Tacit knowledge, tacit knowing or behaving?

Stephen Gourlay
Kingston Business School
Kingston upon Thames, UK
sngourlay@kingston.ac.uk

Abstract

The phrase 'tacit knowledge' is used in a wide range of disciplines. Examination of definitions and usage in knowledge management, AI, sociology of science, and psychology reveals common aspects, but significant variations. It is a concept without consistency, or clear foundation. Polanyi in fact wrote of 'tacit knowing', a process, and so may have been misinterpreted. His emphasis on process may prove fruitful as a perspective on knowing/knowledge as process, specifically as sign-process, is outlined and justified which has the potential to provide a useful framework for conceptual and empirical work on 'knowledge' with a view to its management.

Introduction

The phrase 'tacit knowledge' is used in many fields of research and activity implying that the concept is of broad applicability and relevance. A database of books in print shows that currently 41 titles are concerned with tacit knowledge to some extent. These cover a wide range of disciplines and interests, including knowledge management, organizational learning, adult learning, research methods, business ethics, leadership, evolutionary and institutional economics, econometrics, mathematics, decision making, psychology, and religious thought.[1]

The use of the phrase implies use of a concept common to all these fields. If the concept is a coherent one we would expect to find at least broad similarities in use and application / meaning, and certainly no significant differences. In this paper I will first review some uses and definitions of tacit knowledge from knowledge management and organizational studies literature. I will then look selectively at its use in three other disciplines - artificial intelligence, the sociology of science, and psychology. In part two I turn to consider what Polanyi, as the main philosophical source for the concept, actually said. Finally, I will outline and justify a framework first presented by Dewey and Bentley (1949) that helps us hold 'tacit' and 'explicit' knowledge in a behavioural framework, and thus offers prospects as a base for further conceptual and practical work in the field of knowledge management.

Tacit knowledge and knowledge management

Nonaka and his colleagues introduced the concept of tacit knowledge into knowledge management, and continue to be a principal reference point (Hedlund & Nonaka 1993; Nonaka 1991, 1994; Nonaka & Takeuchi 1995, 1996, Nonaka et.al. 1996). They acknowledged Polanyi's writing as their source for the concept, and claimed to

have developed its more practical side. Tacit knowledge is a non-linguistic non-numerical form of knowledge that is highly personal and context specific and deeply rooted in individual experiences, ideas, values and emotions. In a departure from Polanyi, they distinguished between technical tacit knowledge meaning skills or concrete 'know-how', and cognitive tacit knowledge which refers to ingrained schema, beliefs and mental models that are taken for granted. (Nonaka 1991: 98-9; 1994: 16-17; Nonaka & Takeuchi 1995: 8, 9, 59-60; 1996: 834-5).

Nonaka and Takeuchi's model of knowledge creation (e.g. Nonaka & Takeuchi 1995) places tacit knowledge its heart, and suggests that organizations have to find ways of communicating and capturing tacit knowledge. While on the one hand they suggested that tacit knowledge has to be converted into linguistic or numerical form in order to be communicated (Nonaka & Takeuchi 1995: 9) they also indicated that this is not the primary way in which it is exchanged. Technical tacit knowledge is created by or through individuals' actions and direct experience in the 'here and now' (Nonaka & Takeuchi 1995: 8, 10, 60, 85), and can be acquired through apprenticeships, or learning by doing, but does not require the use of language (Nonaka & Takeuchi 1995: 62-3, 70, 85; Nonaka et.al., 1994: 340). Cognitive tacit knowledge, on the other hand, is apparently transmitted through language involving, for example, social activity and informal discussion of work problems (Nonaka & Takeuchi, 1995: 62-3). It can also be acquired through 'internalization' involving the use of explicit knowledge in the form of documents and similar media, a method they claimed facilitates changing mental models (Nonaka & Takeuchi, 1995: 69).

These perspectives on tacit knowledge inform much knowledge management writing. Huseman & Goodman (1999) reproduce their model, as do Baumard (1999) and Choo (1998). There are, however, some variations. Aadne et. al. (1996:12, 24) for example see tacit knowledge not only as personal, but also residing in individual and social relationships in the firm, implying perhaps a collective aspect or dimension. Despite the embeddedness of tacit knowledge in such relationships they suggest it is not difficult to transfer between organizations. Von Krogh (1996:39) also supports the view that tacit knowledge resides in relationships, as well as in "attitudes, information flows, and ways of making decisions that shape [people's] dealings with each other". However, von Krogh and Roos (1995) argued strongly that tacit knowledge is a characteristic of individuals alone, and cannot be communicated, being 'embedded' in individuals' actions in specific contexts (von Krogh & Roos 1995: 50-51).

Baumard (1999) has provided the most extensive treatment of tacit knowledge in a knowledge management and organizational context. Tacit knowledge is important partly because expertise rests on it, and because it is the source of competitive advantage, as well as being critical to daily management activities (Baumard 1999:8, 22). It was originally identified by Polanyi but he argues that Piaget had also identified a cognitive dimension in the sense of mental patterns that serve to guide our actions in the world (Baumard 1999: 8, 59). Other research into implicit learning and real-world decision making also provides evidence that people appear to posses knowledge that they are not aware of having learned, or that they actually possess (Baumard 1999: 54-8)

He distinguished two types of organizational knowledge that "cannot be articulated or stabilized" - implicit knowledge, and tacit knowledge (Baumard 1999:2). Implicit

knowledge is something we might know, but do not wish to express while tacit knowledge is something that we know but cannot express; it is personal, difficult to convey, and which does not easily express itself in the formality of language and is thus non-communicable (Baumard 1999: 2, 23, 59). He also endorsed Nonaka and Takeuchi's technical/cognitive distinction (Baumard 1999:59).

He argued that it is important to recognize that knowledge in general can be both an attribute of individuals and of groups or collectivities. Thus tacit knowledge itself can also be a property of individuals, and of groups (Baumard 1999:30-33). Baumard also sought to develop a philosophical dimension drawing on studies of ancient Greek though. The Greeks distinguished between four different kinds of knowledge of which two - practical and social wisdom, and "conjectural wisdom" appear akin to tacit knowledge (Baumard 1999: 53).

Choo (1998: 111-119) has drawn some of these threads together. He acknowledged Polanyi as the source of the concept, but distinguished between a Polanyian type of tacit knowledge characteristic of individuals, and a similar phenomenon that is characteristic of groups. Individual tacit knowledge as hard to verbalize as it is expressed through action based skills, and learned through experiencing and doing and is situated in respect of individuals and their associated artefacts. This kind of tacit knowledge can be learned through apprenticeships, and through "rich modes of discourse that include the use of analogies, metaphors, or models, and through the communal sharing of stories." (Choo 1998: 117). On the other hand he notes that various authors refer to the existence of shared practices and tacit understandings among members of groups that relate to working together, and task performance. These observations support the contention that there is a collective or group form (or forms) of a form of knowledge analogous to if not the same as the tacit knowledge of individuals (Choo 1998: 118-9).

