's usage 'tacit' is knowledge that cannot be made explicit. The tension between 'is not' and 'cannot' permeates the entire discussion of tacit knowledge as can be made evident by looking at the antonyms. The opposite of the dictionary definition of tacit is 'explicit;' the opposite of Polanyi's definition is 'explicable.' It is bound to be confusing if, to turn the thing on its head, two different parts of speech – 'explicit' and 'explicable' -- have the same antonym – 'tacit.' And this is not to mention the fact that 'explicable' generally means 'can be explained,' whereas the opposite of 'tacit' means plain and clear and expressed directly; the first is about knowledge, the second is about style. Part of the unexpected difficulty encountered in writing this working paper has arisen because this kind of thing gets in the way of the thinking.

The solution is to stop using the terms explicit and tacit and their derivatives in the course of the analysis. What we mean by tacit and explicit has to be rebuilt from the ground up from simpler components. In this working paper I am going to talk about two of those components, which I call 'codes' and 'languages.'

(i) Code: A 'code,' as defined here, comprises a set of signs. Signs are physical things without intrinsic meaning. They might be marks on paper or other surfaces, they might be sounds, they might be irregular patterns of smoke, they might be electrical states in silicon micro-circuits, the positions of ratchets and cog wheels, or arrangements of animals or humans. What makes a code a code, rather than a set of scribbles, or a work of art, or the pattern of notes in the song of a bird, or a wallpaper design, is that, at sometime, the code has been used to represent something meaningful other than itself. Codes come in two types, digital and analogue.¹ With analogue signs, for example, pictographs or paintings, the substance of the sign seems analogous in some way to the thing it represents. These signs seem to have intrinsic meaning but it will be argued that, in spite of immediate appearances, they do not. They do, however, have internal form and structure based on the physics of the materials from which they are made. Digital signs have less in the way of the kind of substance that appears to make a natural correspondence between analogue signs and the meaningful things signs sometimes represent. The form and substance of a digital sign seems, and is, more arbitrary than that of an analogue sign. Even digital signs lose their arbitrariness, however, when they are subject to regular and stable interpretations in terms of meaning. To say that codes are not arbitrary, however, is not to say that codes contain meaning in themselves. A code is not meaningful but is *available for interpretation* in a meaningful way. It is simply that if it were a code entirely arbitrary it would *not* be available for interpretation in a meaningful way.

In ordinary English usage the term 'code' is often used for 'cipher.' Here 'cipher' will always be used when deliberate encryption is being discussed.

(ii) Language: A language, in contrast to a code, is always full of meaning. A language is a code that is being used in a meaningful way. Whereas a code is just a physical thing, or set of physical things, a language is the physical thing plus the ongoing interpretation.² As will be explained at greater length in a later section, an important difference between codes and languages is that codes can be transformed into one another without loss whereas languages cannot.

Affordance and digital symbols

We say that digital symbols and digital codes are meaningless and (initially) arbitrary because there is nothing inherently A-like about the letter A nor does the A in the word CAT, contribute anything to the meaning of the word CAT. This arbitrariness is still more obvious in the case of binary code – which consists of strings of any two types of thing, such as opposite magnetic or electrical states, or 0s and 1s.

Codes are without meaning, yet we often talk as though they were meaningful. We say things such as 'I have a French language cookery book that explains how to make coq-au-vin.' But a book is a physical thing not a meaningful thing so in our terminology there is no such thing as a 'French *language* book' since language implies meaning. It follows that a book cannot do any explaining since explaining implies meaning. We also say

¹ For a discussion of the meaning of the digital see Haugeland, 1986 and Collins, 1990.

² These are specialised uses of the terms 'code' and 'encoded knowledge.'

things like 'this is a photograph of Ludwig Wittgenstein.' But, again, a photograph is just ink marks on paper and, in itself, is not 'of' anything or anybody. The right way to describe the book and the photograph is as follows: I have a book that is capable of being interpreted by some French-language speakers as a set of instructions for cooking coq-au-vin, and I have a sheet of paper with ink marks on it that is capable of being interpreted by some people as a photograph of Ludwig Wittgenstein.

