CHAPTER THREE

Personal Knowledge

If understanding in general is to be viewed as the faculty of rules, judgement will be the faculty of subsuming under rules; that is, of distinguishing whether something does or does not stand under a given rule. General logic contains, and can contain, no rules for judgement. For since general logic abstracts from all content of knowledge; the sole task that remains to it is to give an analytical exposition of the form of knowledge [as expressed] in concepts, in judgements and in inferences, and so to obtain formal rules for all employment of understanding...And thus it appears that, though understanding is capable of being instructed, and of being equipped with rules, judgement is a peculiar talent which can be practised only, and cannot be taught. It is the specific quality of so-called mother-wit and its lack no school can make good...

A physician, a judge or a ruler may have at command many excellent pathological, legal or political rules, even to the degree that he may become a profound teacher of them, and yet, none the less, may easily stumble in their application. For although admirable in understanding, he may be wanting in natural power of judgement. He may comprehend the universal *in abstracto*, and yet not be able to distinguish whether a case *in concreto* comes under it. Or the error may be due to his not having received, through examples and actual practice, adequate training for this particular act of judgement. Sharpening of the judgement is indeed the one great benefit of examples. Correctness and precision of intellectual insight, on the other hand, they more usually somewhat impair...Examples are thus the go-cart of judgement; and those who are lacking in the natural talent can never dispense with them.

Immanuel Kant[1]

Understanding a sentence means understanding a language. *Ludwig Wittgenstein*[2]

1.The Physical Basis of Tacit Knowledge

Learning is the outcome of a process of interaction between the individual and his environment. The information of all kinds with which the individual is constantly bombarded as a result of his transaction with the environment is comprehended by means of an interpretative setting in the form of "tacit knowledge", which is itself the result of accumulated experience. Tacit knowledge is divided into "schemata", of which there are a great variety, consisting of areas of knowledge which "belong together", such as interests, tasks or common situations. At the level of psychological process, therefore, "learning" always involves the modification of schemata. It is this process which is the subject of the present chapter.

Tacit knowledge may be understood at different levels or from different points of view, the physical, the psychological and the philosophical. Knowledge cannot be studied from a philosophical point of view without reference to the psychological processes by which it arises, and these psychological processes cannot be fully understood without reference to their physical base. It is necessary, then, to have in mind the physical basis of perception and knowledge. The term "schema", which Bartlett used to describe the way tacit knowledge is organised, was drawn from the work of Sir Henry Head, who used it to refer to a physical mechanism. Head was interested in certain types of brain damage. One important area of impairment he identified was the lack of an "ongoing postural model", or continuous awareness of bodily position. By contrast with certain brain damaged patients, Head was able to identify as an important function of the brain the maintenance of an ongoing model or representation of the current position of the body. Such a model was, of course, holistically or globally organised, consisting not

of individual memory "traces", but of a single representation continuously modified by a process of feed-back. Head called this model a "schema". It forms an actively orientated organisation of past reactions organised to form a setting for present experience.[3]

Thought of in this way, the schema is a kind of continuously updated and highly flexible bodily memory. In an activity involving bodily skill, such as in a game of tennis, no two movements are exactly the same. Each backhand, forehand or overhead shot is a variation on a theme. Any particular game involves a large number of shots, no two exactly alike. The essence of a bodily skill, such as tennis, Bartlett believed, was the use of the body's ongoing postural model continually to update the awareness of the position of the body, coupled with the outwardly-directed intention to play the ball in a certain way. Although in the course of a practice session, it is possible to "work on" a shot by consciously paying attention to the coordination of the movements involved, during a game such movements are almost always unconscious, although intentionally directed. There is, therefore, in the performance of a skill, a considerable tacit element. This involves "knowledge" held by the body in the form of schemata, the content of which is incapable of reduction to explicit description.[4] Michael Polanyi gives several examples. In terms of explicit description, the ability to stay on a bicycle can be defined by a complicated mathematical formula. But it is quite unnecessary for the would-be bicycle rider to learn that formula. What is learned is the art of keeping one's balance. The knowledge represented explicitly by the formula is comprehended tacitly in quite a different way. By the same token, Polanyi argues, the knowledge of the expert chef is more than can be set down in a cookery book, learning to drive involves much more than

simply reading the manual, and competence in scientific investigation is not reducible to the explicit analysis of justification.[5]

Bartlett's earlier work on the mechanisms of memory can fruitfully be compared with that of Polanyi. It was he who, in his book, *Personal Knowledge*, and many subsequent publications, drew attention to the important role of tacit knowledge. Polanyi proposed that perception be understood not as the passive contemplation of objects but as a motor skill. Significantly, he used the sense of touch, rather than sight, as paradigmatic for the understanding of perception as a whole. With touch, the active, exploratory role of the perceiver is much more obvious than with sight or hearing. One example he frequently repeated was the use of a stick in the dark or by a blind man to feel one's way. The particulars of immediate sensation are the movements of the stick, but the user is interpreting these movements and the degree of resistance they indicate to identify the unseen features of the surrounding environment. Polanyi used the terms "proximal" and "distal" for the separate levels, contexts of meaning or objects of attention. The "distal" term is the object of exploration, the walls and floor of the surroundings. The "proximal" term is the particulars of the movements of the stick. The user's attention is directed "away" from the particulars of the "proximal" term towards their joint meaning given by the "distal" term. By means of this "from-to" structure of attention and inference, the particulars are integrated and given meaning by the object of attention. The stick becomes an extension of the user's body. The sensations conveyed by it become a part of tacit knowledge; they are assimilated to the structure of the sense of touch and used to comprehend the features of the surface in the same way as a hand might be used. The meaning of the particulars lies in what they jointly convey. To concentrate on the

particulars of the proximal term is to lose sight of the distal term, and with it the meaning of the whole, in much the same way as a proof-reader ceases to read for the meaning of the text in order to concentrate on the details of the type.[6]

Tacit knowledge, therefore, has a physical basis. The body, says Polanyi, is the one thing of which we are never normally aware as an object.[7] In our knowledge of things, the body is always subject. The tacit clues integrated in perception are bodily clues. Just as the stick becomes an extension of the body, the whole apparatus of tacit knowledge is an extension of the perceptual skills of the body. As the body is "indwelt", says Polanyi, so, metaphorically, tacit knowledge is indwelt. It becomes a tool for interpreting experience and the ability to interpret experience is, like tacit knowledge, a skill. A skill has no sharply definable boundaries or limits. It is the capacity to deal with a relatively indefinite range of objects in a relatively indefinite range of ways. The skills involved in knowing always involve more than can be reduced to description.

Tacit knowledge, then, is originally bodily knowledge. Memory arises from bodily feed-back mechanisms. Tacit knowledge is "indwelt" as the body is indwelt. The subject, which forms the fundamental element in tacit knowledge, is essentially the embodied subject. It may be that this provides a sufficient explanation of why such concepts as causation and substance, without being derivable from experience, are nevertheless present in all experience. We experience our bodies as substance and as causes. It is also, perhaps, the bodily nature of subjectivity which explains the priority of the global in perception and comprehension, the reason why it is the whole which is the primary level of meaning in any given context or situation, and the particulars are to be

understood by means of their relation to the meaning of the whole. The body forms an original unity, integrating the diverse particulars of sensation into a single meaningful awareness of the present situation.[8]

Because we are embodied beings, the physical, psychological and philosophical aspects of knowledge are all inter-related. A schema is to be understood, therefore, in three different ways:

a) as a neural feed-back mechanism, for equipping an organism to respond discriminatingly to the environment.

b) as the mechanism of memory: it organises the past in such a way as to provide a framework for the comprehension of the present situation.

c) as the unit of tacit knowledge: which, as we shall see, is organised in a quite different way from the explicit knowledge with which we are familiar.