Finally we can note that Scharmer (2000) proposed to distinguish two forms of tacit knowledge. He claims that the tacit knowledge described by Polanyi and Nonaka denotes knowledge that is embedded and embodied in everyday practices; he calls this "embodied tacit knowledge". On the other hand is "not-yet-embodied tacit knowledge ... 'self-transcending' knowledge.". According to Scharmer, these two forms are quite distinct, the former being based on action, the latter on imagination and aesthetic experience. He further claims that it is the only latter form that is a sustainable source of competitive advantage.

While the authors reviewed here share some common understanding of the nature of tacit knowledge there are also differences. Two key issues are apparent from this review. First, is tacit knowledge something that characterizes individuals, or both individuals and groups? Von Krogh and Roos provide strong conceptually well grounded arguments for tacit knowledge being wholly a trait of individuals. For Nonaka and his colleagues it is a personal form of knowledge, but they also appear to hold that groups can have shared tacit knowledge. Baumard, however, argues that tacit knowledge can be both individual and collective. Choo's account confirms this, but he is more cautious about equating the phenomenon called 'tacit knowledge' at the level of individuals with an apparently similar phenomenon characteristic of groups.

The second issue concerns whether tacit knowledge can be made explicit. Von Krogh and Roos state that it cannot be communicated, and are supported by Baumard and to some extent by Choo. Nonaka and his colleagues simply aver that it is difficult to make explicit, while Aadne and his colleagues see no difficulties in transferring collective tacit knowledge between organizations despite it being embedded in specific situations.

It is also evident that the arguments for and about 'tacit knowledge' rarely supported by good empirical evidence or a sound conceptual framework (excepting von Krogh and Roos in the latter case). Nonaka and Takeuchi's examples are not convincing (Gourlay 2000). Baumard claims tacit knowledge is not communicable but then describes patents so as to imply they are a form of explicit knowledge derived from tacit knowledge (Baumard 1999: 23). He also makes remarks to the effect that if some knowledge is codified it will be lost (Baumard 1999: 21) which is difficult to understand and his discussion of the characteristics of tacit knowledge contains many unsubstantiated assertions that make it difficult to evaluate his ideas. Just has he drawn on arguably outdated philosophical sources (see Dewey 1929/1984 for a discussion of some limits of Greek thought in modern contexts) so Scharmer derives a new and extremely vague type of tacit knowledge not from empirical investigation, but from speculative philosophy.

Tacit knowledge in other disciplines

The extent of use of the phrase, and implicitly the concept, means that a proper review of its use elsewhere is beyond the scope of this paper. Here I will present discussion from three fields where there is evidence of considerable conceptual and/or empirical work.

Tacit knowledge in work and AI

In the 1980s and early 1990s the question of being able to reduce all knowledge to explicit form was discussed extensively in the context of exploring the implications of artificial intelligence for work (Göranzon & Josefson 1988; Göranzon & Florin 1990, 1991, 1992). Contributors sought to provide firm grounding for the concept of tacit knowledge by drawing on Wittgenstein's later philosophy to counteract criticism of Polanyi's ideas (Janik 1990).

Janik (1988) reviewed several studies of work exemplifying tacit knowledge, and argued that the term is used in two senses: first, to refer to knowledge that could be made explicit, but which has not yet been so rendered; and second, to those 'aspects of human experience which are *wholly* knowable self-reflectively ... but by their very nature are incapable of *precise* articulation' (Janik, 1988: 54; see also Prawitz 1990:58-9). The second sense he called the strict sense of knowing tacitly (Janik, 1988: 56). He identified five forms or types of tacit knowledge that could be placed within these two categories:.

Types of 'tacit knowledge' (Janik 1988: 54-8)

things not (yet) put into words	***things inexpressible in words***

trade secrets	'knowledge by acquaintance or familiarity' e.g. sounds, smells
things overlooked e.g. craft knowledge/skill	"the open-textured character of rule-following" acquired through practice
presuppositions	

'Tacit knowledge' that could be put into words tends to remain tacit three main reasons: concern with secrecy and power, because no one has bothered to recognize the knowledge or tried to explicate it, and, because it concerns presuppositions we all generally hold. There are, however, no insuperable barriers to making this kind of knowledge explicit. On the other hand the second type of tacit knowledge *cannot* be expressed in words because, following Wittgenstein, it relates on the one hand to sensuous experience or to practice, and on the other to rule-following (Janik 1988: 54-8; Josefson 1988; Johannessen 1981, 1988, 1992). A purely sensuous experience is one such as smelling coffee, or identifying a musical instrument from the sound it makes. We 'know' what coffee smells like, how a particular musical instrument sounds, but these kinds of 'knowledge' cannot be expressed in words or other explicit communicable form but must be gained through experiencing the sensations (Janik 1988; see also Janik 1990; Prawitz 1990 for further discussion).

Janik also drew from Wittgenstein the idea of the "open-textured character of rule-following behaviour" (Janik, 1988: 56; 1990). Wittgenstein observed that we cannot fully specify the rules for carrying out an action since any such specifications would themselves requires rules for interpreting them, which would in turn involve more rules - an infinite regress. We have in fact to learn how to accomplish something before we know how to follow the rules for doing it and ultimately rule-following always rests with actual doing, practice, or activity (Janik, 1988: 57-8).

The sociology of scientific work

Collins and his colleagues have been studying scientists and other skilled professionals with a particular interest in the role and nature of tacit knowledge (see Collins 2001a for references). Early in this work he suggested that all knowledge consists in part of "tacit rules which may be impossible to formulate" (Collins 1974: 167). Recently he defined tacit knowledge as "'knowledge or abilities that can be passed between scientists by personal contact but cannot be, or have not been, set out or passed on in formulae, diagrams, or verbal descriptions and instructions for action'." (Collins 2001b: 72; see also 2001a: 108). He acknowledged Polanyi's contribution to the idea of tacit knowledge, but argued that the notion was "immanent in the philosophy of Wittgenstein" from whom he drew more inspiration (1974: 184; see also Collins 2001a).

Two of his studies explored the difficulties scientists faced in replicating experiments successfully carried out by others (Collins 1974, 2001b). Tacit knowledge was evident where teams could perform the experiments, but were unable to transmit that to other because in fact they were unaware of the real reasons for their success. In

both instances it turned out that features of the experimental set-up they regarded as marginal or routine practice, and hence overlooked in reporting their results, were critical to success of the experiment. This was only discovered when teams worked together, and each gradually learned what the critical factors were.