The second two descriptions are each a bit of a mouthful and they miss out on something. The something is the philosophical point that anything is 'capable of being interpreted' as anything else; humans are just so brilliant at interpreting 'this' as 'that' that saying 'capable of being interpreted' tells one nothing about what it is that is being interpreted. For example, I might say, 'there is a cloud in the sky which is capable of being interpreted as Ludwig Wittgenstein and when I listen to that piece of music I always remember the sequence of notes by thinking of it as the recipe for coq-au-vin.' To make progress, instead of saying 'capable of being interpreted' I will adopt the usage, 'affords the interpretation,' which carries the implication that there is something in the signs that make them easier to interpret one way rather than another. To use the terms 'afford' and 'affordance' is to be lazy. As I will indicate in due course, these terms merely plaster over deep cracks in understanding. Luckily, for the purposes of this working paper it is not necessary to do a proper job of repairing the cracks. Nevertheless it is proper to suspect that something hidden and mysterious is going on whenever 'afford' and 'affordance' make their appearance; one should try to maintain a sense of discomfort. With that in mind, here is the reformulated way of speaking: 'to French-speakers, this book affords a recipe for coq-au-vin and to people brought up in certain Western literate groups, this photograph affords Ludwig Wittgenstein.' The words are weasel words, but the risk is worth taking to avoid the much worse mistake of saying the book tells French speakers how to make coq-au-vin or that this is a photograph of Ludwig Wittgenstein; these usages are seductive but dangerous because they seem to imply that there is meaning in the physical things even in the absence of human interpretation.³

With bandage of affordance in the conceptual medicine chest we can return to the difference between digital and analogue signs. If we imagine some moment when written language was still being invented, there was an even-handedness about whether to choose the sign CAT or the sign HOUSE to refer to a house and either choice would have served equally well. That is what is meant by saying that the signs are arbitrary. Nowadays, however, the choice is not even-handed because of the way the use of the alphabet has become inscribed in the social life of the language. Nowadays, if I want to refer to a house, it is much better to write 'HOUSE' than 'CAT.' Nowadays, HOUSE affords house much better than CAT affords house so some of the arbitrariness has been lost. If I was a dictator with similar ambitions to the one who runs the society depicted in George Orwell's 1984, I might decide that henceforward everyone was going to refer to

³ For an example of a term which works this way and does damage to the process of proper understanding of how scientific controversy plays out consider the Actor Network Theory's invocation of the 'immutable mobile,' something that seems to carry fixed meaning across entirely different communities of interpreters; there cannot be such a thing.

houses with the letters CAT. I'd probably have to change quite a bit more than a couple of words only to make this happen, but it could be done with enough effort, and afterward things would run quite smoothly.⁴ Thus we can recapture the sense of the arbitrariness of the relationship between the symbols and their interpretation. But the fact is that it would take a lot of work to make the change whereas continuing to use HOUSE to represent a house takes relatively little work -- which is what is expressed in the idea of affordance as it is being used here.⁵

Analogue signs and affordance

Now let us see how this works in the case of analogue signs. It is not so clear that analogue signs start off without any meaning in themselves. Suppose I adopt the following pictograph to represent 'house' in my language.

It is tempting to say that it is an appropriate pictograph because it looks like a house. But



actually, it doesn't look anything like a house -- if you doubt that, just take the working paper into the street and compare the sign with a real house. Nevertheless, we are inclined to say that the pictograph is a good one for representing house is to do with the fact that it 'affords' the interpretation 'house' more easily than say, this one:



Here the affordance seems to have a little more to do with the symbol itself than it did in the case of the word HOUSE. It appears, in other words, that even at the imaginary moment when signs were first being given their first interpretations, it would be more 'natural' to assign the meaning 'house' to the upright pictograph rather than the inverted pictograph in a way that it would now be more 'natural' to assign the meaning house to HOUSE rather than CAT (something that is true only as a result of long usage). But this is one of those moments when it is good to experience the discomfort that should always come with the idea of affordance. Given that the upright pictograph bears so little

⁴ Among the more things that would have to be changed would be all the usages in books since written words are related to the other written words around them; Orwell's ministry of truth, gets it exactly right.

