10. On Knowing - Feeling and Expression

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The basic assumptions for CAD, and for any use of computers, are re-examined. They refer to how we know things, how we think of knowledge being represented, and the impact of representation techniques on evolution of knowledge. Japan offers stimulating clues on how we might regard the usefulness of computers, and these are explained. Evocative illustrations are presented, to show a direction for future developments.

Introduction

Here follows a plea for something different: a shift of emphasis away from techniques inside computers, and towards thoughts on how we envisage computers being used. After long experience in design and CAD, it is now time to look again at the intended relationship between computers and designers.

The activity of designing employs knowledge in a way which does not rest on fixed demarcations between abilities of a technical kind and our aesthetic sensitivities. As I will try to show later, interaction between persons engaged in designing depends on affinity between each other. Computers are logically determinate machines, materially very different from ourselves, so they are inherently insensitive to *our* knowledge. What, then, do we think about the possibility of designers using computers?

Computers do perform useful tasks for people, but do we have to think of them being like people? What different expectations ought persons to have of computers and of other people? Might the differences tell us something about the kind of usefulness we want from machines?

We are familiar with the strong association between computers and knowledge - the notion of knowledge being represented and acted upon within computers.

We are also familiar with the notion of aesthetics. I use this term to refer to all such human feeling as we are not able to externalize in logical form, as in the form of logically articulated written words, or mathematics. It refers to knowledge in mind, and expressions with evocative intent - normal occurrences indicated by ordinary human behavior. Designers and other persons from the arts quite properly exercise such behavior professionally.

My central question, and it is a very general one, is illustrated in figure 1. Can knowledge within a person be externalized, detached, and realized in a machine, so that it will show intelligent behavior as though from the person? The reference to aesthetics in my figure makes this question very difficult.

Figure 1. Externalizing Knowledge?

These questions are not helped by partisan arguments over contending representational strategies in computers. Differences at that level, as between classical logic, production systems, frame systems, semantic networks, and neural networks, do not alter the logically determinate nature of computers. Few researchers now claim that we can define a single coherent logic which accounts for our knowledge.

Paradigms such as object oriented systems, hypermedia, and machine learning get closer to these questions. They offer metaphors by which people might gain some appreciation of functionalities available from within computers. But too often these paradigms are accepted too quickly as justification for developing particular computational techniques, based on assumptions hidden from users. They entail assumptions which rest uneasily with people's ordinary knowledge.

More critically, developments aimed at standardization and data exchange, associated with product modelling, imply dangerous assumptions about routine design separated from innovative design. Over time, given unforeseen changes in demand, responses from designers have to be innovative even in 'mundane' fields of design. If innovation is inhibited then designing will not be possible.

Stimulus From Japan

Why do we need to trouble ourselves with these questions? Many people in AT will claim there are different kinds of knowledge, and certain kinds can be realized in machines. That position presumes clear demarcations between kinds of knowledge, which can be explained to users of computers. Knowledge can then be detached from persons and hidden within computers, and computers can be made to act autonomously so as to determine the actions of persons. We ought to consider what all this implies. What can motivate a computer's actions, in whose interests, and with what responsibility? What will be the effect on people's normal evolution of knowledge?

We need to think about knowledge: how it might occur within persons, how it is made evident and shared between persons, and how it is used in the actions of persons. It is on these points that I found my recent visits to Japan very stimulating - there I found a fresh perspective from which to reassess common Western notions about knowledge.

The special quality found in Japan I think is largely attributable to its long period of closure, for over 200 years, up to 1868. That period of closure, of isolation, engendered the homogeneity of its population (the Japanese Spirit), its sense of togetherness, its suppression of individual difference; and closure preserved the Eastern blending of material and

spiritual sensitivities. These effects are passed between generations, and they are still evident today. The quality found in Japan is special in being combined with (and providing a necessary basis for?) its material success in accordance with Western standards.

In ordinary day-by-day experience there were some surprises. Contrary to impressions many of us might have from afar, within Japan its people have a light and easy sense of humor, enjoy informality, and avoid conflict. It is true they are always busy, but that is just their way of being alive (not the same as working hard). Japanese people are exceptionally law abiding (no common mugging, theft or extortion, not even tipping), and that also is just part of being alive. They see no point in doing things differently. All this is very comfortable for a visitor.

Central to what I found in Japan is the feeling of togetherness, based on acceptance of the notion of similarity. This refers to Japanese minds being similar; knowing what is in one is in another, and acting together without requiring full and explicit communication. Here we begin to have a clue to a different approach to knowledge.

One might say that all human minds are similar, and different from other species or artefacts *we* make. This similarity is masked by the common Western assumption of individual difference and external reference. From my experience in Japan, coupled with experience in design (Bijl 1989), it is fruitful to consider how this similarity might form the necessary basis to any corpus of human knowledge, and how it is effective without explanation.

Logic and Aesthetics

In my Ohio paper (1991a) I argue that human decisions and actions are largely influenced by aesthetic sensitivities. Aesthetics is usually associated with expressions of *beauty;* but, more generally, this can be taken to indicate any stimulation of any of our senses, and our ability to judge whether it is good. Acceptance of the central role of aesthetics, in this broad sense, is evident in Japan. It is evident in ordinary everyday behavior, politeness, and in most things that are within reach, which can be touched (but not in distant things, such as objects in modern urban space). This acceptance of aesthetics is also evident in the appearance of food, a very important part of Japanese life.

Aesthetic sensitivities determine what we want things to be, and more generally, how we express what we know. Overt techniques and formal logic can be useful for realizing what we want but, deep down, the knowledge on which they rest is aesthetically determined within ourselves.

If formal logic does not determine expressions from human knowledge, how, then, can people expect to benefit from their use of computers?
What can Japan tell us about the act of realizing expressions from aesthetic sensitivities?