Tacit knowledge can only be passed on only by personal contact. Collins identified five types of such knowledge (Collins 2001b: 72-3):

concealed knowledge	tricks of the trade; concealment may be intentional or unintentional (the concealer is unaware)
mismatched salience	different parties focus on different variables or aspects of a complex piece of research, resulting in mismatched perspectives
ostensive knowledge	words may not be available to convey knowledge that pointing can
unrecognized knowledge	the successful experimenter may be unaware of critical actions that an observer successfully but unconsciously imitates
uncognized/uncognizable knowledge	our ability to utter meaningful sentences without being able to say how; learning requires apprenticeship

We can reasonably infer that all but the last category of these types can be made explicit in some form. Concealed and unrecognized knowledge, as in the examples above, can be spoken about once exposed, or recognized; things known ostensively can be named, and words used to refer to them, and different parties to an activity or experiment can come to recognize that they were both dealing with the same thing.

Collins has recently explored the question of making tacit knowledge explicit. Many examples of tacit knowledge fall into what he called the motor-skills category. This is exemplified by riding a bicycle or performing any such similar skill. A second group he called the rules-regress model, and is based on Wittgenstein's observations about rule-following. The third category is what he called the 'forms of life' approach. People in different social groups take different things to be knowledge, but are unaware of the social basis of their certainties. Thus, if the true sources of our beliefs are largely social, yet we do not recognize this, then, he claims, the sources of our beliefs are hidden from us, and thus based on tacit understandings (Collins 2001a: 110-1).

Collins argues that there is nothing philosophically fundamental about the motor-skills and rules-regress forms of tacit knowledge since advances in neural net computing make it possible to incorporate both types into a non-symbolic computer program from where, in principle, it might be possible to derive a symbolic computer program. On the other hand, the ‘forms of life’ type of tacit knowledge is beyond the reach of neural nets since they do not and cannot participate in human society, and so is inherently beyond explication. Moreover, even though motor-skills and rule-regress forms can be replicated by computer programs, both these types of tacit knowledge are actually exercised in infinitely varying and therefore unpredictable

contexts. Any setting down of such tacit knowledge would therefore only be of limited value (Collins 2001a: 111-17).

Practical intelligence and tacit knowledge

The third group of studies to be reviewed here were carried out by psychologists who have focused on professional groups, including managers (Sternberg, 1999; Wagner, 1987, 1991; Wagner & Sternberg 1985, 1986; Sternberg & Horvath 1999). They acknowledged Polanyi's contribution (Wagner & Sternberg, 1985:438) but did not discuss his ideas. Instead they apparently defined tacit knowledge as knowledge that is tacit in the dictionary sense of 'tacit' (Wagner & Sternberg, 1985: 438-9). Tacit knowledge is an attribute of individuals (Sternberg 1999:232). It is "practical rather than academic, informal rather than formal" (Wagner & Sternberg, 1986: 54); it is "practical know-how" (Wagner, 1987:1236), or "procedural knowledge" (Sternberg, 1999: 231). It must be acquired in the absence of direct instruction through experience as it is not usually taught (Wagner & Sternberg 1985: 54; Wagner, 1987: 1236; Sternberg, 1999: 233). However, it is not " inaccessible to conscious awareness, unspeakable, or unteachable" (Wagner & Sternberg, 1985: 439).

They have operationalized a three dimensional model of managerial tacit knowledge (Wagner & Sternberg 1985; Wagner 1987) and developed and tested questionnaires and other tools to collect and describe it. Through their experiments they have identified four key characteristics. The first three are only of interest to their programme of investigating practical intelligence and expertise. Their fourth finding is that "a substantial part" of tacit knowledge appears to be relatively general and broadly applicable as opposed to situationally specific (Wagner, 1991: 178, 181). While this has been established through experimental studies Sternberg (1999: 233) appears to contradict this finding. He concluded from a review of other studies (Sternberg & Horvath 1999) that the tacit knowledge required for different activities differs, and that it is best learned from experiences in an environment where it will subsequently be used.

The state of 'tacit knowledge'

There is general agreement that Polanyi played an important role in identifying tacit knowledge, though some see his arguments as weak, and in need of support or separate development from Wittgenstein's philosophy. Nevertheless, both these groups agree in seeing tacit knowledge as personal and private, and generally difficult to make explicit. Only Sternberg and his colleagues depart from this, viewing all tacit knowledge simply as knowledge that has not been made explicit.

On the individual/collective dimension, Janik and his colleagues implicitly, and Sternberg and his co-workers explicitly see tacit knowledge as an attribute of individuals. Collins, on the other hand, see it as an attribute of both individuals and groups. Collins and Janik identified several different types and forms of tacit knowledge, differentiating between that which can be made explicit, and that which cannot be made explicit at all. They do not agree, however, on which types fall into which of these major categories. For Janik, rule-following cannot be made explicit, but Collins argues that it can, at least in principle. Collins does not consider sensuous knowledge, and for him the strong form of tacit knowledge is that embedded in social

processes - the 'forms of life' perspective. Most of Collins' specific types can be related to Janik's list of things that can be made explicit. One exception is Collins' ostensive knowledge which seems an addition to Janik's list. This can be made explicit since we know that human beings are adept at creating words to refer to minute nuances of ideas or activities and things of importance to them, and so that is no reason to suspect that ostensive knowledge will necessarily remain tacit.

It thus appears that away from knowledge management and organization studies the phrase 'tacit knowledge' is also used to mean different things, and key differences match those found in knowledge management writings - whether it is an individual or a collective trait, and whether it is explicable or not. These writings, particularly those of Janik and Collins, advance our understanding of the latter issue since they propose, on the basis of empirical studies, that while some of what is called tacit knowledge can be made explicit, other forms or types cannot.

Polanyi, tacit knowledge and tacit knowing

Since Polanyi first developed the idea of tacit knowledge, and since some regard his and Wittgenstein's ideas as essentially similar (Gill, 1974) it is reasonable to turn to Polanyi's writings on the topic to seek conceptual clarification.

In the 1960s Polanyi published an important series of papers (Polanyi 1966, 1968, 1969a, b, c, d) from which two interpretations of his views can be derived. On the one hand there is strong evidence to suggest he was primarily concerned with a *process*, 'tacit knowing' and not at all interested in a putative 'thing', 'tacit knowledge'. On the other hand, a much weaker case can perhaps be for a wholly and irreducibly tacit form of knowledge as an outcome of tacit knowing. With the exception of *The Tacit Dimension* (Polanyi 1966) little of this work has been considered in the context of knowledge management.