2.The Cognitive Domain: Exemplars

A schema is the basic unit of memory and of tacit knowledge. It is both the means by which knowledge resulting from past experience is stored and by which it is made available in the present for the comprehension of new experience. Within the cycle of interaction by which information is perceived, understood and remembered for future reference, schemata have a number of related functions.

1. A schema provides a conceptual framework to enable comprehension and thus the assimilation of new information.

In any given act of comprehension, there will usually be a number of schemata operating at once. In reading a book, for example, the activity of reading depends entirely on the schema for reading, the ability to extract meaning from print. This not inconsiderable achievement must operate entirely unconsciously so as not to get in the way of the real task, which is to understand the particular text. But assimilating the information in the text depends on another schema, that which expresses the reader's prior understanding of the subject area. If the area is entirely unfamiliar, the reader may begin by picking up information at random and endeavouring to make sense of it by the use of some other related area which he or she understands better. But quite early in the process the random pieces of information begin to acquire some shape of their own, a rudimentary understanding of the subject begins to form and a new schema is born. The schema then begins to provide an outline of the subject, and new information is assimilated to and helps to fill in the gaps in that outline.

2. A schema generates a series of anticipations or expectations which direct the understanding.

Most people notice that as they become more familiar with a subject, their speed of reading increases. The greater the familiarity of a given subject, the more efficient is our comprehension. This is because the schema, by providing a framework for comprehension, actually guides the search for new information. It closes off alternatives which we grow to recognise are less likely. New information begins to become more "predictable". This is why a good writer must always clearly signal, by the way he introduces it, information which is novel, which disrupts or goes beyond the framework of understanding he expects of the reader.

The role of schemata in providing both a framework of understanding and an expectation of what is coming next is seen more clearly still in fiction. Take, for example, the following three sentences:

1. Mary heard the ice-cream van coming.
2. She remembered her pocket-money.
3. She rushed into the house.

The fact that these three sentences describe a comprehensible sequence of events is due to the role of schemata. These supply the facts which are required as essential background, that people like ice-cream, that ice-cream is bought with money and that money is often kept in houses.[9] In addition, we expect a story. We expect that the three sentences will have something to do with each other, and on the basis of this expectation we construct for ourselves a context which includes motives and feelings. If, in place of "ice-cream

man" and "money", we were to read "teacher" and "homework", the motives and feelings supplied might be very different. What is true in the case of reading is also true in the comprehension of situations in life. Here too, experience must be assimilated to a pattern of meaning before it can make sense.

3. Schemata guide actions.

A visit to the dentist, for example, consists of a typical sequence of events. After a few visits, we construct a schema, which specifies the need to make an appointment, to check in a few minutes before the appointment is due, to wait in the waiting room, to bring something to read if we don't want to be bored, etc. The schema supplies rules for actions and decisions, such as "If it goes on hurting, contact the dentist". It also tells us the way the dentist is supposed to carry out his role - firmly but with sympathy without being too apologetic, making light conversation but nothing too personal, and so on. In this way schemata enable us to cope with life by reducing its unpredictability and giving us a modicum of confidence and control of our own destiny - even in the dentist's chair![10]

Learning takes place whenever a schema is modified to take account of a new situation or of new aspects of an already familiar situation. Conversely, learning is to be understood as the modification of schemata, and it is something which is taking place all the time. The psychology of learning will be concerned, therefore, with the way in which schemata change. But before we can study the way schemata change, we need to know what they are like. The question at issue is the way knowledge is represented in the mind. A schema is a "data structure". If we want to know the form in which knowledge is

stored, what knowledge "looks like" in its tacit form, then the answer is to be found in terms of the "structure" of schemata, the way in which specific items of information are related to one another within the overall schema.

Before embarking on the analysis of schemata, however, two distinctions must be made:

1. A distinction between the form in which knowledge is represented and the means by which it is processed. Tacit knowledge may be understood either as a product, by concentrating on the way it is organised, or as a process, by looking at the way it is used. In practice, this distinction is difficult to maintain, since schemata are actively organised data structures in which the means of processing is actually included in the way the knowledge is represented. However, it is important to bear the distinction in mind, so that, in concentrating on the form in which tacit knowledge is represented, we are not led to think of it as simply inert or reproductive.

2. A distinction between the cognitive or intellectual aspect of mental functioning and the affective or emotional domain. In the section to follow, we shall be concentrating on the purely cognitive aspect of knowledge representation, but this is not to forget the powerful effects of emotion on cognitive activity familiar from everyday life. Later in the chapter, it will be necessary to examine in greater detail the affective domain and its relation with the cognitive.

3. A question which emerges from the consideration of these two distinctions is, What is the relationship between them? Is it possible to divide the cognitive and affective domains of intelligence along the same lines as the product and process aspects of cognitive functioning, to see the form of representation as the cognitive aspect and to

identify affective factors supplying the motivation or mental drive for the various acts of processing, such as recall and comprehension? Such a simple division of function is to be avoided. Just as representation and processing go hand in hand, so we shall find both cognitive and affective elements on both sides of the distinction.

A major contribution to the understanding of the way knowledge is represented in the mind comes from the work of Thomas Kuhn.[11] Kuhn's central concern is the form of knowledge shared by a given scientific community. His starting point is the assumption that what defines a scientific community is the knowledge it holds in common. Conversely, any group which holds a given body of knowledge as common property is a scientific community. Such communities exist at different levels, from all scientists, down through all biologists or all physicists, to all nuclear physicists, to all working in a given specialist field, to a particular laboratory team. Kuhn's concern was to discover the form in which the knowledge which provides the community's cohesion and identity is held, and the way in which it is passed on to or learned by the novices or apprentices within the community.

Explicitly, this knowledge consists in a set of formalisms, or symbolic generalisations. Kuhn gives the example from physics, $f=ma$. Another famous example might be $e=mc^2$. Apprenticeship in the scientific community consists of the learning of these generalisations and their application to concrete scientific problems. But it was at this point that Kuhn found again and again that his students' understanding broke down. Having read and understood the text-book's explanation of a new topic, they were, nevertheless, frequently unable to do the example problems at the end of the chapter. The theoretical relations were perfectly clear and coherent; it was their application to reality

which was causing problems. A full understanding of the concept required more than the ability to manipulate certain formal rules. It required also the ability to apply these rules to experience, and this, Kuhn concluded, did not come automatically with the understanding of the rules. Complete comprehension includes the application of the tacit element in knowledge, the ability to "see" the way the rules relate to experience.[12]

What Kuhn found was that students were frequently able to do the problems they found so difficult, not by simply applying the rules they had learned, but by spotting a resemblance between the new problem and an old, familiar one. The problems given in textbooks, he pointed out, are frequently variations on a few standard examples or "exemplars". Students extend their knowledge, not simply by learning new symbolic generalisations, but by increasing their stock of exemplars. This is done by making connections between them, by observing points of similarity, and so by extending the old, familiar exemplar, by small steps, to cover new situations.