Knowledge

In Japan I found that knowledge is recognized only through an association of expression with *position* (of a person). Position is important, and without it an expression is treated as though it were not present. I have developed this view in my Edinburgh paper (1991b). There I concluded that knowledge is seen as some integral combination of whatever constitutes the intelligent party and abstractions it forms from its sensations of other things. Externalized representations or expressions from such knowledge, detached from the intelligent party, cannot be knowledge.

Basically, the understanding seems to be that each one of us can be confident about our ability to know, embracing all ways we have of knowing, including use of all our sensations, our feelings. We have this confidence without explanation. It then follows that we cannot be sure (in a definite and shared way) what it is that each of us knows. We act together by invoking responses from each other's knowledge, and we use language to reach into and stimulate states of such knowledge.

Language expressions can be logically inconsistent, ambiguous, and their effectiveness relies on affinity between persons - the presumption of similarity.

Ambiguity is effective in allowing different and unreconciled interpretations, and in stimulating unexpected and informative responses.

Position is accepted as implying separate but similar truths within persons, with validity determined by responsive behavior of society - the position it grants to a person.

How, then, does Japan view the idea of computers operating on representations detached from human knowledge?
Can we think of computers being artificially intelligent, as machines operating on their representations of our expressions?

Formal Logic

My reassessment of concepts employed in computer technology goes back to fundamental philosophies of thought. These appear to determine (or reflect) our perceptions of ourselves in the world. The dominance of determinate logic in Western philosophy is now being realized in the form of computer technology, and we may have something to learn from the different philosophies of the East.

We commonly think of logic as dealing with how we can know our world, and it sets conditions on what the world has to be so as to be knowable, as indicated in figure 2. This world has to be subject to orderly decomposition in terms of logically distinct and related entities, and resulting representations have to be verifiable outside ourselves, objectively. We have the belief that logical representations can match things as they really are, and when we think they do we say they are true.

A world conditioned in this way can then be recreated in a computer. This is no accident we have made computers to be logic machines.

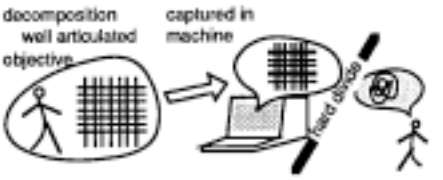


Figure 2. A Logical World.

This line of thought, reflected in our scientific tradition, is evident in our search for singular and exclusive truths, our endeavors to simplify. We do not tolerate contradictory views of the same thing. Difference must be resolved. Only one answer can be right. Resolution is equated with progress.

We can find evidence in social behavior and politics, even amongst scientists. We value competition. Success goes to winners who have destroyed their opposition.

We can also find evidence in religion. We have single exclusive Gods: "I am all.., there is no other...".

This 'I' translates into the individuality of persons, their free will, and competition. Interaction between persons is based on an expectation of difference, with resolution calling on external reference... and we have the dictum "knowledge is power".

These might be extravagant observations, but I think they do have some bearing on our attitude towards computers. The expectation of difference between individuals, and belief in the objectivity of logic, may underlie our use of highly articulate and explicit forms of language expression. We think of expressions as conveying knowledge so completely that it does not matter who or what they come from. They can be verified by reference to reality. And computers can be made to use expressions just as well as persons.

Of course I am setting out an extreme position, but its prevalence is evident in the way we give pejorative connotations to words like ambiguous and inconsistent. Too many people (including computer scientists) appear to hold the view that expressions which are ambiguous cannot be referring to knowledge - the condition of classical two-valued logic. Thus we get a hard divide between those people and the more ordinary perceptions of other persons (figure 2) - this divide cuts off many ordinary activities as being beyond knowledge, and it is very uncomfortable for designers.

We need to bracket our understanding of logic in order to broaden its application. In my Edinburgh paper I concluded that we ought more commonly to regard logical truth values as referring to states of expressions, independently of how expressions might relate to our knowledge about the world. By doing so, we should be able to employ logic on any forms of expression serving any human knowledge.

Eastern Philosophy

My understanding of Japanese philosophy of thought (Bijl 1990) has come to me through conversations with professors at RCAST, Tokyo University, and the Universities of Kyushu, Kyoto, Osaka, Tohoku, and Hokkaido. Most of these conversations were with professors of computer science - with some exceptions: an architect, a musician, and a philosopher of science. My interest was to try and explore the relationship between Eastern thought and the kind of thinking which is realized in computers.

Japan offers its own way of knowing the world. This embraces how we know things, but transcends formal logic and religion, without mysticism... employing a distinction between our knowing and the actuality of things. It sets no limits on what the world can be, or on our sense of knowing. This way of knowing is associated with Buddhism, but it is on a plane above religious practices and accommodates the earthly order of Confucianism.

Professor Hon of RCAST described the Buddhist world as being nebulous, chaotic, and full, as indicated in figure 3. To a Western mind, these are vague and difficult terms, and we are inclined to attribute them to woolly thinking or mysticism. However, I came to understand this description as referring simply to a *whole* world extending beyond things that might be captured in a single logical view, and extending beyond human perceptions. It is a whole world which does not presume decomposition into separate things - what we see as the separating spaces in between are no less significant than what we see as things. For a

trained Buddhist, philosophical endeavor might be characterized as self-realization of 'full,,. = empty'.

Figure 3. An Eastern World.

The effects of this philosophy on ordinary life are interesting. Truth applies within persons, with no externalized formula for representing truth - so all methods for constructing expressions of partial views of the world are equally legitimate. Different views co-exist in the same space and time, without invoking conflict or the urge to resolve differences.
Evidence can be found in social behavior and politics, in the practice of 'making room', politeness, and in the importance of position over argument.

Evidence can also be found in religion. There we find an accommodation of very many Gods, and the pronouncement of Buddha: "I am nothing... there is all...".