⁵ I think that the use of the terms 'affordance,' and 'afford,' in this book is close to that of Norman (Donald Norman, The Design of Everyday Things). Norman deals with the affordance of everyday things such as door handles. The discomfort of Norman's project should come with the fact that a door handle wrapped in razor wire still works so long as you wrap it in a cloth before grasping it -- this is the equivalent of the extra work of interpretation which is needed when the affordance is low. For the sociologist of scientific knowledge, studying the formation of stable interpretative practices, or the construction of affordances, the indefinite interpretative flexibility is the crucial thing, not the affordance.

resemblance to a house, it is hard to say why the inverted pictograph bears any less resemblance.⁶ In other words the adjectives `upright' and `inverted' should not even apply – neither sign looks like a house so why should we imagine that one of them is upside down? It seems to me that a whole science would be needed to explain why it is the case, if it is the case, that there is a difference between the two signs that goes beyond the difference between HOUSE and CAT. It is a science that I, at least, know nothing about but affordance plasters over the problem well enough for this project.⁷

What makes it worse is that the meaning of many kinds of analogue sign has clearly to be socially established and learned just as with digital signs and what counts as good affordance changes over time. As we become used to one way of interpreting the sign can change and still be recognised even though it would not have been recognised at some earlier time. The sign for `men' as it appears on the door of public toilets – the icon with two `legs' -- would have been unrecognisable years ago.⁸ Likewise, it took me years, and many detours, to learn that French road signs that point to the left mean go straight on.⁹ And the process is nicely illustrated (literally and figuratively), by cartoonists, who slowly train the reading public to recognise a new Prime-Minister in a couple of pen strokes that would have been incomprehensible when he or she was first elected.

It is less obvious still that signs are not inherently meaningful if we think of a photographs and the like. `Surely,' we want to say, `this must represent one particular person.' But it takes some learning to recognise that photographs are representations of people – after all, they are non-living two-dimensional patterns of ink on paper which are

⁶ This is exactly the same problem of why one thing is said to be an analogue of another thing. To use the idea of analogy you have first to solve `the problem of relevance' (Dreyfus 1996 p 173) [Dreyfus, H. L. (1996). `Response to my critics'. Artificial Intelligence, 80, 1850 171–191].

⁷ It could be that the logic of the word, `afford' is rather like the logic of the idea of social rule. I cannot say what the rules are for, say, keeping the right distance away from others when I walk along the pavement (sidewalk) in the country I live in under different circumstances of crowdedness, but I can say when I am not following them and so can every other member of my society. For example, if, on a deserted pavement, I brush up against an attractive woman as I walk past her, I could be arrested. If I do the same on a crowded pavement, no rule will necessarily have been violated. In the same way, with affordances and pictographs, one cannot lay out the rules for good ones – there are an open ended set of possibilities -- but one can recognise bad ones.

⁸ The example can be found in Chandler XXXX where it is attributed to XXXXXXXXX

⁹ It seems to me that the English upward pointing arrow has much better affordance but maybe it would be different if I were French. (When newly touring France I also spent many hours puzzling over maps vainly seeking the town of Poids Lourds -- but that's a digital-sign story.)

the wrong size weight and temperature; unsurprisingly, there are peoples who have not come into much contact with Western society who do not recognize photographs. Nevertheless, we can still say that a photograph of Ludwig Wittgenstein more easily affords the interpretation 'Ludwig Wittgenstein' than the interpretation 'Bertrand Russell.' Significantly, the fact that few of us have 'set eyes on' either Wittgenstein or Russell does not stop us thinking of the resemblance as inherent within the photograph. -- 'That's Wittgenstein,' we say -- whereas really we are just 'seeing' resemblances between one photograph and another. What we should say is something like, "This sign looks similar to me to other signs I have seen that people tell me afford the interpretation 'Ludwig Wittgenstein.'"

The point is made still more clearly by considering the well-known 'photograph' shown in Figure XX. To those who can see the face of Che Guevara (or Christ) in that image it is as compelling as a photograph; to those who can't, it is merely a set of black and white blobs (or perhaps, as it is said to be, a photograph of a mountain range covered in snow).



Figure XX: Che Guevara, Christ, blobs, or a mountain range?

Does the image in Figure XX really afford the face it shows to some people? One can see that it could only afford it for those who are used to black and white blobs on paper being interpreted as living humans and, even then, only to those who live in societies where men have beards. To the extent that the image does afford anything, the thing it affords is obviously very much mixed up with the interpretative tendencies of the viewer.