Tacit knowing

The evidence that Polanyi was concerned with a process of knowing is overwhelming, though seemingly not noticed by many who refer to his work (for exceptions see Gill, 2000; Malterud 1995). While he used the phrase 'tacit knowledge', and wrote of 'knowledge' being 'tacit', he used 'tacit knowing' approximately five times more often in the series of papers referred to above.[2] Moreover, he wrote: "Knowledge is an activity which would better be described as a process of knowing." (Polanyi 1969a: 132), and, "I shall always speak of "knowing," therefore, to cover both practical and theoretical knowledge." (Polanyi 1966: 7; see also Polanyi 1969a: 131, 133). How he used and described 'tacit knowledge' and 'tacit knowing' is a more important indicator of his intentions than these claims for he could well have been inconsistent.

Some background is necessary in order to understand his arguments. Polanyi's approach to knowledge/knowing was based on a part-whole model of perception and cognition derived from gestalt psychology (Polanyi 1969c: 138-9, 145). He did not use the terms 'part' and 'whole', but, variously, the pairs subsidiary/focal; proximal/distal; clues/entity; or particulars/whole (Polanyi 1969c: 148; Polanyi 1968: 31). According to him, seeing involves a part-whole relationship whereby parts are

integrated into the whole that is perceived. This applies to all forms of perception, not just vision. Generalizing this model further, he argued that activities ranging from perception of a simple object to scientific endeavour, from everyday motor actions to appreciating the scenery have 'focal' and 'subsidiary' elements which are 'integrated' to produce their effects.

Looking first at tacit knowledge, Polanyi described this as having two logically related "terms" - the subsidiary and the focal - of which only the "subsidiary elements of perception" are known tacitly (Polanyi 1966: 9; 1969c: 142). Somewhat confusingly he also wrote that tacit knowledge comprises both "subsidiary awareness and focal awareness" (Polanyi 1969c: 144), implying that both "terms" were only known tacitly. Thus he argued that a traveller's experience of new sights and sounds is "a purely tacit knowledge ... both its subsidiary and its focal awareness were tacit" (Polanyi 1969d: 195).

When we turn to tacit knowing this has the same basic "structure" as it "always involves... the two terms" (Polanyi 1966: 9) subsidiary/focal, proximal/distal, and so on. These are functionally related, meaning that that which is subsidiary (proximal, etc.) is so in relation to that which is focal (distal etc.) (Polanyi 1966: 10; 1969d: 194; 1968: 10). Since the structure of tacit knowing is identical with that of 'tacit knowledge', this supports the claim that the two are identical. Polanyi later extended the "structure" of tacit knowing to include a third element, the knower without whom there could be no integration (Polanyi 1969d: 181; 1968: 30-31).

He used this 'structure' model to analyse a wide variety of activities and thus to substantiate his arguments. These activities included implicit learning ("subception"); visual perception; scientific research and discovery; learning physical skills, and the pattern detection skills characteristic of experts; mastery of tests; use of tools; speech and language; reading, and the formation of class concepts (such as 'man') (Polanyi 1969c: 143; 1969a: 123-28; 1968: 30; 1966: 7; 1969d: 182-3; 1969b: 166-7). Although he initially wrote of perception providing a 'logic' for tacit knowing, he later declared that it was "the most impoverished form of tacit knowing", forming "the bridge between the higher creative powers of man and the bodily processes which are prominent in the operations of perception." (Polanyi 1966: 7).

While he said little directly about 'tacit knowledge', which is not surprising if he regarded it as synonymous with 'tacit knowing' he devoted much attention to describing the latter. He concluded from his studies of science that scientific discovery is due to "the tacit powers of the mind, and its content ... can only be tacitly known." (Polanyi 1969c: 138). Gestalt psychology provided him with clues as to the "logic by which such tacit powers can achieve and uphold true conclusions" (Polanyi 1969c: 138). He claimed this shows that we have "... powers of perceiving coherence" that can make us see the "thousand varied and changing clues" of a moving object "jointly as one single unchanging object" (Polanyi 1969c: 139). Just as these "powers" integrate these "clues" to a single object, so

> ... a scientific discovery reduces our focal awareness of observations into a subsidiary awareness of them, by shifting our attention from them to their theoretical coherence. This act of integration, which we can identify both in the visual perception of objects and in the discovery of scientific theories is

> the tacit power we have been looking for. I shall call it tacit knowing. (Polanyi 1969c: 140).

"Tacit knowing" is thus a "tacit power", an "act of integration" or perhaps more specifically the 'power of perceiving coherence' among 'thousands of clues', and it is a "fundamental power of the mind" (Polanyi 1969c: 156; see also 1969d: 185, 191, 196; 1968: 29, 32, 37). 'Integration' is a key process in making tacit inferences (Polanyi 1969c; 1969d: 194), and he later argued that the "dynamics of tacit knowing" whereby coherence is constructed are maintained by a "mechanism of imagination-*cum*-intuition" (Polanyi 1969d: 195 ff.).

Since Polanyi regarded 'tacit knowledge' as a process, better called 'tacit knowing', it is not surprising that he saw it as being quite distinct and separate from 'explicit knowledge' though not sharply divided from it (Polanyi 1969c: 144). He only used the phrase "explicit knowledge" occasionally[3] and defined it as knowledge: "... capable of being clearly stated ..." (Polanyi 1966: 22), implying "spoken words, ... formulae, ... maps and graphs, ... mathematical theory" (Polanyi 1969d: 195), arrived at by "explicit inference" (Polanyi 1969d: 194). Elsewhere he wrote of "explicit rules" (e.g. Polanyi 1969c: 138; 1969b: 164, 172), and "maxims" (Polanyi 1969b: 164) to refer to this kind of knowledge. A "communication", specifically a letter, was described as a "piece of explicit knowledge" (Polanyi 1969d: 195). It is clear that he used this phrase in its conventional sense.

He argued that "*tacit knowledge* [is] opposed to *explicit knowledge*" (Polanyi 1969c: 144) because knowledge of the mathematical formula for keeping balance on a bicycle, for example, was ineffectual unless known tacitly. Similarly, when a traveller wrote a letter, he claimed that "this focal awareness of an experience was introduced subsidiarily into a communication which was a piece of explicit knowledge, the meaning of which was tacit." (Polanyi 1969d: 195). Thus 'tacit knowledge' cannot be expressed in explicit form but can only in some unexplained sense be secreted within the words making up 'a piece of explicit knowledge'. As he put it: "... While tacit knowledge can be possessed by itself, explicit knowledge must rely on being tacitly understood ..." (Polanyi 1969c: 144). Hence his claim that all knowledge is tacit, or rooted in tacit knowledge.