This 'I' translates into suppression of individuality in persons, in the sense that persons do not proclaim their separateness. Instead, as described to me by Professor Murakami of RCAST (the philosopher of science), people have a collective identity and an ability to reach consensus without relying on verbal articulation. The effect can be seen as a spontaneous form of democracy which is said to be at least as representative as Western democracy.

This collective identity is further indicated by the relative lack of structure in language expressions. These expressions are not meant to be explicit, ambiguity is normal, and meaning relies on uniformity of context *within* persons - again, the presumption of similarity. Professor Tanaka of Hokkaido University expressed this well when he described his ambition to me. He wants to work on an approach to language which emphasizes use of "very large vocabularies *not based on anything*" - *allowing* vocabulary terms to be formal entities (with behavior) which people can use in any way they choose.

As a tentative conclusion which has relevance for computing: Japanese philosophy appears to accept no external reference for determining forms of expression. Formal logic is accepted, but without any priority over other constructions (figure 3). We find, therefore, a softer divide between technically precise knowledge and expressions from human aesthetic sensitivities.
This softer distinction could become the focus of an important contribution from the East, to our understanding of design support systems and, more generally, systems that have to accommodate people's ordinary perceptions of the world, in the West.

Computer Science

It seems clear that scientists and other people in Japan can make innovative contributions to the way we regard computer technology. However, to do so they need to overcome an inhibition induced by their own tradition.

When Japanese scientists present their work to the international scientific community they see that community as one which is already established, which has position. Given the importance attached to position, Japanese scientists see themselves as having to serve their time, 'play a game' according to rules set by people from the West. This game is not just science in isolation. It is a game which draws on all that is embraced by Western philosophy: separateness of individuals, logical articulation, objective reference, competition for the truth. Instead of accepting this entire game, Japanese scientists ought to be encouraged to change some of the rules. Uncritical acceptance of the rules gives credence to common Western assumptions, despite these assumptions feeling foreign within Japan. This I think explains the apparent contradiction of Japanese scientists presenting their work in terms which imply acceptance of external reference and the naive 'real world' assumption, whilst denying that assumption in much of their behavior within Japan.

That assumption is accepted for what it enables scientists to do, alongside contrary assumptions which are useful for doing other things, without sensing conflict. Computers then are not justified by some overwhelming argument about how all things are or should be known - no singular and exclusive view about human knowledge. Computers just are things we make, coexisting with other things, and they offer an opportunity for commercial and scientific success in the international community.

We are still left with questions about how computers should be accepted as coexisting with other things, if they are used and if they exert influence on expressions from human knowledge. It is on these questions that Japanese philosophy might offer useful insights.

Computer applications

The non-scientists with whom I was able to have lengthy discussions, Professor Hara of Tokyo University (the architect) and Mr. Hayama (the musician), both saw the role of computers as a medium for expressions. They envisaged the prospect of being able to realize dynamic expressions in ways which presently are impossible without computers. Professor Hara saw computers as expanding the ways in which persons can imprint their record of life on the world, and evoke responses from other people. Mr. Hayama foresaw a new media oriented society, with a new kind of literacy supported by computers, leading to improved understanding between people.

These views reflect deep consideration of how people communicate, and the evocative role of expressions. Computers are seen as offering an opportunity for enriching contact between persons, as well as the more usual advantage of communication over distance and spreading to many persons.

Our conversations focused on expressions, but with little discussion of the significance of their structures, or their meaning. It was as though such matters are best left to persons who decide what particular expressions are to be, and that might turn out to be a good strategy.

It would be helpful to have more contributions from the design community, and from people engaged in the arts. What is it that such people see themselves doing? What do

drawings and other expressions of their work do? What do designers offer which is distinct from the services provided by other persons? In whose interest do they do so, and with what purpose? Given their answers to some of these questions, how do these people think computers can help?

Where This Leads...

The different perceptions I found in Japan offer promising insights into my central question (set out in the introduction). These can now be summarized as follows:

a) a world that is whole, chaotic and nebulous
   - not orderly decomposable and objectively knowable;
b) knowledge within persons
   - not separable from persons;
c) communication based on similarity
   - does not anticipate difference in individuals;
d) expressions sparse, evocative
   - not representational, explicit;
e) tolerance of inconsistency across expressions
   - not logically resolvable to singular outcomes;
f) soft distinction between technical precision and aesthetic sensitivities
   - no hard divide between testable knowledge and human feeling.

Taken together, these points indicate a human centered view of the world, they indicate optimism in persons exercising responsibility, and they favour collective evolutionary progress. They deny any separate external reference as authority for particular actions, and do not favour revolution. This does not preclude innovation, but implies conditions on how innovations come about and how they become accepted.

The notion of knowledge being inseparable from persons, while expressions are accepted as serving communicative intent between persons, provides a clue to a different way in which we might regard computers. The strategy which begins to emerge for CAD, and for any use of computers, then rests on three main premises.

1. Our knowledge remains within and is part of persons, evolving in response to our experience in the world.
2. Expressions are externalizations, artefacts, from our knowledge, used with communicative intent - and computers are artefacts, expressions.
3. Forms used to realize expressions are without meaning, yet are necessary to our recognition of instances, and are durable within cultures.

I know that I am using terms here in a slightly unusual way. 'Without meaning' refers to relationships we feel between ourselves and particulars we sense in the world. Knowledge has to take account of such feeling, even if we cannot explain how this happens. Knowledge considered in this way is important to most human decisions and actions, and evidently so in the case of designers.

On the following pages I present evocative illustrations to show where these premises start and how they might be developed. My illustrations are intentionally evocative since they deal with matters which cannot be contained in one logically coherent argument, but which

nevertheless are important to us. I hope they stimulate some useful thoughts on how we might view the further development of computer technology.