Artifacts as codes

Can the argument about the essential meaninglessness of even analogue codes be carried all the way through to artefacts themselves? The logic suggests that it should. After all, when one looks at an object one sees just one aspect of it, one does not grasp the whole concept of the thing unless one already knows that concept. When we encounter unfamiliar objects what we see is, as it were, the object as a sign that represents itself.

Turn the object round and there is another sign, and so forth. Consider the object shown in Figure XX and imagine you were looking at it through the eyes of someone born before the 1970s. What do you see -- jewellery, perhaps?

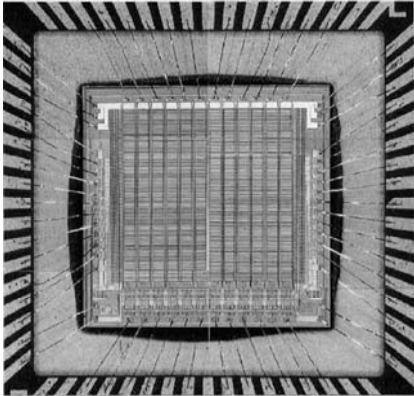


Figure XX: An integrated circuit

Looking at an artefact is, then, somewhat similar to looking at a picture of an artefact – it has to be interpreted before it represents anything. And looking at a picture is like looking at a diagram which is in turn like reading a description in words. All of these things are codes, in the sense used in this working paper. Though it is tempting to think that an artefact cannot be merely a code because it really does contain the knowledge of how it works the temptation is to be avoided. Think of the integrated circuit falling into the hands of a computer engineer before the invention of the semi-conductor – it would contain nothing usable in terms of information about how it works. Or think of a slide rule in the hands of a tribe without arithmetic – it contains no more knowledge than the smile of the Mona Lisa without the onlooker. And think of the process known as ‘reverse engineering.’ Reverse engineering is taking an artefact apart to see how it works. But reverse engineering cannot be done unless the engineers are pretty near to the point of being able to ‘forward-engineer’ the same artefact – otherwise one might as well expect the cave men to reverse-engineer the mysterious black obelisk with which Stanley Kubrick opens his famous film, *2001: A Space Odyssey*.¹⁰

¹⁰ Ribeiro (2007) considers proximity to artefacts and processes – what he calls ‘physical contiguity’ – is of special importance in the transfer of knowledge. According to the account given here, there is no discontinuity between physical contiguity and linguistic immersion in the absence of the artefacts. The only discontinuity occurs between attempts to gain knowledge without social contact and attempts to gain knowledge that do involve social contact. Physical contiguity is likely to shorten the time taken to gain understanding but it does not provide a different kind of understanding. That said, there are individuals, such as myself, that learn easier from artefacts than written texts – I have never felt comfortable doing sociology studies of fields that are not experimental and thus provide apparatus (or diagrams of apparatus) for me to look at; no doubt others learn better from texts and prefer to do studies in more theoretical areas.

In sum, artefacts seems somewhat more meaningful than analogue signs, and analogue signs seem to be a bit less arbitrary than digital signs, but in logic they are all the same – they are codes without meaning in themselves. On the other hand, the affordance of artefacts and analogue signs is more closely related to their internal structure and physical materiality than is the case with digital symbols.

Transformation of codes and translation of languages

In the case of all signs, digital or analogue, or artefacts themselves, we can create unambiguous ‘look-up tables’ that can transform one set of signs into another without loss. This may sound strange and it is strange to the extent that it is generally easier to do this with digital than analogue signs or artefacts, but the difficulty, as we will see, is a matter of degree, not principle.

In the case of digital signs, using a look-up table (or its spoken equivalent), we can replace a lost pawn in a chess set with a matchstick or bottle top. Or we can replace letters of the English alphabet with semaphore or Morse code or combinations of binary symbols. Or we can replace letters of the English alphabet with letters of the Greek alphabet, or any other alphabet, or different kinds of bottle top, though no-one will be able to make any sense of it inscriptions written in these signs until they are transformed back to the original sign system by use of the look-up table/s. Any digital code can be transformed into any other. (There won’t often be one-to-one correspondence between individual sign and individual sign but combinations of signs will do the trick: binary code, which has only two symbols, is an extreme example of the case where a lot of symbols in one code are needed to replace only one symbol in another code). Note the word ‘transform’ in this paragraph which is used to contrast with the term ‘translate.’