Polanyi's views on the relationship between 'tacit knowing' and 'explicit knowledge' slowly changed throughout the 1960s. Initially he argued that if "explicit rules" for "intuitive actions" (i.e. tacit knowing) could be set out (implying they could not) they would have to spell out not only the particulars on which perceiving the entity relied on, but also the integrative relations by which they were brought to bear on that entity (Polanyi 1969b: 162-4). In *The Tacit Dimension* (1966), however, he conceded that it was possible to 'know' 'particulars' explicitly, and, in certain cases, the relations between them could also be stated. Moreover, such a process could go beyond "tacit integration" just as an engineer's understanding of a machine goes beyond that of a user, or a physiologist's theoretical knowledge of our body is more revealing than our practical knowledge (Polanyi 1966: 18-20) and linguists know the complex rules of language that are only known subsidiarily to speakers (Polanyi 1969d: 204). While in 1967 he still maintained that the integration of particulars to an entity depended on the "tacit operation of the mind" (Polanyi 1969d: 191) by 1968 he conceded that "one can paraphrase the cognitive content of an integration" even though "the sensory quality

which conveys this content cannot be made explicit." (Polanyi 1968: 32). Thus he eventually agreed that both the content or 'structure' of tacit knowing, and the means whereby the parts are integrated can be described. This still left 'the sensory quality' of the experience as tacit and personal, and tacit knowing as wholly a personal, private experience.

A case for 'tacit knowledge'?

While close examination of Polanyi's arguments clearly shows his focus was on the process or activity of knowing, a case can perhaps be made for 'tacit knowledge'. Alexander and Schallert (1991), for example, regard a person's "prior knowledge" as tacit until activated by some on-going activity. For them, an activity is any kind of organism-environment exchange or relationship, but it could perhaps also be identified with 'tacit knowing'. Appealing though this may be to some, there is no warrant for it in Polanyi's writing.

For Polanyi, tacit knowing results in the perception of "phenomenal qualities of external objects" and "mental qualities" of feeling, action and thought" (Polanyi 1969c: 153); and the sensing of sensory experiences elsewhere than in the cortex by an individual knower (Polanyi 1969b: 162; see also Polanyi 1968: 32). More generally, tacit knowing results in understanding: "Since tacit knowing establishes a meaningful relation between two terms, we may identify it with the understanding of the comprehensive entity which these two terms jointly constitute." (Polanyi 1966: 13). For Polanyi, tacit knowing/knowledge is a subjective, qualitative experience or process.

Polanyi - a conclusion

In Polanyi's accounts both 'tacit knowledge' and 'tacit knowing' have the same two-fold structure ('tacit knowing' has a tripartite structure, but the third element was a late addition) and centre on individuals. Both were derived from gestalt psychology, and finally, the examples used to illustrate both were not only identical but also involved some kind of activity. His claim that when he wrote 'knowledge' he meant 'knowing' can be accepted. The overwhelming use of 'knowing' rather than 'knowledge' shows that Polanyi was actually concerned about a process, an activity, and not a particular kind of knowledge as a thing resulting from a process.

Within his framework full descriptions of activities can be made including both subsidiary elements and relations between them. Nevertheless, he insists that the descriptions are not the same as the activity, a point made more recently within situated cognition (e.g. Clancey 1997; see Gourlay 2001). Finally, it would seem that tacit knowing guarantees an individuals sensory or qualitative experience of doing something, and that it cannot be made explicit.

Is 'tacit knowledge' - a form of 'knowledge'?

When the history of the phrase 'tacit knowledge' is written it is likely researchers will find we misread Polanyi because of our prior concern with 'knowledge', and because of the difficulty, not to say lack of familiarity, of writing or thinking in processual

terms in English. Before looking at a conceptual framework that may help in this endeavour one further test of 'tacit knowledge' can be applied.

If the phrase 'tacit knowledge' indicates a form of 'knowledge' then it should be possible to substitute a definition of 'knowledge' in the phrase, and for the phrase still to make sense. 'Western' philosophers currently define knowledge as "true warranted belief" (Klein 1998) rather than 'justified true belief' (e.g. Nonaka and Takeuchi 1995:25). The distinction is important in so far as justification only depends on sound reasoning that itself may rest on false premises - thus "justification is not sufficient for warrant." (Klein 1998). How knowledge is warranted is a matter of debate amongst epistemologists, and need not detain us here.

If 'knowledge' is 'true warranted belief' then the phrase 'tacit true warranted belief' should make sense. Although some philosophers hold the concept of 'tacit belief' to be meaningful (Lycan 1986), the idea of a 'tacit true warranted belief' seems implausible if not impossible. If 'tacit knowledge' is unspoken and unspeakable, it is difficult to see how reasons could be produced to warrant such a belief and therefore demonstrate its truth. If it is made explicit, and is then open to warrants and truth tests, then of course it is no longer tacit.

This result is hardly surprising since, according to Klein (1998) western philosophers have only dealt with propositional knowledge, the more formal philosophical term for 'explicit knowledge'. It is interesting to note that the *Routledge Encyclopaedia of Philosophy* (Craig 1998) provides entries for knowledge (Klein 1998), and for tacit knowledge (Delaney 1998), but no attempt was made to link them. Klein also noted that there are two other forms or types of knowledge in addition to propositional knowledge, namely, know-how or skill and acquaintance. In so far as these can both be treated as 'tacit knowledge' (Janik 1988) this suggests that either epistemologists *do* consider 'tacit knowledge' a form of knowledge, but have not yet considered how it might relate to propositional knowledge, or that 'tacit' and 'explicit' 'knowledge' are actually two different 'things' for which the same label, 'knowledge', is somewhat confusingly used.

In this context it is interesting to note that Dewey (1922/1930: 177-8) wrote that people commonly identify know-how and practical skill with knowledge, but that to do so left "other things also called knowledge, knowledge *of* and *about* things ... a different sort, ... unaccounted for and undescribed". Later, in a joint publication with the polymath Arthur Bentley (Dewey & Bentley 1949), they argued that

> The word "knowledge", ..., is a loose name. ... We shall rate it as No. 1 on a list of "vague words" ... Only through prolonged factual inquiry, ..., can the word "knowledge" be given determinable status with respect to such questions as: (1) the range of its application to human or animal behaviors; (2) the types of its distribution between knowers, knowns, and the presumptive intermediaries; (3) the possible localizations implied for knowledge as present in space and time. (Dewey & Bentley 1949: 48).[4]

The confusion surrounding 'knowledge' in the most recent dictionary of philosophy referred to above (Klein 1998) suggests that the 'prolonged factual inquiry' Dewey and Bentley called for has not taken place, or is yet to reach firm conclusions.