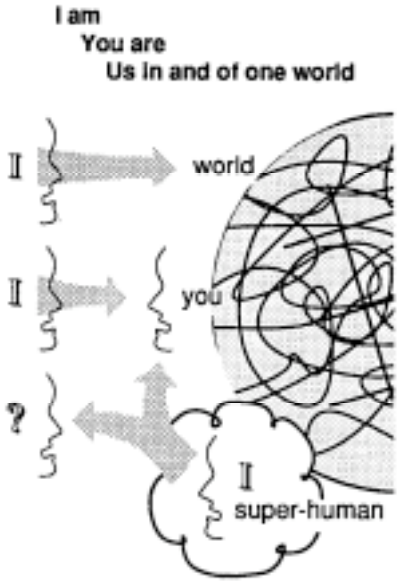


Figure 4. Metaphysics. This figure illustrates a relationship between ourselves within a whole and nebulous world. I sense that 'I' am, I see the 'world', and see 'you' in this world.- but I cannot stand outside myself, which presents problems for my perception of 'us'. These are the problems we face when we program 'our' knowledge into computers - someone has to assume the role of super-human, which is likely to result in conflict.

1. Us

I
My mind sees the world
And I see you
But not myself
To see us
I have to be detached
Super-human
I can tell you what I want
But not what you must do
Not program you

You
What my mind knows
Yours cannot
Yet we know each other
You might know the same
If we know what sameness is
Being both similar and different
We are inside ourselves
And show ourselves
In the world out there

World
The world is
We are in and of it
We know it
Knowledge of the world
Felt within ourselves
Determined by what we are
One world known by all
And many loosely bounded worlds
Felt separately in each of us.

We might think of ourselves as bounded individuals, as discrete things, but to know ourselves within a larger world we have to call on larger systems which include ourselves. That gets us into religion and philosophy.

Notions of 'us' imply some super-human (or metaphysical) external reference: "something else, which we have no way of sensing, must be out there in order to preserve the coherence of what we know from experience". So we get sub-atomic particles in physics, 'dark mass' in astronomy, and 'necessity' in logic. And we have religious deities whom we call upon to preserve social order.

Is such external reference really necessary? To put this question more gently, do we have to explain and agree a singular external reference? Alternatively, we can accept that such references come from within ourselves, moderated by each of us being part of the same whole.

These references have to be fixed, to provide adequate support for what we do, and they have to be loose, to accommodate new knowledge.., including design innovation.
Whenever any one of us believes he or she has the authority to tell someone else what to do, we invoke some metaphysical position. And that is the case when we develop computers as a means of programming other persons... with the attendant danger of inhibiting innovation.

Figure 5. Knowledge and Expressions.

2.Out There

Knowledge
Our abstractions
From our sensations
Held as meanings within ourselves
Exercised on expressions
And other things in the world
Entailing recognition and prediction
Accommodates feelings
As determinants of actions
Without explanation

Objectivity
We share particulars
Only by what we show outside
Outward expression
To respond to expressions
To act with each other
We invoke detached authority
We have logic and mathematics
Poetry and painting and music
Christianity and Buddhism

Reality
They give us forms
Turning our insides out
Shaping our outward reality
Forms of expression
Invite more expressions
To sustain our shared reality
We have many realities
Realized in different expressions
Joined within ourselves.

Figure 5 illustrates a relationship between knowledge and expressions, as set out in my Edinburgh paper (1991b). Knowledge refers to states of mind, partly innate and partly abstractions from our sensations of the world. Abstractions give us particulars which we generalize, to produce further particulars which get realized as our expressions. Expressions are objects of the world, ready to be subjects for further knowledge.

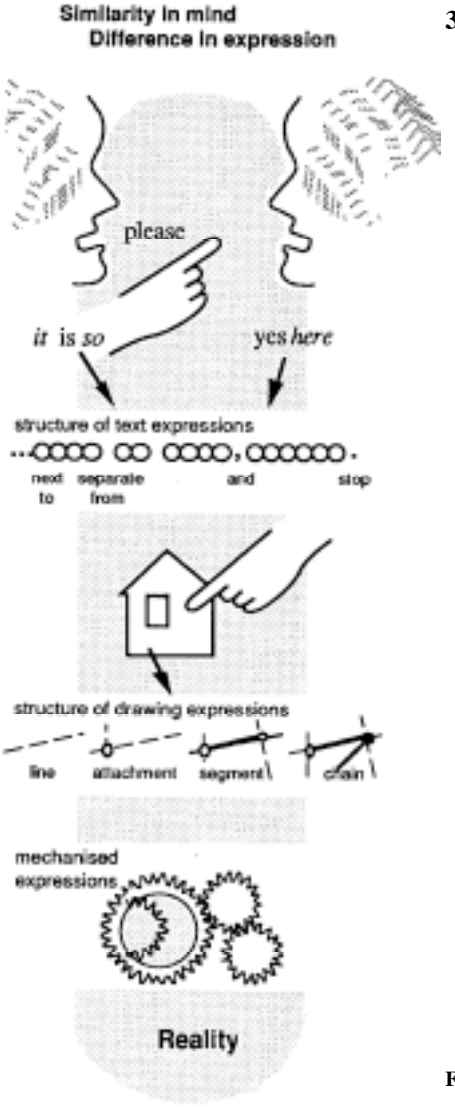
This explanation draws a distinction between knowledge as an integral part of persons (or other dissimilar things, but we would have difficulty appreciating their knowledge), and expressions as realized objects produced with communicative intent. Knowledge here accommodates feelings as determinants of actions.

I am looking for an explanation which accounts for everyday knowledge, and which does not exclude any expressions from within persons. I mean to include aesthetic expressions, coming from feelings included in knowledge, which determine expressions about things not verifiable by overt systems of logic. I see this non-logical knowledge as essential to ordinary

human behavior, and as the foundation of specializations which offer 'technical and testable' knowledge.