> The student discovers, with or without the assistance of his instructor, a way to see his problem as *like* a problem he has already encountered. Having seen the resemblance, grasped the analogy between two or more distinct problems, he can interrelate symbols and attach them to nature in the ways that have proved effective before. The law-sketch, say *f=ma*, has functioned as a tool, informing the student what similarities to look for, signalling the gestalt in which the situation is to be seen. The resultant ability to see a variety of situations as like each other, as subjects for *f=ma* or some other symbolic generalization, is, I think, the

> main thing a student acquires by doing exemplary problems, whether with a pencil and paper or in a well-designed laboratory.[13]

Kuhn went on to describe instances of scientific progress which came about through the application of a generalisation originally worked out in one area to a new area of investigation. He gave as an example the extension of the principle first worked out for the pendulum first to an inclined plane and then to problems in hydraulics.[14]

An "exemplar" is a form of knowledge in its own right. In fact, Kuhn hypothesises that the difference between scientific communities, particularly between closely related communities, is a difference of exemplars. Each community shares a slightly different set of working examples which comprises its basic working knowledge. The ability to acquire an exemplar, to add it to the stock of one's working knowledge, depends on the perception of a similarity relationship. The student learning to solve a novel problem is not so much applying explicit rules from symbolic generalisations to particular examples as looking for a familiar pattern in an otherwise jumbled or incoherent scene. The student's situation is similar to that of the radar operator, searching for a meaningful pattern of signals against a background of "noise". But the ability to perceive such similarity is independent of and prior to any explicit rules specifying similarity with respect to what. The analogical sensitivity, or ability to spot similar patterns is, Kuhn maintains, original, prior to explicit formalisation.

Having established the relevance of exemplars to scientific knowledge, Kuhn goes on to explore their place in everyday life.[15] A young child learns, by means of ostensive definition, how to group the objects of experience into categories, how to

differentiate water-birds, for example, into the separate categories of ducks, geese, and swans. In the course of this learning, he acquires the expectation of being able to sort objects into "natural families", distinct categories separated from neighbouring families by a "perceptual space". He learns to expect to be able to place any new object in one of these families, and not to find a bird half-way between duck and swan. The existence of natural categories as a basic form of cognitive organisation has been confirmed by the work of Eleanor Rosch and associates. "Bird", for example, is a category with a large number of members, grouped into sub-categories. Some of these, she found, are generally thought of as prototypical of the overall categories. In the case of birds, robins are usually recognised as prototypical, while chickens, although still classified as birds, are more peripheral members. While distinct, however, natural categories are also open-ended. Rosch found disagreement over whether pumpkins, for example, ought to be classified as fruits or leeches as insects.[16] In different cultures, there will be different "natural" distinctions. It is well known that Eskimoes recognise 15 diferent varieties of what we simply call "snow". Understood in this way, concepts are essentially "open-textured". They are not firmly bounded by explicit definition, but gradually and pragmatically organised by the accumulation of experience.

3."Frames" and the Structure of Schemata

For the further development of these ideas, it is necessary to turn to the field of artificial intelligence, and in particular to a paper by Marvin Minsky in which he introduces the idea of "frames".[17] The particular subject of the paper is the use of computers to simulate visual processes, but its potential application is much wider, since what Minsky does is to propose a theoretical framework by which to understand the way the knowledge required for the simulation of vision is represented. What Minsky calls "frames" are comparable, therefore, with exemplars or schemata, and Minsky explicitly states that his work is to be seen as an attempt, in the tradition of both Kuhn and Bartlett, to investigate the representation of knowledge in memory.[18] A "frame" is a data structure which represents a given stereotyped situation. It includes certain types of information, in particular information about how the frame itself is to be used, expectations of what is likely to happen in a given situation and possible alternatives in the case of these expectations not being fulfilled.

The basis of the frame, in Minsky's terminology the "top level", is the information which is always true of the situation to which the frame relates, such that if the expectations specified by this information are not fulfilled, the frame is rejected and a new one sought. In a frame for a room, for example, walls, floor and a ceiling are mandatory. If they fail to appear, then the expectation, on opening a door, of finding a room on the other side must be revised: a coal-cellar, perhaps, or else a roof-garden. Similarly, if a restaurant is expected, but no chairs or tables found, expectation switches to something related, perhaps a bar or disco. Items at "lower levels", however, are not

specified. A room may be decorated and furnished in a variety of different ways, according to its function. The frame for a room leaves such items to be filled in, and they may serve as clues to the function of the room in question. Conversely, expectations about the function of a room lead to expectations about the appropriate furniture and decor. Such expectations are termed "default assignments", items of information about the setting or situation sketched in according to expectation rather than observation. We are reminded here of Bartlett's experiments on perception, in which he found subjects supplying missing information according to their sense of what was appropriate.[19] Having discovered the bathroom on the upstairs floor of a house, for example, we normally assume the other rooms to be bedrooms with fair degree of probability. However, other possibilities, based on past experience, are also supplied by the frame, with varying degrees of probability. A study may have a high probability, or a model railway layout, depending on what we know of the occupant; an indoor swimming-pool is highly unlikely.[20]

The main problem of human cognition is the complexity of the world. In order to understand at all, it is necessary to simplify, to reduce the enormous range of experience to easily manageable proportions, while remaining sufficiently flexible to deal effectively with the novel and unexpected. This is what frames achieve. A frame represents a portion of reality by stereotyping it, by specifying as many as possible of the constant relationships while leaving the less important elements to be filled in. The basic level is relatively inflexible with respect to the particulars and the relations which make it up. A children's party is thus differentiated from an office party, a street party or a house party. Each of these typical situations or settings then generates a series of expectations

for the relevant variables, such as dress, food, entertainment, behaviour, number of participants and so on. Stereotyping is thus similar to "unitising".[21] The single unit which comprises a large amount of related information performs the same function as the frame. It is a device for bringing as much tacit knowledge as possible to the comprehension of a given situation, within the limits of the capacity of human intelligence. The frame thereby combines maximum flexibility with a stable overall framework.

The degree of stability required of one's overall mental world and the degree of flexibility one is able to tolerate will vary both from individual to individual and within the same individual in different situations and at different periods of their life. In a similar way, default assignments are open to individual peculiarities. As Minsky observes,

> Such default assignments would have subtle idiosyncratic influences on the paths an individul would tend to follow in making analogies, generalisations and judgements, especially when the exterior influences on such choices are weak. Properly chosen, such stereotypes could serve as a store-house of valuable heuristic plan-skeletons; badly selected, they could form paralysing collections of irrational biases.[22]

Like exemplars, it is clear that frames are a description of the cognitive aspect of what we began by calling schemata. Later papers in this tradition of AI take up Minsky's ideas under a variety of terminology, including "scripts" and "memory organisation packets", but the terminology of "schemata" occupies a central position.[23] Having dealt with Minsky's original paper in his own terminology, we will, therefore, revert to the use of

"schema". As Minsky makes clear, frames or schemata are to be seen as parts of larger systems. Schemata are both capable of division into sub-schemata and themselves embed in larger dominating schemata.

For example, the schema GIVE has three basic elements:

GIVER, GIFT and RECIPIENT.

Each of these is a schema in itself.

Thus GIFT includes, as well as GIVE,

BUY and WRAPPING.

BUY includes, not only

SHOP, or some variation specified in the schema,

but also MONEY, with all the intricate ramifications associated with it.

The schemata, GIVE and GIFT are also controlled by the relevant dominating schema, such as

CHRISTMAS, BIRTHDAY or WEDDING.

At the same time, GIVE is a variety of action, and is therefore controlled by the more basic schema, DO. DO includes specific variables such as

CAUSE and EFFECT, PURPOSE and RESULT,

which must be specifically instantiated in the case of GIVE.[24] Schemata are thus related to one another in a variety of ways. It is not simply a case of a hierarchy of levels, or the embedding of one schema within another, GIFT, for example, within GIVE.

The relations between schemata are multi-dimensional, these relations themselves specified by more abstract schemata.