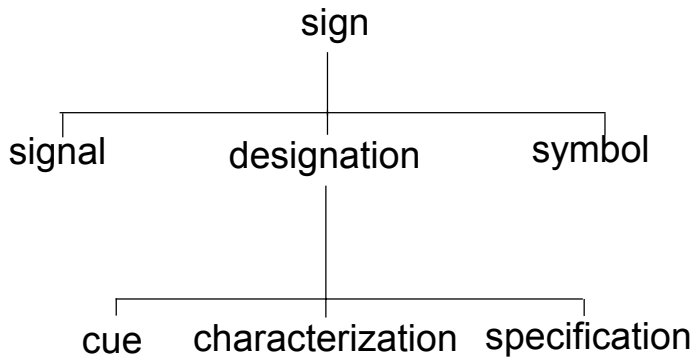
Knowing: towards a conceptual framework

Polanyi has drawn attention to 'knowing', an activity, which others have also suggested should be a focus (e.g. Blackler 1995). This shifts the burden of conceptual work, from 'knowledge' to 'knowing'. In this context it is useful to consider some propositions made by Dewey and Bentley. Between 1942 and 1948 Dewey and Bentley wrote a series of philosophical papers (Dewey & Bentley 1949) in which they set out some postulates for the study of 'knowledge', outlined and developed parts of a new framework, and proposed a formal terminology without which they felt attempts to clarify understanding of 'knowledge' would fail. Their framework, I will argue, provides a useful conceptual base on which to place investigation of 'tacit knowledge/knowing'.

Dewey and Bentley proposed to concern themselves "directly with knowings and knowns" – things that could be observed in relation to the knowing process (Dewey and Bentley 1949:48). One basic postulate was that "Knowings are behaviors" (Dewey and Bentley 1949: 74)[5], a word that indicated "the wide ranges of adaptive living ... including thereunder everything psychological and everything sociological in human beings". A second crucial postulate was that behaviour can best be studied in terms of organism-environment transactions - "behavioral inquiries [involve] organism and environmental objects jointly at every instance of their occurrence, and in every portion of space they occupy." (Dewey and Bentley 1949:129-30). They distinguished "transaction" from "interaction" because, in Dewey's words, of their insistence that organisms live "not ... *in* ... but by means of an environment", and that organism and environment are an "integration", not two separate things that come together (Dewey 1938/1984: 32; Dewey & Bentley 1949). Lack of space prevents consideration of the implications of their second postulate for 'tacit knowledge/knowing', and we will concentrate on the first postulate.

Behaviour itself was seen as necessarily entailing signing or sign-process. They did not use 'semiosis' or 'semiotics' probably because they disagreed with a recently published monograph that used those words (Dewey & Bentley 1949). They cited biological observations as evidence that sign-process was manifested even in relatively simple organisms, as when sea-urchins responded defensively to a shadow as if to a threat. For them this showed that sign-process is a characteristic behavioural process, one that takes place "only when organism and environment are in behavioral transaction" (Dewey & Bentley 1949: 150-1). Sign or sign-process covers the entire range of "behavioral activity" from the "sensitive reactions of protozoa to the most complex symbolic procedures of mathematics" (Dewey and Bentley 1949: 71). Dewey recognized this committed them "to recognition of a knowing-known aspect or phase in all behavior from protozoa all the way through." (Ratner & Altman 1964: 241). In turn this also meant that "sign-process" held 'knowledge' in one scheme from the "perceptual-manipulative" behaviours of protozoa and of human beings to "regions of mathematical and syntactical consistency" (Dewey & Bentley 1949: 91, 299; Ratner and Altman 1964: 123).

On the basis of these preliminaries they described and developed parts of a sign-process "spectrum" covering "the bodily end to the symbolic" (Ratner and Altman 1964: 142), as follows:



They distinguished three "genera" of sign: "*signal*" (covering "perceptions, manipulations, habituations") or the 'perceptual-manipulative' phase, "*name*" (or alternately, *designation*) (where "organized language is employed as sign") and "*symbol*" (for mathematical regions). Within 'name' or 'designation' they further distinguished cue, characterization, and specification to mark degrees of linguistic sophistication. Cue covered grunts and similar noises; characterization was the phase of everyday language while specification marked the development of scientific terminology (Dewey and Bentley 1949: 71; Chaps. 6 & 10). They did not develop signal, or symbol.

This framework thus linked together non-verbal, verbal or linguistic, and symbolising behaviour in one scheme as forms of sign-process through which life-forms 'know'. The notion that these differences are not just stages in evolution, but also contemporaneous levels of activity (Dewey and Bentley 1949: 302) allows us to hypothesize that *all* are found in human behaviour, not just the complex sign-processes of designation (involving levels of language complexity) and symboling, but also signalling their pre-verbal sign-process category. This is not to understate the importance of language, but to remind us that we still have other modes of behaving, and thus knowing.

On this basis it is evident that 'tacit knowing/knowledge' corresponds to signalling, and 'explicit knowledge' to designation/name, and symbol. In order to develop and substantiate this hypothesis in the rest of the paper I will consider the question of the link between sign-process and behaviour; examine whether human behaviour involves non-verbal signing or whether human sign-processes have evolved beyond these forms to exclude them; and explore whether 'tacit knowledge' can be explained in terms of non-verbal signing.

Sign-process and behaviour

Were Dewey and Bentley justified in claiming that sign-process was, in large part at least, an intrinsic feature of behaviour? Certainly they are not alone in making such a claim. Von Uexküll, a theoretical biologist writing in the first half of the 20th century, also viewed semiosis as the criterial attribute of life (Sebeok 1979: x) although neither Dewey nor Bentley appear to have been aware of von Uexküll's work and ideas. Kaplan (1964: 32) wrote that the most generally applicable discriminant of 'behaviour' as a subject-matter is 'the use of signs'. Sebeok (1981:136) using the term 'semiosis' instead of sign-process, claimed that it "is as much a critical attribute of all life as is the ability to metabolize." (see also Sebeok 1979: viii). Leach (1976), a

social anthropologist, also saw communication and thus sign processes as central to human societies. It is therefore widely accepted that behaviour involves semiosis or sign-process; whether sign-process or semiosis *is* equivalent to or only part of behaviour is another matter that is not crucial to Dewey and Bentley's framework, or the current debate.