Knowledge cannot be externalized in some definite and shared way, and formal logic is no exception. In this view, logical expressions cannot be the same as knowledge of logic: what makes our logic useful remains inside and part of us.

In putting forward this view, I am not advocating the idea that knowledge is mysteriously idiosyncratic in different persons. We can see ourselves as materially and mentally similar, linked within one world, so we can assume similarity in knowledge. We can do so without explanation.



3.Acting Together

Homogeneity
No one form works alone
They all are mediated in us
Conditioned by what we are
Ourselves unrevealed
Instruments of knowledge
Excluded from expressions
Sharing any reality
Presumes similarity in us
Without explanation
Expressions
What we show of ourselves
Serves to stimulate responses
From knowledge in each other
Richness in expression
Ambiguity and contradiction Stimulates unforeseen knowledge
Poverty in expression
Singularity and consistency
Produces a dead reality
Machines
Realizations of just one form
Overt logical determinacy
Sustaining mechanical action
Bounded in their inner worlds
Their artefactual internal consistencies
Blind to the outer world
Action
Without knowledge
And no responsibility.

Figure 6. Similarity.

Figure 6 illustrates the notion of similarity and how it relates to expressions. Minds are presumed to be similar by nature and nurture, as compared with the materially very different

things we make. The things we make are expressions - the purpose we associate with them is to move our physical and mental states.

This view of expressions, and their purpose, covers all artefacts. They are used without us having to know (in any definite and shared way) what is actually in our minds or exactly how they are similar. We make things and observe the responses they evoke from other persons and, indeed, from other objects in the world. We accumulate knowledge from these responses to condition further things we make.

We have theories for how we exercise knowledge: by deduction, induction, and abduction. None of these theories explain what is actually happening in our minds, or why we produce particular expressions.

Through long use, certain forms of expression become recognizable to us, and they show regularities which we find effective in evoking desired responses. Thus we have text as a form of language expression, overlaid with conditions to make them satisfactory expressions in given contexts. Logical conditions might be included, if the expressions are thereby thought to be more explicit in the contexts of dissimilar persons - and if similarity is presumed then form without logic might be more important.

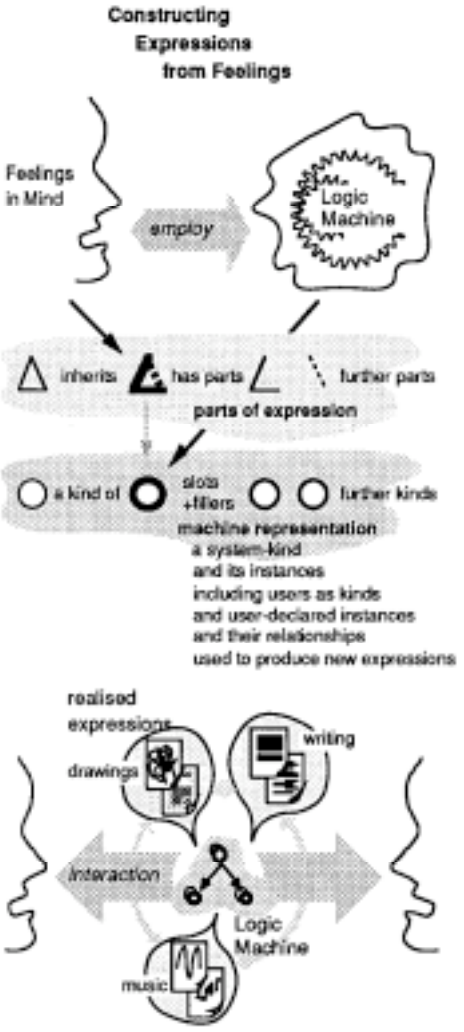
Other forms of expression include drawings, similarly overlaid with conditions. We can extend our examples to include painting, poetry, and music. Expressions can be mechanized, governed by an internal logic which produces external behavior. Such behavior then serves to evoke responses from other persons or other objects. Remembering that these are our expressions, not our knowledge, they include computers.

Taken together, all these expressions are our reality. They are a dynamic reality reflecting our changing perceptions - representing what we know about the world. In developing computer technology, we ought to take great care not to destroy this complex relationship between expressions and knowledge: we should not try to turn expressive artefacts into knowledge. As a diversion (to fill this space between illustrations), let us look at what an artist has said about representation and expression. Nikolai Tarabukin was a Russian philosopher of art from the early part of this century, and part of the Constructivist Movement, (quoted in Duval 1981):

"While old art, from naturalism to early Cubism, is a 'representational' art characterized by the connection between the pictorial forms and those of the real outside world, the new art breaks off this connection, this dependent relationship, in order to create autonomous objects. And while the art of the past was opposed to the real world... the new art is in a sense immanent to the world of reality: it creates objects, and no longer pictorial copies (naturalism) or arbitrary compositions (Cubism)... Pictorial art is not a 'vision'; this would enormously restrict the artist's work and limit its pictorial and philosophical meaning in the extreme. Just as music is not an art of imitating real sounds, so the art of painting is not 'knowledge', for the domain of knowledge lies chiefly in science. Art is 'fabrication' and action... before all else a voluntary function, for it establishes the primacy of creation... Painting is not called upon to 'represent' the things of the outside world, but to fashion, make and create objects. It is not a 'representational' art but a 'constructive' art. It is a voluntary impulse... valuing intuition in the highest degree."

Here we see a challenge against art expressions as representations that imitate reality (irrespective of what reality might be) or as reproductions of visual stimuli. Art expressions are autonomous objects in their own right, and are immanent or inherent to reality. The objects are fabrications or constructions in our world of experience. Creation of these objects is

seen as a voluntary or independent function, not determined by overt knowledge. An interesting distinction is drawn between pictorial and philosophical meaning of art objects, and knowledge as a domain of science - the latter probably refers to a restricted notion of knowledge being verifiable by scientific method, implying some separate scientific reality. The "primacy of creation over knowledge" then calls on some whole human sense of knowing which is invoked by art.