A further problem is the mode of representation of knowledge by means of schemata. In giving schemata the titles, GIVE, GIFT and so on, it might seem to imply that knowledge is represented in verbal form. It has also been suggested that the mode of representation develops gradually through stages, from purely physical or "sensori-motor", through images to the final stage of symbolic representation.[25] Neither images nor symbols are sufficient by themselves, however. As Kant pointed out, the schema for a triangle requires a much richer conceptual representation than the image of a given triangle. It must be capable of generating the image of any possible triangle.[26] In the chessboard experiment, described in the previous chapter, the visual image was the same for all three participants, but one had a much richer conceptual representation of the meaningful games. Behind both pictorial and symbolic expression of knowledge is propositional or conceptual representation. What is meant here by "propositional" is not a given set of words but the conceptual content expressed by those words. This content might have been expressed by a variety of different sentences. Indeed, the composition of a sentence usually involves a considerable narrowing down of the potential meaning in the writer's or speaker's mind. It is possible to know in conceptual form "more than we can tell", more than we have the vocabulary to describe.[27] It has been shown that children learn their first language, not by learning a string of fixed word meanings, but by first conceptualising a given situation and learning subsequently to describe their pre-verbal conceptualisation in words.[28] This means that, rather than remaining fixed, word

meanings change in the course of intellectual development. The learning of shared ranges of meaning attached to words becomes the most powerful way in which the child's intellect is socialised.[29] The representation of knowledge in the mind is thus closer to a description of an image than to an image pure and simple, and it is this which accounts for the bewildering multi-dimensionality of the relations between schemata.

The representation of tacit knowledge is, therefore, entirely different from that of explicit knowledge. Explicit knowledge relies on images or verbal propositions, while tacit knowledge is represented at a more basic, pre-verbal, conceptual level. Kuhn wishes to make the point that the relation between categories or exemplars is one of similarity. Connections are made by means of the perception of similarity, prior to and independent of any formal rules to specify in what the similarity lies. First comes the analogical connection, then the formal rule expressing the relation. Tacit knowledge, therefore, does not require definitions or correspondence rules. Kuhn extends his example of the classification of ducks, geese and swans to make this point. To add to the cognitive representation of swans, as members of a natural family defined simply by experience, an explicit definition to the effect that "all swans are white" imposes rigidity on the category by placing a boundary around it to exclude anything not white. This rigidity adds nothing to the concept of "swan" which is not already achieved by the perceptual space between it and other types of birds, but it does make the category less useful as a heuristic device for future experience. The discovery of what appears to be a black swan forces the person for whom this rule is an integral part of the concept either to abandon "swan" as a natural category or to announce the discovery of a new family.[30]

The effect of such rules, which are a feature of explicit knowledge, is to distinguish between universals and particulars and between form and content. The definition sets up a universal ("white"), and adds a rule specifying its relation ("all") to the particular ("swans"). In contrast to the flexible, open-textured nature of tacit knowledge, explicit knowledge is formalised by the division of formal, universalisable properties, such as attributes, from the particular content to which these universals (contingently) apply. Tacit knowledge combines form and content in "natural" families, the representation of whose relationships is necessarily multi-dimensional, to form the basis of a flexible "model" of reality. Although necessary for hypothetical construction, form and content are, therefore, abstractions from the underlying form of tacit knowledge, which is essentially concrete.

"The logic of tacit inference" is thus essentially different from that of explicit inference, because the form of representation of tacit knowledge is different from that of explicit knowledge.[31] We can express this in a number of ways:

1. Whereas explicit knowledge requires a distinction between form and content, universals and particulars, these distinctions do not apply to tacit knowledge.

2. Whereas explicit knowledge is static, tacit knowledge is always in process. Explicit knowledge is like a single frame from a film compared, not with the film, but with the real thing.

3. Tacit knowledge is multi-dimensional. As a comparison, when we use a word in a sentence, we qualify its meaning by its context. On

> its own, the word has not only several possible meanings, but infinite shades of meaning, nuances, personal associations etc. Explicit knowledge is like a dictionary definition, while tacit knowledge is like a person's accumulated experience of the use of the word.

The process of learning has two aspects, *assimilation* and *accommodation.*[32] In the course of interaction, new knowledge is assimilated to the structure of the schema. In order to learn something new, the learner must *do something* to the new knowledge. To be learned, knowledge must be changed by assimilation to the schemata of the learner. Not only is the new knowledge changed, however, but the schema is also changed in order to *accommodate* the new knowledge. Learning changes the learner. In general, there are three possible stategies for dealing with new information:

1. Ignore it. This may be the result of a conscious decision. The information may be deemed irrelevant or uninteresting. Or it may be too threatening - the emotional or social consequences of attending to the new information may be seen as too great.[33] Alternatively, the information may be ignored because the individual is not capable of assimilating it. There exists no schema by which he or she could make sense of it. In this case, the information may not be noticed at all, or if noticed, passed over as beyond comprehension.

2. Assimilate it to the structure of existing schemata. In this case, there is the possiblity of "distortion" or "falsification". But the criteria by which a judgement will be made as to whether distortion has taken place can only be relative to a generally accepted

norm or expectation of what an individual should have learned in a given situation. Standards for small children's understanding regularly differ from those for adults, but even those for adults are governed only by social consensus, and individuals like artists frequently suggest new ways of looking at familiar things.

3. Accommodation to the perceived structure of the new information. That is to say that a new structure is created or an existing one modified in order to make way in the understanding for what is clearly seen as something new and previously not understood. This is, or is intended to be, the characteristic of formal learning, but all experienced educators appreciate that in practice accommodation is usually preceded by at least some degree of assimilation, which must be allowed for and if possible made use of.

In practice, all three strategies are likely to be found in differing proportions in any given learning event. In cases where the individual is in charge of his or her own learning, either because the learning is informal or participation in a formal situation voluntary, there is likely to be a decision, wholly or partly conscious, whether to ignore new information, assimilate it to previous understanding (thus ignoring whatever cannot be so assimilated) or to make the effort to accommodate and thus to change. Capacity to learn is thus determined to a large extent by the perceived need and the desire to learn, the factors that influence which are the subject of the next chapter.

4.Analogy and the Affective Domain: Salience

The previous two sections have dealt with the "cognitive domain" of the understanding, the way knowledge is represented by means of schemata with respect to classification and logical inference. But in the course of this exploration, it has become apparent that the forms of classification and logical inference proper to tacit knowledge differ in fundamental respects from those familiar to philosophers and logicians from their studies of explicit knowledge. The "logic of tacit inference" must be understood to be fundamentally different from the logic of explicit inference. Explicit processes are, in fact, abstractions from the the concrete, tacit base of information processing. The "confirmation" of a perceptual "hypothesis" is a lightning-fast, semi-automatic and multi-dimensional process, unlike the more laboured, conscious process of explicit inference and conclusion. Polanyi suggests that the process of discovery is similar to the process of perception. The scientist who brings coherence to a set of experimental observations by proposing a hypothesis is performing an operation similar to the use of "hypotheses" in perception. He is proposing that a particular phenomenon be "seen" in a certain way.[34]

The logic of tacit inference, it has been suggested, is analogical. That is to say, it depends on the perception of similarity relationships. The relationships in a particular given piece of new information, or some of them, are perceived to be similar to those of a familiar, previously comprehended situation or piece of information, and on the basis of this similarity a schema is selected for the comprehension of the new information. Thus, the science student works out the answer to a problem in a new field by applying the principles learned in the solution of an old problem, the scientist learns how to predict

and explain natural phenomena by seeing them as related to and thus *like* situations for which a formula or generalisation already exists, and people in everyday life learn to make sense of new situations by seeing them as variations on situations with which they are familiar.[35]

The similarity relationships by which tacit knowledge is related exist, we have insisted, prior to the formulation of a rule stating the respect in which two things may be said to be similar. First comes the analogical connection and only subsequently, if and when it proves to be necessary, is a rule sought to explain the similarity. As Kant pointed out, there can be no rules for subsuming under rules, which means that the faculty of judgement must be unanalysable, incapable of reduction to explicit analysis.[36] This, however, leaves a logical gap. The place of explicit rules of inference is taken by "intuitive fit", an unanalysable sense of the rightness of the analogical relationship perceived. It has frequently been noticed that the process of problem solution goes through a number of stages. First, the facts are absorbed and then follows a period of uncertainty in which possible solutions are tried out one by one. Frequently, all that results is perplexity, a sense of being "stumped". Often, however, the answer arrives in a "flash of inspiration" even at a time when the problem itself has not been under direct consideration, and with the solution comes a conviction, a "sense of rightness" about the proposed solution.[37]

The explanation for these familiar features of the process of tacit inference, the logical gap involved and its bridging by a sense of "intuitive fit", is to be found in the affective domain. What is proposed is that the information represented in schemata is not

limited to the kind usually included in the "cognitive" domain. It has already been suggested that it includes also procedural rules for the way the schema itself may be used. Here we suggest that, in addition, schemata include information pertaining to the affective domain, specifically a judgement of the information's importance or salience.