The term, ‘transform,’ applies to codes, the term, ‘translate,’ applies to languages.

The crucial point is that, given look-up tables which stabilise correspondences between one set of signs and another – and, as pointed out, the correspondences are arbitrary prior to being stabilised – any code can be transformed into any other code, backwards and forward as many times as desired, through any number of steps without loss. ‘Without loss’ means that after any number of transformations, through any number of other codes, the original string of signs can be recovered, completely unchanged, by using the appropriate look-up table or set of tables. In the next section we will find that things are a bit more complicated in real life, but indefinite transformability without loss in the case of codes is the principle to hold on to.¹¹

When we get to analogue signs, things are a little harder. The reason that it is easy to return to the original symbols without loss after any number of transformations in the case of digital signs is that we don’t care if the signs we end up with are drawn a little differently to those we began with because these differences have no significance. Indeed, in so far as we treat the signs as digital, such differences will be, literally, unnoticed; if we start with ‘A’ and finish with ‘Æ’ nothing of significance has changed so

¹¹ This does not take into account the kind of mechanical noise in the translation system discussed under the heading of Shannon’s ‘information theory.’ Here the assumption is that, in spite of thermodynamics, there is no mechanical noise.

long as we are only interested in the `A-ness' of the symbol.¹² But if our house pictogram changes, in the course of its journey through a set of look up tables and back again to the origin, from this:


to this:



something may have changed. The changed sign might be felt to afford the idea of house less effectively than it affords the idea of `hut.' This, however, does not mean that analogue symbols cannot be transformed backward and forward indefinitely and without loss, it just means that it has to be done with much more care than is the case for digital symbols. For example, the transfer could be done so long as the relative position of every atom in the ink were recorded and noted in the look up table. Which is to say, in the last resort, in the world of signs, every analogue code can be reproduced, in principle, by a digital code, if enough trouble is taken. It is just that this degree of trouble can rarely be taken in practice -- it is often a case of cannot(*logistic impossibility*) -- and that is why there is a distinction between digital and analogue for all practical purposes. Exactly the same arguments can be used in the case of artefacts: so long as we record the exact position of every atom in the integrated circuit it can be transformed into some other kind of code, transformed back again, and will be same artefact as it was before. (At this point in the discussion we are clearly dealing with principles not practice.)

To repeat the principle that was introduced at the start of this chapter, as defined, a code, to be a code, has to represent something meaningful at some time or place; if it has never represented anything meaningful it is just scribbles or art. But, though codes sometimes represent meanings, their relationship to meanings is not stable and cannot be stabilised in the way that the relationship between one code and another can be stabilised. There are no stable look-up tables that translate codes into meanings where meanings are the interpretations of codes in lived societies. Therefore, though there can be any number of transformations between code and code without loss, there can be no transformation that can be guaranteed to be without loss between signs and meanings however much care is taken.

What was probably going on when the `house sign' was changed into the `hut sign' was a passage through meaning. The house sign, as it left my society afforded the concept of house as being something with a pitched roof. Its meaning was developed, we may

¹² Actually, if you can see the point of stressing that `nothing has changed' in this example then you must be treating the A and the *A* as something other than digital – you are seeing the difference. In Collins and Kusch (1998) we describe the way that printed script is not only a digital code but also affords certain other kinds interpretation as a result of the way it is printed: the right margin may be ragged or justified, different fonts have different connotations, and so on. These differences are built up in just the same way as other social conventions.

imagine, by ostensive definition – holding the sign up and pointing to houses -- use in conversation, and the general settling down of the sign into the network of meanings that make up a society's relationship with its language. We can imagine that the sign was then taken to a society where people lived in huts without pitched roofs that they still thought of as their houses. The idea of house in that society is more efficiently afforded by the hut sign. So when the attempt is made to transform the house sign backward and forward through meaning as an intermediate step, a significant change happens. In the last paragraph it was explained that such changes were not inevitable just because the signs were pictographs but the way the pictographs had to be transformed if they were to be preserved without change was by creating a look up table that stripped them of meaning: the transformations treated the signs as material entities described as positions of ink molecules on paper. The look up table could show how the house sign corresponded to the hut sign and the transformation could go backward and forward as often as one pleased. But there cannot be a look up table with meanings in one of the columns because we don't know how to represent meanings outside of the lived context in which they are found. 'House' just means something different in the house society and the hut society and if the signs are transformed through meanings then the signs might well change.