4.Information Technology

Computers
Logic machines
With artificial intelligence
Used to process our expressions
Dealing with forms in expressions
Not determined by things out there
Understood and used by us
Used to construct further expressions
To stimulate our interaction
And extend our reality
Disaster
Machines with hidden assumptions
Presumed fixed reality
Obscured responsibility
Computers that are 'easy to use'
Institutionalize repetition
Stop us thinking
Autonomous machines
Dictating instances of expression
Limiting what we can say and do
Hope
'Meaningless' machines
Offering logical mechanisms
For making evocative expressions
A formal logic
Realized outside knowledge
For non-logical human expressions
A new literacy
Employing that logic
In our whole and dynamic reality

Figure 7. Machines for Processing Expressions. This figure indicates how we might view the usefulness of future computer systems. They might be used as logic machines operating on expressions, to realize expressions from feelings persons have in mind. We want them to operate on expressive forms without knowing what expressions might be about.

Art, as in the form of drawing and painting, is sensed visually, and the stimulus invokes meaning. We feel and know art invokes meaning even if we cannot articulate and re-express this meaning in some other form, as in words. These expressions serve communication between persons, just as the writings of authors of novels or poetry communicate with other persons. The meaning we derive from art contributes to our knowledge and influences our actions. Where I differ from the position indicated by this quotation from Tarabukin, is that I am trying to reduce the distinction between expressions from art and science. Science might employ *different* abilities within ourselves (which we cannot see) but, in both art and science, expressions can be viewed as immanent to our world of experience, constituting our realty.

A system should offer correspondences between the different parts of users' own expressions and the machine's differentiated instances of its representational entities (called kinds in the figure) - without those entities being like user-expressions, or being seen by users. Users should then expect to have control over the machine's behavior, thereby controlling the machine's operations on arrangements of its entities, in order to produce new instances of users' own expressions. Evaluations by the system refer to states of its representation, and not the world outside the machine. Usefulness is to be seen in terms of machine-support for person-to-person interaction.

5. Examples

Numbers

A little fun with plus 1
take primes
divisible by no numbers
other than themselves and 1
3,5,7, 11, 13, 17
to each add 1
you get primes
31, 71, 131
or products of primes
51, 111, 171... or you get evens
3 + 1 = 4,
5 + 1 = 6,
7+1= 8... except for 2
2 + 1 = 3 ... distinctly odd

A form of expression
For which we have arithmetic
Which tells us 'right from wrong'
Numbers come from us
We cannot sense them outthere
But use them to show what we know
We manipulate numbers
According to our formalism
But what makes this system right?

Figure 8. Sameness and Similarity.

Numbers are our notation for quantities (of units of measure: length, volume, and numbers of instances...). Arithmetic is our formalism for associating and performing operations on numbers, independently from anything else to which we apply numbers.

The two responses to adding 1, in the above figure, indicate different perceptions of these numbers. One sees them as numerals, objects which are the numeric expressions, which depict numbers; to which a further numeral is added. The other sees them as numbers which

are eligible for operators from the formalism of arithmetic; to which the + operator is applied. In both cases the results can be assessed arithmetically, in terms of primes and evens. The first case results in further primes or products of primes, arising from a function that does not come from arithmetic. Yet the results present a certain order which has arithmetic properties. Is this purely chance?

The second case does employ an arithmetic function and it points to the number 2 as posing a question. Here we have a function and value applied to 2 which produces a result that is different from the results of the same function and value applied to all other primes. This might make us consider sets of primes, and we might think of one set containing 2 and another set containing all other primes. What then is the use of a set containing only one member? Ought we to reconsider whether 2 really is a prime?

These cases illustrate numbers as coming from us, and show how fragile our notion of numbers is - there is nothing 'out there' to tell us what numbers must be. The second case illustrates our general difficulty in knowing from what points of view things can be considered to be the same, as when they are primes. How different can things be before they are no longer the same? - the old problem of differentiating between types and instances.

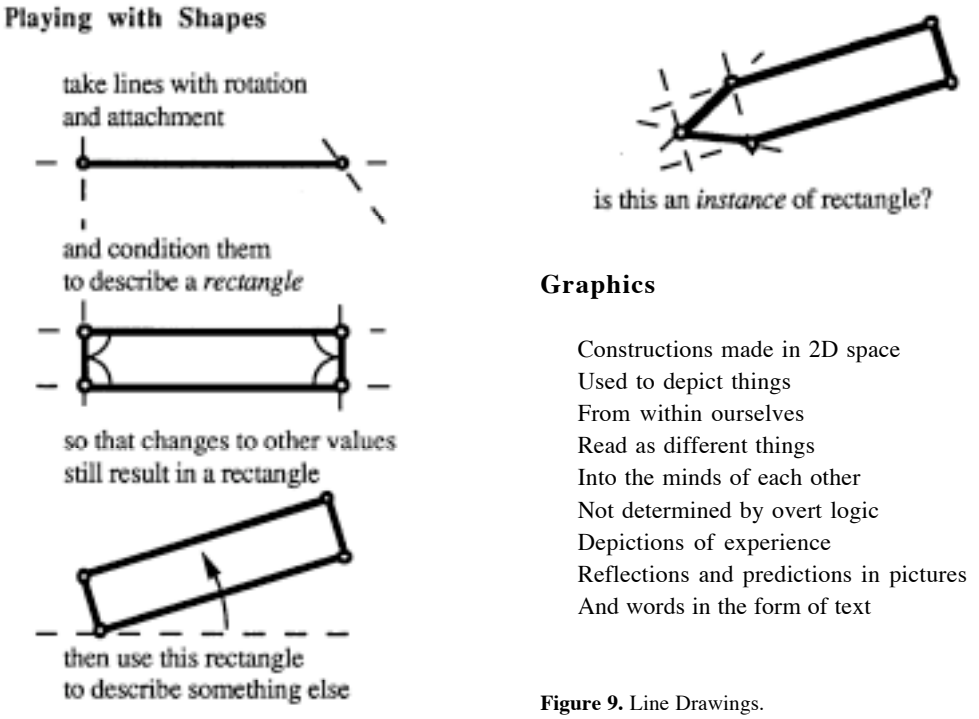


Figure 9. Line Drawings.