The effects of "perceptual salience" on the judgements of children have been demonstrated in a series of experiments by Richard Odom and co-workers. A typical experiment involves the use of cards carrying a variety of designs with four key variables - the number, form and colour of the designs and the position of each design on the cards. Each subject in the experiment is pre-assessed for the readiness with which they respond to each variable, in order to obtain a measure of the relative salience for each child of each of the variables. Odom found that in problems involving logical tasks performed with the cards, children systematically made less mistakes when the information relevant to the task involved variables which were more salient for them. In tasks where the information required for the solution involved a variable which was less salient for the child, mistakes were much more likely to occur. The ability of the child to concentrate on the task in hand was affected by the presence of salient but irrelevant information. On recall tasks related to logical problems, salient variable were typically remembered better than solution-relevant variables.[38]

Odom's contention is that it is not simply the ability to handle logical problems which develops with age, but the ability to process an increasing range of information. To demonstrate this, he ran an experiment in which an identical problem was given to 20 adults and 20 children. The problem, which was to be solved mentally from verbal instructions, included a sentence irrelevant to the correct solution suggesting the use of a

judgement of probability. Of the 20 adults, 17 accepted the sentence as relevant to the solution, used a probability judgement and, as a result, gave the wrong answer. Of the children, for whom the concept of probability was not a salient one, 19 solved the problem correctly. In a further test with 10 children, the salience of the probability information was increased by rephrasing the irrelevant part of the problem, and 9 out of 10 gave the wrong answer. This supports the contention that it was not because the children did not understand probability that they avoided paying attention to the irrelevant sentence and so arrived at the right answer. It was because, since they were able to handle a more restricted range of information than the adults, the concept of probability was not as salient for them as it was for the adults.[39]

Perceptual salience is also a factor in another, widely differing area of psychological investigation, attribution studies. Such studies form part of the field of social perception, which is itself part of the broader field of research into attitudes and attitude change. The topic under investigation in attribution studies is the attribution by experimental subjects of causal effectiveness to one or other actor in a role-played situation. They are asked to make a judgement as to which person is playing the dominant role in the conversation. The aim of the studies is to discover the factors which affect subjects' attribution of causality, as a guide to the factors which lie behind attitude and attitude change. The problem with perceptual salience is that, from a logical point of view, it is irrelevant. It is an unwelcome intrusive element in what the experimenter would otherwise like to understand as a judgement governed by rational considerations.

However, a series of studies have shown that perceptually salient features such as red hair, a loud shirt or a leg-brace worn by one of the actors in the role-played

situation has a systematically distorting effect on perceptions of their role. Various attempts at the manipulation of other factors showed that salience effects are not an isolated aberration, but a regular part of every such situation. The problem, then, is to explain them. A "cognitive" explanation would accept that salience is a part of the way information is represented. It is incorporated in the schema the subjects use to make their judgements of causal effectiveness, and this can only be because it is accepted as relevant by the schema. Experimenters unwilling to accept this conclusion must suppose that only logically relevant information is included in the schema but that the salience effect is a feature of the situation, which systematically interferes the "rational" operation of making a judgement.

Initial supposition that salience is a "top-of-the-head" phenomenon, characteristic of judgement under pressure, was shown to be doubtful when salience effects refused to disappear under a variety of different conditions. Nor were salience effects to be explained by differential amounts of attention, as measured by observations of eye movements. Although the salient actor did attract a disproportionate amount of subjects' visual attention, judgements of causality were unrelated to the relative amounts of attention given to each actor. A third possibility is that the influence of salience is mediated by the relative ease of recall of perceptually salient information. However, in circumstances in which less salient information is also recalled, the salience effect persists. A modification of this argument proposes that because visual information is relatively more salient, visually presented information is exaggerated at the recall stage, at which the attribution of causality is justified. But in order to have this effect, visually

presented information must be represented by a schema. Unless the schema is capable of representing this information as "more salient", it must fail to register or to be recalled.[40]

Despite a natural unwillingness on the part of the investigators to allow logically irrelevant factors a permanent place in the schemata for such attributions, it seems likely that perceptually salient information is being registered by the schema as conceptually important and thus tending to "bias" the schema in the direction of "non-logical" attributions of causality. This explanation, in which salience is a feature of the initial coding of information, is supported by a related study by Smith and Miller on attributions of causality in the comprehension of verbal material. They found a salience effect in the comprehension of sentences describing causal effectiveness which resisted modification by subsequent supplementary information and was not diminished in later recall tasks. Smith and Miller's conclusion is that comprehension of such sentences involves a single conceptual representation of the contents of the sentence, which includes the effects of the relative salience of the information given.[41]

The main conclusion to be drawn from studies of perceptual salience is that comprehension includes an evaluative element. The representation of information by means of schemata includes not only conceptual relationships but also an evaluative component. Dominance or relative importance is an integral part of the conceptual structure of the schemata. This conclusion is further supported by the extensive work to have been done in the field of selective attention. The earliest investigations concentrated on what was known as the "cocktail party phenomenon". A guest at such a gathering has the task of "paying attention" to one particular conversation in a room full of sound. This

is achieved by attending strictly to the words of the speaker with whom he or she is engaged and "filtering out" the rest. But if someone in another part of the room mentions the guest's name or if a neighbouring conversation turns to a topic of interest, concentration on the original conversation becomes more difficult and the effort of selective attention becomes conscious. Experiments were begun in 1953 by E.C.Cherry, who played recordings of different messages simultaneously to participants over headphones, varying the subject matter, voice and position of the messages between the right and left ear. The subject was instructed to "shadow" one of the messages, that is to repeat it, in order to divert attention from the other message, and the aim was to find out what characteristics, if any, of the "rejected" messages are retained. The results indicate that in fact surprisingly few details of the rejected message even register. "Crude physical characteristics", such as whether the voice is male or female, can usually be recalled, but an account of the material in the rejected message is hardly ever given. This, however, does not mean that the rejected channel is not heard. "Highly probable stimuli", such as cliches, the sudden appearance of something new, such as a new voice, and "emotionally important stimuli", such as the subject's name, frequently catch the attention.

Initial attempts to explain these results postulated various types of filters, processes by means of which information was filtered out at various stages of processing. The problem with these explanations is the difficulty of explaining the great variety of information which may get through on the rejected channel if the conditions are right. In particular, it is variation in the task demands of the experiment, the information the subject is asked to listen for, which most affects the range of information to be perceived. In 1973, Neville Moray put forward an explanation, which has still received little

attention, based on the theory of sampling. This is a model developed from the experience of aeroplane pilots, who are required to pay attention selectively to a wide range of instruments. The task requires the observer to construct an internal model of the source of information, which must include the likely importance of information coming in from various directions, and continually to update this estimate of the relative salience of different sources as the information is sampled. The observer constructs a strategy for the distribution of attention based on past experience of the characteristics of the various information sources.[42]

The idea of a hypothetical filter mechanism reflects an earlier, information-processing, approach to cognition. Moray and Fitter's theory moves in the direction of a broader, cognitive orientation, drawing attention to the employment of dynamic strategies in the search for information. Such strategies are directed by the relevant schema, the one which includes the information relevant to the situation in which the observer finds himself. A crucial and integral part of the relevant information provided by the schema is the relative importance of different parts of the environment or elements of the situation. Like every other piece of tacit knowledge, salience information is continually up-dated. Judgements of salience are and must be flexible. The conclusion to which we are led is that the representation of knowledge by means of schemata includes an evaluative, or essentially affective element, an estimate of the likely importance of a given piece of information.