Life is not complete chaos because the relationship between signs and meanings is stabilised for much of the time through the sharing of 'taken-for-granted' 'ways-of-going-on' in social groups. It is through socialisation that we learn to attribute roughly the same meanings to the same symbols most of the time.¹³ And those roughly the same meanings extend across areas of social life which have overlaps in their ways of going on or cultures.¹⁴ Mathematical symbols are very stable because the mathematical way of life is almost entirely uniform across societies that are different in many other respects. The same goes in the case of, what we understand since Kuhn, to be the relatively uniform but still open to mistranslation, realm of science in general. The use of symbols within a social group, which all know how to use them with roughly the same meanings, is called 'using a natural language' (or sharing a scientific paradigm).

All this should be pretty obvious. For example, I have on my desk the Chinese translation of a book I originally wrote in English. The translator has had to translate the world of English concepts into Chinese concepts but there is no accurate match of Chinese concepts and English concepts so the book cannot mean in Chinese translation exactly what it meant in English. If we asked for the Chinese version to be translated back into English (informing the translator that the job was to translate something from

¹³ Various philosophical traditions reach this conclusion; the one that influences this treatment most directly is the later philosophy of Wittgenstein.

¹⁴ For a discussion of exactly how these overlaps work, see Collins, Evans, and Gorman (Collins, Harry, Evans, Robert, and Gorman, Michael (2007), 'Trading Zones and Interactional Expertise' in Collins (ed) *Case Studies of Expertise and Experience: special issue of Studies in History and Philosophy of Science*, 38, 4, 657-666 [December])

the original Chinese), what we would get, I am sure, would be quite a bit different from the original.¹⁵

A slightly more subtle point is that the same would apply if we were trying to transform a piece of writing in English, through the world of meaning, and back into English writing. It is hard to visualise how this might work with a whole book so imagine a piece of code one paragraph in length. I read the paragraph to someone else and ask them to re-write it. Assuming the 'someone else' was not an expert in memory techniques so that they could, as it were, print out the paragraph on their brain, the way they would remember the paragraph would be via its meaning. When they re-wrote it, they would almost certainly use at least some different words and this would likely result in a small change of meaning. Repeat the process over and over again and the meaning would change more and more, just as in the game of 'Chinese Whispers' or 'Telephone.' In fact, anyone who transcribes recorded spoken English into written form tries this experiment again and again. I do a lot of transcription and I find that if I listen to a segment as small as a sentence and type it out exactly as I believe I heard it, there are a surprising number of subtle changes where the speaker's phraseology has been unconsciously converted into my phraseology. If one wants an exact transcription one must always read through the typed version while listening to the words a second time and correcting the errors. These errors, incidentally, are of a quite different kind to the errors that might be made by a computerised speech transcriber. The latter would produce something that sounded the similar but was different in meaning, the human produces something that sounds different but is similar in meaning.

If all this is so obvious why belabour the point? The answer is that it is vital to contrast the imperfect translatability of languages with the perfect transformability of codes.¹⁶ Perfect transformability can come only with meaninglessness. And the hardest part of this point is that even analogue signs and artefacts are perfectly transformable so long as they are treated as signs within codes and therefore they are meaningless in themselves. And all this is to show why it is a mistake to confuse a code with a language. In sum, this whole detour has been to make crystal clear, in another way, the point that when knowledge has been encoded the code does not contain the knowledge. Codes behave differently from languages and it is lived, interpreted, languages that contain knowledge. Nevertheless, it remains that there cannot be explicit knowledge without codes. Let us try to make the point in yet another way. This working paper, in itself, contains code not language therefore it does not, in itself, contain knowledge. This working paper is like the smile of the Mona Lisa. Examine the painting very carefully and it will be