As with numbers, lines are not seen in the world, other than those we make. Unlike numbers, we have no general and agreed system for manipulating and reading arrangements of lines. They can be ambiguous and evocative, which makes them effective.

Like arithmetic applied to numbers, we sometimes apply geometries to arrangements of lines, and those lines depict our geometries. We also produce arrangements of lines not de-

termined by geometries, just as we express sequences of words not determined by grammars. Where do those lines come from, within us? Why do we use them?

When we try to show ourselves being logical in our use of lines, we face odd difficulties. We do not have external criteria for our geometries, and geometries do not tell us how they should be applied to depictions of other things.

So the question posed in the above figure can be rephrased more generally, just as in the previous example of numbers. For something to be an instance of something else, to what extent must it be the same? In the present case it might be misleading to call the pointed shape a rectangle. But it might be useful to do so if we want to preserve its inherited rectangular properties in any further manipulations of this shape.

Expression I Shaped from Stone

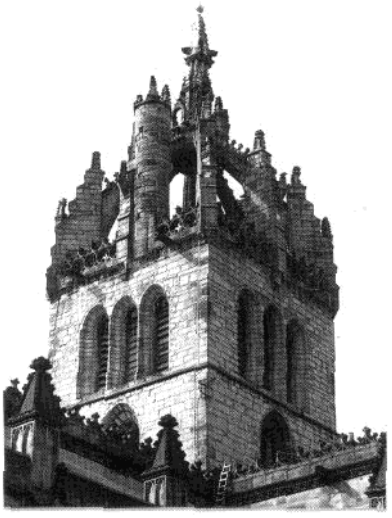


Figure 10. St. Giles Cathedral, Edinburgh.

Architecture

Constructions made in 3D space
Used to express human aspirations
With money as a measure of priorities
Designs for non-existent things
Drawing on inner human sensitivities
And realized through use of logic
Buildings evoke responses
They are seen as functioning practically
And judged aesthetically

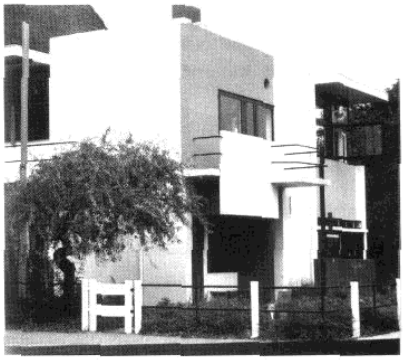


Figure 11. Rietveld's House, Utrecht.

These two examples from architecture illustrate the role of aesthetic sensitivities in human decisions and actions, and in the value attributed to results.

The first, St. Giles Cathedral, is an expression from the 12th Century, intended to reach many people. It expresses spiritual aspirations and a sense of place in the world. These are functions for which we have no calculations or other explicit methods of explanation. The form was determined by aesthetic sensitivities from within persons. The effectiveness of this expression is evident in responses it has evoked from many people through time, including destructive acts indicating conflicts.

The building has served as a focus for interaction between persons, and its importance as an expression is indicated by the energy which people have continued to expend on it. The second example, Rietveld's house, closer to our time, has survived some 70 years. It has been through a period of neglect, and has been restored to be a show-piece of Dutch architecture. Why? It is not particularly noteworthy in fulfilling the practical functions of a house. Its sole justification is as an aesthetic expression. We value what we see of someone in the past giving expression to his perception of a changing world: a reconciliation between man and a modern technological world.

This house makes us feel good about the prospect of a vigorous new reconciliation with our newer technology. We might still ask why has this and other older examples of architectural expression proved to be so durable, while present-day examples are pushed into oblivion by a rapid and bewildering succession of still newer buildings? Might the answer be that our current architectural expressions fail to touch deep aesthetic truths within people?

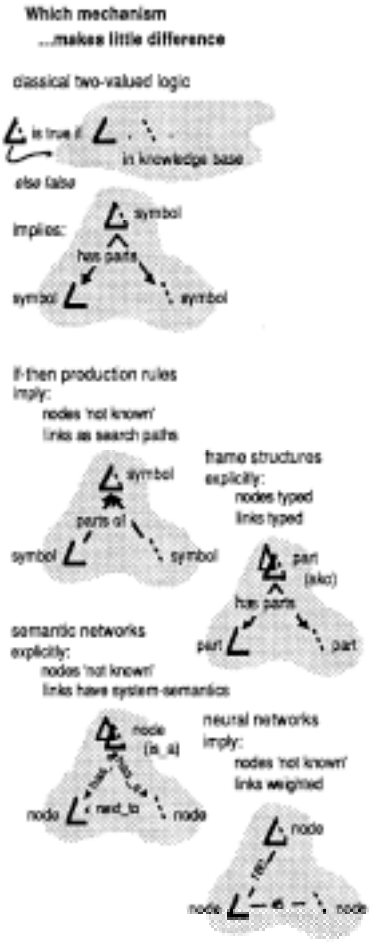


Figure 12. Logic.