5.Dissonance: A Cognitive Theory of Emotion

If evaluation is an integral part of the coding of information, then evaluation must have a considerable effect on cognition. One theory which offers the possibility of a description and perhaps an explanation of this effect is the theory of cognitive dissonance. As outlined by Leon Festinger in 1957, the theory is an attempt to explain the phenomenon of "dissonance" and its effects by constructing a cognitive model. It is an attempt to explain affective factors involved in judgement and decision-making in cognitive terms. In Festinger's terminology, a "cognition" is an item of knowledge. But cognitions may include not only facts and concepts, but also such things as beliefs, hopes, attitudes, likes and dislikes. Thus, if I happen to like animals, this knowledge is expressed in the cognition, "I like animals". Cognitions are related to one another in three possible ways:

1. They may be *irrelevant*, which is another way of saying they are not related at all, for example, "I like animals" and "My wife is wearing a blue dress".
2. They may be *consonant*, for example, "I like animals" and "We own a cat".
3. Or they may be *dissonant*, for example, "I like animals" and "I believe that dogs are dirty".

A relation of dissonance is said to exist between cognitions when the converse of one follows from the other. But dissonance is not the same as logical contradiction. "I dislike cats" would be not only dissonant with "I like animals" but logically contradictory. But

there is no necessary logical contradiction between "I like animals" and "I believe dogs are dirty". The dissonance is not logical but psychological, a definition much more flexible and difficult to define.[43]

Integral to the theory of cognitive dissonance is the proposition that there exists an inbuilt motivational drive to reduce dissonance. People tend to avoid dissonance, or, if it is impossible to avoid, to do everything possible to reduce the dissonance. Take, for example, a man who supports the Labour party, but whose wife votes Conservative. If the man is at all interested or concerned about politics, the cognitions, "I vote Labour" and "My wife votes Conservative" are potentially dissonant. To reduce the dissonance, it may be possible simply to avoid the issue, to come to an agreement with his wife not to talk about politics. Alternatively, the man can change his behaviour by voting Conservative, or seek to change his wife's behaviour. Festinger quotes examples of experiments in which subjects were asked to take part in "dissonant behaviour". They had to write an essay justifying a point of view with which they disagreed. As a result, many of the participants changed their point of view. Their attitudes changed in such a way as to reduce the dissonance aroused by their behaviour in the experiment. It is possible to argue that dissonance had nothing to do with this result, that the subjects simply convinced themselves of the merits of the opposite point of view. But some of the participants were offered a large sum of money for writing the essays, and follow-up tests found that these subjects had changed their points of view much less if at all. To engage in "dissonant behaviour" with the excuse of making money did not arouse feelings of dissonance. These subjects were able to write their essays "with fingers crossed". For the

others, it was the dissonance aroused by the experiment which produced the need to change their minds.[44]

Dissonance, Festinger argues, is not an isolated occurrence, but a regular feature of everyday life, and much of our behaviour can be explained by the attempt to reduce the dissonance between cognitions. Every disagreement and every decision involves an element of dissonance. In rejecting the possible good results of one particular choice in favour of its alternative, which may have a number of possible drawbacks, one incurs dissonance, and one of the features of subsequent behaviour will be to minimise this dissonance by taking steps to persuade oneself that one made the right decision. The extent to which this is the case will depend on the amount or magnitude of dissonance. The magnitude of dissonance is affected by the salience or importance of the cognitions involved. The degree of dissonance aroused by different political affiliations depends on how important a person sees politics overall. A man and wife of different political persuasions may have heated arguments or they may simply not care. The imminence or otherwise of a general election may also make a difference.[45]

Dissonance theory, then, offers the possibility of a theoretical framework within which the relation between affective factors, such as likes, dislikes and attitudes in general, and cognitive representation might be explored. A number of problems arise, however, in connection with its application to experience. One of the most important is the near impossibility of either defining dissonance or predicting its occurrence. Although it includes logical inconsistency, dissonance is not the same thing, and cannot, therefore, be so tightly defined. Nor can dissonance be predicted simply by the

observation of external factors. Dissonance arises as a result of the interaction of the individual and his or her circumstances. If, as a result of past experience, a person has come to dislike dogs, then the experience of being asked to look after a friend's dog is likely to arouse dissonance. It is not the request itself which gives rise to the dissonance, but the schema which says, "Dogs are dirty, potentially fierce and a nuisance." Dissonance cannot be defined because it depends on the individual's past experience.

This difficulty draws attention to the close connection between dissonance theory and the features of cognitive theory discussed so far. As well as being explicitly cognitive, the theory is also implicitly interactionist. In particular:

1. It is the interaction between the individual's schema and the external situation which decides the occurrence and the magnitude of dissonance.

2. The strategies available for dealing with dissonant information are closely related to those discussed in relation to the learning of any new material. Dissonant information can be ignored, or it can be reinterpreted in such a way as to reduce the magnitude of dissonance (assimilation), or it can be accepted and the dissonance reduced by a change in behaviour or in related opinions or beliefs (accommodation).

3. The "magnitude of dissonance" depends on the importance or salience of the cognitions involved.

A second problem concerns the motivation for dissonance reduction. The theory itself does not attempt to explain this; it simply asserts such a motivation. In some cases at least, the very existence of dissonance is dependent on motivational factors. Festinger gives the example of a gambler who knows he is losing and likely to continue to lose, and

yet goes on playing. The cognitions, "I am losing" and "I am still playing" are only dissonant given the assumption of a third cognition, "I intend to win".[46] To explain the supposed drive to reduce dissonance, another source of motivation must be postulated. In other words, dissonance must be placed in the context of a broader motivational theory.

It is not difficult to discern what this broader context must be. To take another of Festinger's examples, the cognitions "I am a smoker" and "Smoking is injurious to health" are dissonant only in the light of a third cognition, "I am a rational person and intend to maximise my own health".[47] In other words, the existence of dissonance depends on a suppressed premise about oneself. The broader context required by dissonance theory is a theory about self-perception or self-image. This conclusion can be supported by the findings of the series of experiments on the influence of dissonant behaviour on attitude change. The tendency of subjects asked in the experiments to tell lies or to express support for a point of view opposed to their own subsequently to change their attitudes has frequently been confirmed, but with the proviso that this change of attitude only takes place when the subjects perceive their behaviour as freely motivated. In cases where the subjects were able to attribute their behaviour to some other factor, where, for example, a large sum of money was offered, no such change takes place.[48] This finding brings dissonance theory into the field of self theory. The explanation of motivation involved is the need to maintain coherent self-image and high self-esteem.[49]

6.Attitudes and Affective Processing

The coherence and stability of self-image is expressed in the phenomenon of attitudes, whose defining characteristic is the stabilising effect they exert over an individual's behaviour, opinions, values and general orientation. An attitude was described by Gordon Allport as "a mental and neural state of readiness to respond, organised through experience, and exerting a directive and/or dynamic influence on behaviour".[50] William McGuire describes an attitude as a heuristic, an informal empirical theory whose function is to comprehend a given situation by means of generalisation and simplification.[51] An attitude is, therefore, a schema, an "active organisation of past reactions", a means of simplifying or stereotyping experience for easier comprehension. But an attitude is also implicitly evaluative. By means of attitudes, situations are not only comprehended but also evaluated and behaviour thus directed.[52]