¹⁵ A problem that is revealed by the process of 'back translation' in ethnography (XXXX)

¹⁶ I say perfect transformability, but affordance may be lost. Thus, if I transform a piece of English script into binary code, the binary code would not afford meaning to me in the same way as English script. But this is like saying that if I reduced the English script to the size of a microdot it would not afford meaning in the same way. In both cases a transformation is needed to recreate the affordance. Nothing is changing in the world of meaning as the transformations take place. (Thanks to Rodrigo Ribeiro to drawing my attention to the need to make this point.)

found that the smile consists of nothing but paint. But the paint is not the smile. The smile is some combination of the paint and the person looking. In the same way, the book is not the knowledge – the knowledge is the book and the person reading it – so long as they are the right kind of person.

And again, if the Mona Lisa does not contain knowledge or meaning, should this not mean that the Mona Lisa can be transformed into some other code and transformed back again without loss? And the answer is `yes' once more. It is not hard to imagine that we could build a machine that, by scanning the painting with different frequencies of electromagnetic radiation and measuring colours and contours from the reflection it would be possible to record the composition and position of every atom on the surface of the painting on digital tape. We then imagine this tape being transferred to another machine that could use the code to produce a painting that, with the naked eye, was indistinguishable from the original Mona Lisa – a kind of perfect and infallible, and almost literal, `painting by numbers' that could not be achieved by any human.¹⁷ That the machine has painted a smiling Mona Lisa remains, of course, a matter of the paint plus the humans who look at it, not the paint alone. The rules regress arises because, in the last resort, it is impossible to set out in any commonly interpretable code the instructions for interpretation of the symbols – one cannot explain to anyone who cannot see the smile how it is to be seen. That is why Polanyi was right to say that `... all knowledge is *either tacit or rooted in tacit knowledge.*' Nevertheless, the term `explicit knowledge' still has meaning: it means a code that, when appropriately transformed, affords, say, the Mona Lisa for those who know how to interpret the transformed code (that is, those who know how to see the smile).

Reading digital signs in real life.

Readers who lose patience with the following section can skip it. It is all about making sense of Polanyi's remark that `all knowledge is *either tacit or rooted in tacit knowledge.*' In real life, even digital symbols are not so straightforwardly transformable as the in-principle analysis of the difference between codes and languages suggests. One has to know what an `A' is to know that an **A** is the same as an **A** in terms of A-ness. In other words, there seems to be some interpretation involved before one can know what counts as the area of tolerance around the symbol that enables two `different' A's to count as the same A. Furthermore, biology also comes into the picture. I cannot distinguish, in any simple way, a circle that is 1cm in diameter from one that is 1.00000001 cm in diameter but I can easily distinguish it from one that is 2cm in diameter; the letters of the alphabet have to differ in a way that is readily recognisable to me as an organism. These two problems are not of real importance, however, because they can be resolved without reference to social context. They can be resolved by transforming the symbols. If one wanted to use a circle 1cm in diameter to represent A and a circle 1.00000001cm in

¹⁷ We could say that by this means the secret of the Mona Lisa has been rendered into explicable knowledge. (Which is not to say that the secret of painting a smile has been rendered explicable; it is only the secret of painting the Mona Lisa's, particular, already existing and frozen in paint, smile.)

diameter to represent B, one would simply use a machine to measure the difference and give me the answer in easily readable form (the process is just another transformation of the code). Likewise what counts as an A can be defined mechanically. One way to do it would be to use a template. Think of the infant's toy that involves pushing plastic shapes – a star, a cross, a circle, and so forth – through a series of holes. The template could be designed to have a degree of tolerance that matched our commonsense idea of the different ways to draw an A while remaining an A. Finally, nearly all the problems discussed in the paragraph can be resolved by transforming the idea of an A into digital code and then transforming back again into an A; this is effectively the same idea as was introduced to allow that pictographs and even paintings and artefacts were indefinitely transformable without loss. The principle remains unscathed, therefore, so long as we allow transformations that are machine `readable.'¹⁸

Codes as used in real life

But humans are not very good machines and when we examine human-to-human transmission of symbols, even when nothing more than transformation is the goal, the domain of meaning cannot be avoided.¹⁹ It turns out that humans inscribe or speak what are essentially digital symbols in ways that violate even the wide zone of tolerance that such symbols are meant to tolerate. Bad handwriting is the classic example. To interpret such badly drawn symbols a passage through meaning is inevitable. This is not hard to show: in the sentence