6.Where Next

Discovering Forms
Properties of expressions
Serving communicative intent
Durable within cultures
Laws of forms
Observed and obeyed
So we can know expressions
Dynamics of forms
Which can be realized in machines
To support people's interaction
Logic
Focus on structure of forms
Parts and relationships
Including conditions
Truths in logic
Reference within ourselves
Revealed by our use of forms
Forms interposed
Between man and machine
Displaying human responsibility
Applications
All forms of expression
Realized as artefacts
Outside persons
Mechanized operations
Used to express knowledge
Technical and aesthetic
Integration of science and art
Industry and politics
Without boundary

Logic now becomes strongly associated with 'mechanisms' operating within perceiving parties. For us, it includes all relationships as we are able to comprehend, irrespective of what else might be 'out there'.

When we make machines and intend them to behave as perceiving parties, we do so by devising logic mechanisms which govern their internal operations, as in the above figure. All these mechanisms are 'blind' in that they are unable to share our sensations for particulars in the world, and we ought therefore to be cautious in regarding them as being intelligent.

Such mechanisms might be used to construct models, conceived as logical abstractions showing relationships between our knowledge and observed phenomenon. Showing then entails some partial realization in the form of an expression. However, the point I am trying to illustrate is that a machine cannot know it is realizing a model, and it cannot assess relevance to observed phenomena outside itself. Such knowing has to be exercised by persons using the machine, and for that purpose it might make little difference which variant of logic the machine employs.

Positions of Others

Readers of my writing ask: How do I fit within the spectrum of Al's critics? This question is not easy to answer. It supposes clear comparisons between distinctly different positions, and when we look into them we meet qualifications which point to similarities.

I have presented a personal view. It reflects my own experience, including influences from cursory readings of Russell (1912) and Wittgenstein (1953), with welcome assistance from Pears (1985), and of Steiner (1978) on Heidegger, and Kripke (1980), Putnam (1981), and Magee (1987). My view on logic seems quite compatible with those of many logicians, including Wittgenstein's in both his early and later works. Divergence occurs when people use logic to validate correspondence between their expressions and other things as-they-actually-are.

Referring to work more directly connected with computing, I will now risk gross misrepresentation. Hubert Dreyfus (1979) is well known for condemning Al's preoccupation with 'toy systems', arguing that they do not display intelligence, and making them bigger and more complex will not make them intelligent. Following the path of Heidegger, he claims formalizations involve regression, and they cannot account for our sense of being-in-the-world. We cannot make autonomously intelligent systems that can deal with our real everyday tasks. Dreyfus' position is sometimes criticized, unfairly I think, for implying that computers cannot be made to do anything useful. His position seems to me to be acceptable if we see it as an attack on artificial human intelligence.

John Searle (1984) criticizes the notion of artificial intelligence by identifying aspects of human beings and claiming they cannot be replicated in machines: focusing on aspects such as intentionality. Interestingly, he adopts a 'hard realist' and reductionist stance, arguing that we can know (definitely and in a shared way) what people actually are, and we can know how machines are different. This is interesting because if such knowledge were to be possible we might then have a specification for humanly intelligent logic machines. That would appear to undermine Searle's own criticisms of Al.

Winograd and Flores (1986) have attracted the interest of the Al-in-design community. They question the realist and reductionist position, also citing Heidegger. They argue that

"language cannot be understood as the transmission of information... [but rather] as interlinked patterns of activity... [based on] commitment" (pp 76). I would agree that this refers to a kind of commitment which cannot be found within computers. However, their conclusions seem odd: advocating 'co-ordinator' systems, as ready-to-hand tools, "whose use leads to better domains of interpretation.., convey a kind of 'coaching'... train people to improve their effectiveness.., reveals for people how their language acts..." (pp. 179) - presuming proper knowledge about language acts, detached from participants who make and use them. This is odd because Winograd and Floris appear to recognize knowledge in persons in a manner which questions such detachment.

My conclusions differ in that I am advocating 'simple' tools for constructing expressions, disconnected from knowledge we variously might associate with particular expressions. Here my distinction between expression and representation is important, regarding representations as occurring within intelligent parties and not in expressions themselves. I envisage people using computers to construct expressions which invoke meanings variously within themselves, supporting evolving patterns of person-to-person interaction - the notion of computer literacy.

Conclusions

In this paper I have discussed knowledge including meaning and intention, and separately we have expressions including machines. Meaning and intention are included in knowledge in the sense that they link ourselves with particulars of things we observe in the world -constituting what we know and determining our actions.

Expressions are tangible things we use to prod and invoke states of knowledge in ourselves and each other. They are subject to formal conditions which are necessary to our recognition of the presence of expressions: how else do we distinguish music from other noise, visual art from other manipulations of light, and architecture from other heaps of matter?

Forms used in expressions are neutral (or meaningless) in the sense that they are not determined by varying particulars of things we observe in the world; we can accept that they are meaningful only in the task of realizing expressions, not in determining what instances ought to be. In this sense, forms might include geometry used in architecture, tonal scales in music, and meter in poetry.

Durability of forms used in expressions depends on their being meaningless, as in the example of our treatment of numbers detached from other things numbers might be used to describe.

The dynamics of expressions then constitutes our reality, on which we exercise our knowledge. The emerging strategy for using computers, then, is to target machines at manipulations within and across forms, and to give persons full control of forms they decide to use in their expressions.

We need to become clearer about the nature of forms, their durable properties and the ways in which they are used. We can then expect to target computer technology at forms so that computers can be used by many people to construct interrelated expressions from a broad spread of human knowledge. We can expect to do so without determining what knowledge actually is, and we might find that suitable computational systems can be quite simple.

We want computational systems which know nothing about their users'

knowledge. The abstract formal systems they support should be apparent in their surface behavior, resting on minimal machine-functionality applied to a minimal set of representational entities and relationships. Machine-representations then refer to parts and links in users' expressions, and that ought to be enough to be useful to people constructing their own expressions.

My plea is that we ought to put more effort into research on forms of expression, beyond formal logic and mathematics, and independently from computers and particular applications. We want to discover how forms in general cohere, and how they are used to evoke human knowledge. If we can become clear about our use of forms then we will have a sound target for widely useful computer systems.

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