An attitude is an affective or emotionally organised schema. Take, for example, a man's attitude to his work. The schema will include a number of beliefs and items of information of varying degrees of salience. The job may be well-paid or it may be particularly difficult or carry a certain amount of status. These are likely to be salient items. The fact that he has flexible working hours or congenial colleagues may be more or less salient. Other items, such as the form of the works football team, may not figure as important at all. Attitudes are based on the evaluation of the attributes expressed by the most salient beliefs about a given element of experience. The man's attitude to his work is based on his evaluations of the salient set of beliefs. The attitude expresses his relative

evaluation of the different aspects of the job. He may either resent the difficulty of his job or value this aspect highly for the self-esteem it gives.[53]

The function of an attitude is to provide evaluative coherence in a given situation. This it does by imposing an evaluative gestalt on the various beliefs which comprise the situation. As long as the evaluation of the salient beliefs is favourable, a man may be able to take the less desirable elements of his work in his stride. But some change in the situation, a difficult new boss for example, might jump quickly to the top of the salience league, downgrading the more positive aspects of the job and giving greater significance to the negative aspects, previously overlooked.

To understand attitudes as affectively dominated schemata is to emphasise the importance of the evaluative dimension in cognition. Salience is to be understood, not as an extraneous biassing factor, but as a fundamental component, without which cognition could not operate at all. Without the capacity to make judgements of relative importance, such essential features of cognition as selective attention would be impossible. The importance of affect in cognition is, moreover, well supported in the literature. Bartlett's studies of the processes of reconstruction in memory, for example, highlight the role of what he called a global "attitude" as the basis around which the reconstruction takes place. This "attitude" was an affective gestalt, which Bartlett called a complex psychological state, difficult to break down. In the process of remembering narratives after a passage of time, first would come a salient detail as the key to the overall "feeling" of the passage. Details would then be filled in in accordance with or even in justification of the original feeling, with the result that any given story would be retold in a wide

variety of ways corresponding to the various attitudinal reactions of the different hearers.[54]

Further evidence for the importance of affective processing comes from experiments concerning the phenomenon of "perceptual defence".[55] In these experiments, subjects were presented with words for visual recognition and verbal response, but by measuring at the same time the subjects' psychogalvanic responses, it was found that in the case of some words, physiological reaction actually took place before the word was recognised. The words where this pattern of response was noticed were those with threatening or taboo associations. In these cases, the affective reaction, apparent from the psychogalvanic response, occurred more quickly than the cognitive processes necessary for recognition. Subjects appeared to respond emotionally to the taboo words before they had had time to read them! This conclusion makes no sense if it is assumed that emotional reactions must be subsequent to and dependent on cognition. But if, as the evidence of Bartlett's experiments suggests, cognitive processes are dependent on a framework of direct, "global", affective processes, then the "perceptual defence" hypothesis and other related findings fall into place. Not only is affective processing fast and inescapable, but it forms the framework for the cognitive aspects of communication. During the course of a conversation, for example, affective messages difficult to express in either words or conceptual form are conveyed fast, accurately and for the most part subconsciously by means of bodily and facial gestures.

These observations on affective processing help to explain the way in which attitudes gather up a variety of cognitive material, including facts and beliefs, within an

overall affective framework. Schemata, it was noted above[56], are related to each other in a variety of ways. In some cases, schemata "embed", in the sense that one schema may form a sub-schema of another. By imposing upon a number of beliefs and items of experience an evaluative gestalt, attitudes form dominating schemata over the whole range of experience. In doing so, attitudes affect cognition in fundamental ways. As John Hull comments,

> The emotional value which is placed upon a construct must not be thought of as a mere feeling which is so to speak painted on the surface of an idea and which remains the same whatever colour it has...If I disapprove of fox hunting, I will place the construct in a constellation together with bull fighting, bear baiting, gladiatorial contests and other forms of inflicting cruelty for entertainment. If I approve of fox hunting, I will associate it with healthy outdoor life, the love of the countryside, the old English traditional values and so on...The fox hunting of which somebody approves is actually known in quite different a manner from the fox hunting of which somebody else disapproves.[57]

Attitudes provide evaluative coherence in specific areas of experience, but attitudes are themselves the sub-schemata of a further dominating schema, the self. Attitudes mediate between the self and specific areas of experience, such as work, family, members of the opposite sex, politics, religion, foreigners, animals, sport and so on. This is the explanation for the relative inflexibility of attitudes. Just as the suppressed premise behind the experience of cognitive dissonance was a particular self-image, an attitude to a

particular area of experience also reflects an implicit self-evaluation. The man who is discontented with his job may consider himself capable of achieving more in the way of satisfaction or financial reward. The man who dislikes foreigners probably considers himself threatened in some way by their obvious difference from himself. Attitude change is difficult, because it involves a change also in the underlying self-evaluation, and this may be the subject of strenuous defence.[58]

Affective processing is the leading edge of cognition. It is fast, inescapable, irrevocable and although pre-conceptual, is very effectively communicated. Affective processing is independent of cognition. Not only do studies reveal separate reaction times for cognitive and affective processing, but attitude change is more effectively brought about by the alteration of affective rather than cognitive components, by changing the way a person feels about something rather than the way he thinks about it.[59] Cognitive organisation arises as a more differentiated intermediary within affective processing. In the case of babies, all they have is affective responses and limited but effective emotional communication. Cognitive responses develop as mediators within the framework of such affective response and communication, but they never replace it.[60] The key to the problem of "intuitive fit" is thus affective processing. The analogical relationship accepted as appropriate to the situation or problem to be comprehended is the one that "feels" right. Explicit, rule-governed inference may enter subsequently to give an account of the relationship, but it can never fully explain it.[61]

Notes

1. *Pure Reason,* B171-174, p.177-178.

2. *Blue and Brown Books*. p.5.

3. Bartlett, *Remembering*, p.198-201.

4. *op.cit.,* p.202

5. *Personal Knowledge.* p.49-50, "Logic of Tacit Inference", p.6-7, *Knowing and Being.* p.144.

6. Polanyi, *Tacit Dimension*,p.12-13; "The Logic of Tacit Inference".

7. *Tacit Dimension.* p.16.

8. See Hamlyn, "Perception and Agency", *Perception, Learning and the Self*, p.53f. This article originally published in *The Monist 61*, 1978, p.536-547.

9. Rumelhart and Ortony, "The Representation of Knowledge in Memory", p.113.

10. R.C.Schank, "Language and Memory", in *Perspectives*, ed.Norman, p.121f.

11. Kuhn's argument is to be found set out most fully in "Second Thoughts on Paradigms", *The Essential Tension*, p.293-319.

12. See J.Searle, "Minds, Brains and Programmes", p.417-457, for a detailed argument on why the manipulation of formal rules does not amount to understanding. Awareness of the relationship between knowledge and the world represented by it is a part of the tacit foundation of knowledge and cannot itself be represented. See above, p.65-66.

13. Kuhn, *Structure,* p.189.

14. "Second Thoughts", p.301-306; *Structure,* p.187-191.

15. "Second Thoughts", p.308-318.

16. Anderson, *Cognitive Psychology and its Implications,* p.129-137. Rosch, "Cognitive Reference Points", p.532-547; Rosch and Mervis, "Family Resemblances: Studies in the Internal Structure of Categories", p.573-605.

17. Minsky, "A Framework for Representing Knowledge".

18. *ibid.* p.213.