TAE CAT SAT ON TAE MAT

there are three As and two Hs. But the As and Hs are drawn identically – they are the same symbol drawn once and cut and pasted into different positions in the sentence. Under these circumstances, humans interpret the symbols according to context. This can be seen by rearranging the letters into nonsense syllables, thus:

TAA SOTA TETCA MENTA

The pesky idea of affordance comes up again even in this example. First, the interpretation of the H/A symbol is partly afforded by letter order. When creating the nonsense syllables I had to be careful to make sure that letter ordering did not favour the A or H interpretation in any instance. There is, I believe only one constraint left in the

¹⁸ In the phrase `machine readable,' `readable' does not always mean the same as it does when used in the context of human reading. Human reading usually implies interpretation and translation, machine reading implies transformation. Of course, the humans can also `read' in the manner of machines – ie, merely use their biological capacity to transform rather than translate. The distinction is between mimeomorphic and polimorphic actions; what is being argued is that the problem of the recognition of an A, as discussed in the paragraph, belongs to the domain of mimeomorphic actions (Collins and Kusch, 1998).

¹⁹ That is, the domain of polimorphic actions cannot be avoided.

nonsense syllables as far as I can see: the last three words can be SOTA, TETCA and MENTA, or SOTH, TETCH and MENTH, while the first `word' can be THA, TAH or TAA, but not THH if English language writing conventions are observed. One can make the point by compressing the letters into one long string which removes structural constraints on the pronunciation:

A E A H A O A E A S T T C T M T T N

Letter order might be considered a matter of interpreted meaning rather than affordance by the signs themselves, but consider the following sentence:

TAE DAG SAT ON TAE LAG

Here the context cries out for some O's, so that the sentence can be read as THE DOG SAT ON THE LOG, but the H/A symbol does not afford `O.' To read the H/A as O would require a lot more work (though, as always, it could be done).

Worse, improve the drawing of the original symbols and the ambiguity is no longer afforded -- thus: TAE CAT SAT ON TAE MAT.'

More interesting, perhaps, is that writing that new sentence has changed the context of the original. Whereas when the sentence was first presented there was only one way to read the H/A signs, their occurrence in the two `THE's' can now be read as A's. Maybe

Really is TAE CAT SAT TAE CAT SAT ON TAE MAT ON TAE MAT!

We can see that because the sentence has passed through the realm of meaning on the way to its transformation from roughly drawn letters to letters in typeface there is ambiguity and the risk of loss. It is no longer a simply *transformation* but contains elements of *translation*.

This is why speech is so hard to transcribe. Transcription of speech into type should be a faultless transformation of one digital sign system into another, but speech is generally very badly `written,' requiring an excursion through meaning to make a good guess at the digital symbols intended. Still worse, a spoken language is not the exact equivalent of a written language: speech continually creates meaning. For example, `uhms' and `ehrs' are used to moderate meaning in a way that is only comprehensible within the particular context of use. If these uhms and ehms are transcribed as exactly as possible to the page, the resulting text as read is generally different in meaning to the text as spoken, giving a far greater sense of uncertainty about what is being stated than was understood at the time.²⁰

²⁰ This is a real problem for sociological research which depends on quotation of transcribed tapes. The only way round it is to allow respondents to edit their quotes so that the meaning on the page corresponds to their intentions. The posturing of the ethnomethodologists, who believe that something true is being captured if the exact phonemes are somehow rendered on the page, is ridiculous.

The fact that transformations are often mixed up with translations in the everyday life of discourse is not important as far as the logic of this argument is concerned. It is important because the example once more allows us to see the distinction between code and language and it allows us to see that what might be pure cases of code transformation are often impregnated with meaning and that means they are impregnated with tacit knowledge. Once more it explains why it is tempting to think that the idea of explicit knowledge without tacit knowledge is unthinkable. It remains, however, that in principle, codes are without meaning in themselves beyond what the affordances that have developed through the developments of convention of use and these make their presence felt only when an appropriate interpreter is interpreting the symbols.