Non-verbal signing in humans

Studies of child development clearly show the importance of non-verbal signing in early life. Gesture and pointing by infants, and between adult carers and infants are important sources of language and linguistic competence (Bruner 1978, Clark 1978). Bruner (1966:10-11) also proposed that human beings translate their experience of the world into a model or some kind of representation in three ways – enactive, iconic, and symbolic. Enactive is learning through action, such as is involved in teaching someone to ride a bicycle. Iconic representation depends on visual or other sense organs and upon summarizing images by means of which we are able to detect patterns. Symbolic representation referred to words or language. Bruner appears not to have been aware of Dewey and Bentley's framework. Nevertheless it appears that enactive and iconic representation correspond to signalling, and thus to 'tacit knowing', while his 'symbolic' covers Dewey and Bentley's designation/name, and perhaps also symbol. In terms of *development* from child to adult, then, there is evidence for the persistence of the non-verbal alongside the verbal or linguistic modes of signing and knowing in human beings. While the idea of enactive representation seems to have attracted little attention among child development specialists, or other psychologists, Kaufmann (1996) has recently reviewed research on mental images to which Bruner's term refers and proposed a model for understanding them.

Turning to adults Sebeok in various writings (e.g. 1994:7) has emphasised that human beings uniquely have two "repertoires of signs" at their disposal - the verbal, which is uniquely human and which forms an 'anthroposemiotic' system (Sebeok 1979: 38), and the non-verbal. The latter he named "zoosemiotics", to indicate components of human communication systems found elsewhere in the animal kingdom (Sebeok 1979: 36). Bateson (1968, cited in Sebeok 1979: 42) also took exception to the view that in the evolution of *Homo sapiens* the non-verbal had been replaced by the verbal. He claimed that "the kinesics of men have become richer and more complex, and paralanguage has blossomed side by side with the evolution of verbal language." Thus, as Sebeok (1979: 42) himself put it, the two kinds of sign system "though they are often in performance subtly interwoven, serve ends largely different from one another."

The view that human adults communicate through a range and combination of verbal and non-verbal signs is thus widely supported. Studies of human communication indicate that the use of words is both preceded and accompanied by many other kinds of signal, and that this is true of everyday communicative activities. The linguist Lyons (1972) noted that in use language is accompanied by a variety of other signals ("paralinguistics") such as nods, gestures, eye-movements, as well as intonation, and Argyle (1972) surveyed a large number of non-verbal signals commonly found in human communication while Ellis and Beattie (1986: chapter 3) provided a further review. Leach (1972: 317) argued that 'non-speech' or "meaningful action that is peripheral to speech action" is highly significant for human beings, and moreover,

that the distinction between speech and non-speech is an arbitrary one. Sebeok (1979: 44) cites research that indicates even human memory has two interconnected verbal and non-verbal components (see also Schooler & Engstler-Schooler 1990: 37).

'Tacit knowing' as non-verbal signing

So far I have established that non-verbal signing is not just an evolutionary or ontogenic stage, but a vital part of all human life, running alongside and complementing, perhaps even enhancing, the verbal or dimension. I will now review some reports of 'tacit knowledge' to see if the hypothesis that 'tacit knowing' is equivalent to non-verbal sign-process can be supported.

Josefson (1988) described two stories illustrating that nurses often knew more than they could tall. In one example a nurse recounted how she had felt there was something wrong with a post-operative patient. A young inexperienced doctor called in on the nurse's insistence disagreed since in his opinion, according to the nurse's account, "the patient's vital signs were normal". The patient died later that day of complications "that could not have been diagnosed by an examination of his vital signs." (Josefson 1988: 27). We are not told why the 'vital signs' could not have yielded such information. The second case involved an experienced nurse reflecting on herself as a novice, faced with violent patients. She recalled that she noticed an older woman, a nursing auxiliary, "was better able than others to induce calm in those around her". She attached herself to the woman from whom she learned a great deal although she never discussed how to deal with problematic situations with the older woman.

A study of weather forecasters who produced local forecasts for aeroplane pilots primarily by 'traditional' non-computerized methods also illustrates 'tacit knowledge' (Perby 1988). The meteorologists began their shift by being briefed by outgoing colleagues, which provided a "sign-post", as they expressed it, for their work. They then drew a map by hand which required analyis and plotting of information from a wide range of sources, including personal observations. They talked about this activity as enabling them to "see signs of other changes" (Perby 1988: 42). Such maps are drawn at three hour intervals during the shift, providing a means and opportunity for continuous reflection on and updating of understanding about the weather. The meteorologists felt that such skills took a long time to learn, and that they did not know how they knew about the weather. They liased with national forecasters, and saw themselves as being "more open to look out for phenomena which may be a first sign of *changes* in the weather situation." (Perby 1988: 44).

Here we have several key ingredients of 'tacit knowledge/knowing'. First people report being able to do something without being aware of or able to say how they did it, or of knowing something without being able to tell it. Second, that they learned something without being able to say why, or without explicit instruction. Third, in the nursing case, this 'knowledge' is held by someone of lower status - the nurse, not the doctor; the nursing auxiliary, not the nurse. Finally, the 'knower' is an older more experienced person; 'tacit knowledge' acquisition depends on experience that comes with age.

We also have clear examples of sign-processes or semiosis, and even that the nurses and forecasters are aware that this is what they are doing, though their awareness is not an analytically sophisticated one. Thus both the nurse and the doctor read the 'vital signs', but came to different conclusions. Whether what each meant by 'vital signs' was the same, or different, or each took the same things as different signs (i.e. the same things meant different things to each) must remain an open question. It is also possible that the nurse unconsciously noticed other things that she treated as signs of impending death. The forecasters also explicitly talked about looking for signs, interpreting phenomena for which they are particularly attuned to look for, and so on. In all instances the non-verbal and the verbal are both present - both forms of sign-process are apparently essential to the nurses' and meteorologists' practice.

Polanyi himself also provided evidence that 'tacit knowing' can usefully be viewed as a non-verbal semiotic process, and even occasionally discussed it in sign-process terms. He saw medical diagnostic practices as providing fundamental evidence for 'tacit knowing', and used this model as a basis for establishing a similarity among medical diagnosis, skill, use of sensory organs e.g. to maintain posture, and the mastery of tools (Polanyi 1969a). For Sebeok and others (Sebeok 1979, 1981; Ginzberg 1980; Deely 1990; Nöth 1990:13) medical diagnosis is among the earliest recorded forms of sign-process that we have, and forms a paradigmatic case for semiosis.

When Polanyi described experiments into unconscious perception he also framed his discussion in sign-process terms. In these early studies of implicit learning (Reber 1993: 17) subjects who were administered an electric shock on seeing a set of nonsense syllables showed symptoms of anticipating the shock when presented with the syllables again, but were not aware of preparing themselves (Polanyi 1966: 7-8). He remarked: "When the sight of certain syllables makes us expect an electric shock, we may say that they *signify* the approach of a shock. This is their *meaning* to us." (Polanyi 1966: 11, his italics).