19. See above, p.53f.

20. Minsky, *op.cit.* p.211-213,221-227.

21. See above, p.58.

22. Minsky, *op.cit.* p.228-229.

23. Neisser, *Cognition and Reality;* Schank and Abelson, *Scripts, Goals...*; Norman, Gentner and Stephens, "Comments"; Rumelhart and Ortony, *op.cit.*; Rumelhart and Norman, "Accretion, Tuning and Restructuring"; Schank, "Language and Memory"; Abelson, "Script Concept".

24. Rumelhart and Ortony, *op.cit.,* p.102-105.

25. Bruner, *Toward a Theory of Instruction,* p.10-21.

26. Kant, *Pure Reason,* A140-142, B180-181, p.182-183.

27. Polanyi, *The Tacit Dimension,* p.4; see Schank, "Conceptual Dependency"; Pylyshyn, "What the Mind's Eye Tells the Mind's Brain".

28. Macnamara, "Language and Learning",p.1-13; Bruner, "Ontogenesis".

29. Vygotsky, *Thought and Language; Mind in Society.*

30. Kuhn, "Logic of Discovery or Psychology of Research", see "Second Thoughts", p.313-317.

31. Kuhn, *Structure,* p.191f.

32. The use of the terms "assimilation" and "accommodation" to describe the action of the mind in cognition was originated by Jean Piaget. Piaget's theory, however, cannot be accepted without considerable modification.

33. On dissonance, see below, p.98-101.

34. Polanyi, "Logic of Tacit Inference", p.1f.; *Knowing and Being*, p.138f.

35. Kuhn, *Structure*, p.191f.

36. Kant, *op.cit.,* A132,B171,p.177f.

37. See Loder, *Transforming Moment,* p.20f. and 29-39. Loder points out that the traditional, logical account of thinking processes, for which he uses the scheme of John Dewey from *How We Think* as an example, fails to describe the experience of bafflement and sudden discovery. Loder summarises Dewey's outline as follows:

1. The sense of a problem.

2. The rational formulation of the problem.

3. Exploration of the problem by means of hypotheses.

4. Selection of the most likely hypothesis.

5. Testing of the hypothesis.

As an alternative, Loder proposes his own outline:

1. Conflict: the sense of a problem important (salient) enough to warrant attention.

2. Interlude for scanning, waiting, wondering, perhaps following hunches.

3. Constructive act of the imagination.

4. A sense of release from the constraint of the problem situation.

5. Interpretation of the felt solution for its implications.

This process can be illustrated from the biographies of several great scientists who have had an Archimedean "Eureka" experience, scientists such as Poincare, Kekule, Einstein and Schrodinger. The case of Einstein is particularly interesting because for some time the text-book presentation of the discovery of relativity represented it as a response to the Michelson-Morley experiment, whose results appeared to contradict the laws of Newtonian physics. In Einstein's biography, however, the discovery of relativity is described as the result of a sense of paradox which first occurred to him at the age of 16. This was followed by ten years reflection, before the solution emerged. The fact that it was philosophical reflection and not empirical research which led to this discovery is emphasised by Michael Polanyi(*Personal Knowledge*, p.10-11). It is an example of the

distortion of what is basically a psychological process by the imposition of the logical criteria of explicit inference.

38. Odom and Guzman, "Problem Solving and Perceptual Salience"; "Development of Hierarchies"; Odom and Corbin, "Children's Problem-solving"; Odom, Astor and Cunningham, "Effects on the Matrix Task"; "Adults thinking..."; Odom, "Decalage Relations and Developmental Change", *Alternatives to Piaget*, ed.Siegel and Brainerd.

See also Donaldson, *Children's Minds*, p.65-69, for a further example of the influence of salience on children's reasoning.

39. The problem, which both adults and children were asked to solve mentally, is as follows:

Imagine that I have two cans. One has red beads in it and it is called the red-bead can. The other has blue beads in it and is called the blue-bead can. There are the same number of red beads in the red-bead can as there are blue beads in the blue-bead can. Let me repeat that. There are the same number of red beads in the red-bead can as there are blue beads in the blue-bead can. Now imagine that I dip a cup into the red-bead can and take out five beads. I pour them into the blue-bead can. Then I mix up all the beads in the blue-bead can. I then dip the cup into the blue-bed can and take out five beads and pour them into the red-bead can. Will the number of red beads in the red-bead can and the number of blue beads in the blue-bead can be the same or different?

The sentence, "Then I mix up all the beads in the blue bead can," is irrelevant to the correct solution. Its effect, however, is to trigger the attempt to reach a solution on the basis of probability for those for whom probability is a salient concept (the adults). As a

result, those adults who gave the wrong answer were, in effect, answering the wrong question. The irrelevant sentence in the problem led them to estimate the probability of all the red beads returning to the red-bead can, which is very low, leading to the answer "different", which is incorrect. The correct answer is, "The same", since for every blue bead transferred to the red-bead can a red bead remains in the blue-bead can.

40. Taylor and Fiske, "Point of View and Perceptions of Causality"; Taylor et.al., "Generalizability"; McArthur, "Illusory Causation"; McArthur and Ginsberg, "Causal Attribution"; Taylor and Thompson, "'Vividness' Effect"; Fiske, Taylor and Kenny, "Structural Models".

41. Smith and Miller, "Salience and the Cognitive Mediation of Attribution".

The article by Henle, "On the Relationship of Logic and Thinking", is a classic study of the prevailing influence of conceptual salience over logical analysis in adults.

42. Barber and Legge, *Perception and Information;* Norman, *Memory and Attention;* N.Moray, *Attention;* Moray and Fitter, "Theory"; Neisser, *Cognition and Reality;* M.de Mey, *The Cognitive Paradigm*.

43. Festinger, *Cognitive Dissonance,* p.9-15.

44. *ibid.,* p.84-122.

45. *ibid.,* p.3-9.

46. *ibid.,* p.13.

47. *ibid.,* p.4-5.

48. Tedeschi, Schlenker and Bonoma, "Cognitive Dissonance"; Fazio, Zanna and Cooper, "Dissonance and Self-Perception"; Greenwald and Ronis, "Thirty Years of Cognitive Dissonance"; Frey et.al.,"Discrepant or Congruent Behaviour".

49. Greenwald and Ronis, *op.cit.,* p.54-55.

50. Allport, "Attitudes", p.798f.

51. McGuire, "Attitudes and Attitude Change", p.159.

52. See McDonagh, "Attitude Change and Paradigm Shifts". McDonagh draws a parallel between attitudes and Kuhnian paradigms, or *formal* empirical theories.

53. Fishbein and Ajzen, *Belief, Attitude, Intention and Behaviour,* p.14-16.

54. Bartlett, *op.cit.,*p.61-62,206-207; see Minsky, "K-lines".

55. Vernon, *Perception,* p.212-217. See also the "subception" experiments mentioned by Polanyi, *Tacit Dimension,* p.7-9,95-97.

56. See above, p.86-87.

57. Hull, *Christian Adults,* p.106. Hull is discussing Kelly's personal construct theory.

58. See further p.131f.

59. The evidence is reviewed by Zajonc, "Feeling and Thinking".

60. *ibid.,* p.169-170.

61. One of the few philosophers to allow the role of intuition in thinking is A.C.Ewing. Ewing points out that the process of deduction depends on the observation of a connection between the various steps in the argument, A_B_C. Even if the process is broken down into smaller steps by the addition of further values, A_D_B_E_C, a logical

gap still remains between A and D, D and B etc. However small the gap, the connection remains intuitve. We must be able to "see" the validity of the particular law of logic. (*Value,* p.41f., *Fundamental Questions,* p.48f.) In *Non-Linguistic Philosophy,* p.34-66, Ewing argues for the presence of intuition in induction, ethics and the apprehension of a whole as a whole as well as in deduction.