The question of noticing particulars which was fundamental to Polanyi's thesis of 'tacit knowing' can readily be explained or framed in terms of Peirce's categories (see Thompson 1963; Hausman 1993). Peirce (1894?), one of the originators of modern semiotics, described a sign as something that "conveys to a mind an idea about a thing" (Peirce 1894?), or "something that stands to somebody for some thing in some respect or capacity" (Peirce, cited in Nöth 1990:42). He argued that we take "three kinds of interest" in something which correspond to three "states of mind". In the first we simply contemplate something as if "in a dreamy state". Second, we may be interested in something because of its reactions with other things as when a sudden loud noise causes an instinctive reaction. Third, we think, and are aware of learning, as when engaging in one action we find it brings about another thus discovering "a third thing which is a means to an end", in short, "a *sign*, or representation."

These 'kinds of interest' or 'states of mind' would appear to relate to Peirce's fundamental philosophical categories: firstness or quality; secondness or relation; and thirdness, or representation (Thompson 1963: 19-29; Hausman 1993: Chapter 3). Polanyi's claim about 'tacit knowing' appears to involve Peirce's first and third kinds of interest. We may be aware uncomprehendingly or contemplatively of something, a 'particular'; or we may be aware of it as a sign of something else which. In the latter

case the sign-process will undoubtedly occupy our attention to the detriment of the thing now taken as a sign. Like the figure-ground phenomenon, we cannot simultaneously consciously hold to something as a quality, (Peirce's first state of mind) *and* as a sign.

This suggests that Polanyi's notion that we attend to something (such as the anticipated shock) from something else (the syllables) can be interpreted without loss into a sign-process or semiotic framework. We do not *need* a vague and elusive notion of 'tacit knowing/knowledge' when we already have a theoretically and practically more elaborated and better substantiated set of concepts and methods to work with. Moreover, from this perspective it would seem that Polanyi's discussion of 'tacit knowing' was actually an attempt to account for such semiotic processes. In so far as they are unconscious it is not surprising that we cannot articulate or 'tell' them, or that they are personal and subjective.

It is also worth noting there are links between 'tacit knowing', and implicit learning. First is the clear link with the reports of 'subception' that Polanyi took as experimental confirmation of 'tacit knowing' (Polanyi 1966: 7-8) which were amongst early experimental attempts to study unconscious or tacit learning (Reber 1993: 17). Useful reviews of the state of understanding of implicit learning have been provided by Jiménez (1997) Marescaux (1997), Stadler and Frensch (1998), and Berry and Dienes (1993). It is clear from some of these that implicit learning involves making a number of complex observations and treating them as signs and thus that at least some implicit learning processes involve signing.

This discussion of non-verbal sign-process in humans could be extended, but space does not permit. For example, a wide-ranging review of research and theories in relation to non-verbal communications indicating they can all be approached as forms of sign-process or semiotics is provided by Nöth (1990). Besides, enough has been said to indicate that such processes do occur in adults as well as infants; and that it is important for the life-processes of adults. The case has thus been established for regarding 'tacit knowing' as that knowing accomplished through "perceptual-manipulative" processes (Dewey & Bentley 1949). It may also accompany or be accompanied by linguistic knowing, but its relationship with "designation" (and "symboling") remains to be investigated.

Conclusion

The existence and significance of non-verbal sign reading and communication is well established fact of some branches of anthropology, psychology, and social science, not to mention semiotics. It seems however to have been overlooked by dominant trends in modern cognitive and information science from which knowledge management draws much of its theoretical inspiration.

Dewey and Bentley's (1949) framework thus provides a useful conceptual tool for thinking about 'knowledge' in relation to practice. We can also conclude there is a good case for holding both as postulates subject to further examination, and as heuristic assumptions, that:

- behaviour/behaving involves sign-process, and knowing; sign-process and knowing are perhaps equivalent (i.e. alternative names for the same behavioural process)

- sign-process extends from the 'perceptual-manipulative' to the symbolic / cognitive

- human knowing involves the whole range of forms of sign-process, not just (or even primarily) those 'cognitive' or 'linguistic' regions Dewey and Bentley named 'designation' and 'symbol'

- 'explicit knowledge' clearly lies within what Dewey and Bentley called designation, and also within symbol

- 'tacit knowledge' is equivalent to Dewey and Bentley's 'signal' (and to Bruner's (1966) enactive and iconic) as pre-linguistic (i.e. pre word-based) modes of human knowing

- treating 'tacit knowledge' as that which cannot be expressed in words as non-linguistic signs (of various kinds) is:

    a) consistent with both Polanyi's and Janik's use of the term as something it is not expressed in words, and therefore (excepting that someone might use words idiosyncratically) is not in a public form. Likewise it is constrained in time and space to particular perceptual-manipulative events undergone by individuals, and their consequences for those individuals (e.g. memory), and therefore also 'personal'.

    b) different from Sternberg & Wagner who treat tacit knowledge as if like any other complex 'invisible' sociological or psychological variable, and have operationalised a means of measuring tacit knowledge.

    c) holds out the potential for more effective study, and ultimately therefore control - insofar as we treat 'tacit knowledge' as non-verbal sign-process, and investigate it accordingly. The nursing examples, for instance, could if investigated for sign-process yield evidence that the experienced nurse *was* reading signs overlooked by the doctor, while the older auxiliary was sending non-verbal signals to both patients and the nurse who learned tacitly from her. If such a study were successful, then it would be possible in some form to train others to read the relevant signs.

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[1] Search of Dawson Books database (http://www.enterbooks.com, 5 Mar 2002) found 41 titles for which 'tacit knowledge' is a keyword.

[2] Content analysis of Polanyi 1966, 1968, 1969a, b, c, d.

[3] 9 times in Polanyi 1966, 1968, 1969a, b, c, d.

[4] Epistemologists do not yet appear to have reached any firm conclusions despite the intervening period to judge by Klein's (1998) account. In some respects knowledge management writers have made the position more complex. In a draft of the essay from which the above quotation is taken, Bentley wrote: "One thing, however, can be said: Whenever men apply the word, living organisms are involved also." (Ratner and Altman 1964: 459). Knowledge management writers, however, have extended 'knowledge' to cover something 'embedded' in material goods and products.

[5] Dewey and Bentley were not 'behaviourists' as they explicitly rejected Watsonian 'behaviourism' - (1949: 77, 97), and their 'transactional' approach is also inconsistent with behaviourism.