Introduction

In this essay I will attempt to position the development of consciousness within a semiotic perspective. I have drawn my inspiration mainly from Peircean semiotics but also from work in the field of neurobiology by Gerald Edelman, and in systemic functional linguistics by Michael Halliday. My reasons for doing this at a conference convened specifically to discuss issues of basic and applied research related to Artificial Intelligence is because it is precisely the interactive (and thus also intersubjective) nature of the evolutionary development of consciousness as intentionality in human beings that seems one of the most difficult and most often subverted aspects of human experience for experts working with modelling systems addressing such problems as natural language processing, development of inferring and knowledge systems, interface design and indeed, advanced human-computer interaction in general. Possibly this paper will provide some food for thought, and open up for useful cross-disciplinary discussions here, and in the longer term, not only with the community of researchers working on more technologically oriented parts of Norwegian AI research, but also the humanities and natural sciences.

I have chosen to approach the question of consciousness from a semiotic perspective mainly because I believe the field of semiotics provides the most useful conceptual apparatus for examining these issues within a broad cross-disciplinary framework, and because I believe that working within a semiotic framework is one of the most profitable ways for myself as a humanist scholar to approach and investigate central issues within this particular field of study. I am aware that the general field of semiotics often is seen as diametrically opposed to that of cognitive science, but I believe that the most exciting area of scientific discourse today is to be found precisely in the area of overlap between these two rather different ways of approaching and studying human phenomena.

Consciousness

So first, a couple of words about what I mean when I say I want to discuss the concept of consciousness. It is common in the humanities to make a distinction between the ideas of consciousness and understanding or enlightenment. With consciousness we understand the subjective experience human beings have of being situated in a world, or a reality. With understanding or enlightenment, we take this to refer to a deeper, essentially rationally founded understanding, developed over time, of oneself as human being, and of the subjective and intersubjective consequences (and thus ethical, moral and ontological consequences) of human beings' situatedness within a real world of being.

Understanding

Traditionally, the problem of understanding or enlightenment is approached in the humanities on the basis of a fundamental philosophical question, namely: "Is true enlightenment possible for human beings?" (cf. Immanuel Kant: "Critique of Pure Reason"). The humanities have developed many sophisticated philosophical systems and tools of logical thought, and there are also specialised discourses on more metaphysical aspects of existence in such fields as theological philosophy and philosophical theology (see for instance Corrington 1993). According to Kant the determining conditions or prerequisites for human enlightenment (Erkennung) are a limited number of a priori perceptual forms and ideational categories, such as causality, quality, time and space. It is up to each individual thinker who desires to do so, to retire to a meditative space and to think one's own way systematically.
andreductively 'back' to these prerequisites for enlightenment by use of the intellect (Verstand). In Peircean pragmatism however, the central idea is one of a "community of interpreters". This ties the idea of the process of achieving enlightenment (which for Peirce is more or less synonymous with some kind of consensually evolved and constituted knowledge) to active participation by scientists as interpreters in a socioculturally mediated semiosis, where ideas and concepts are continually being generated, investigated, turned around and revised though the interaction of signs in dynamic sign processes. Within a pragmaticist paradigm enlightenment is then associated with an ongoing process of empirical and speculative scientific enquiry over time in such a community of interpreters, and always must be related to real, observable phenomena in the real world, rather than being a transcendental state of mind arrived at by one particular individual (or group of individuals) at some particular period of time. The process of enlightenment - the search for truth if you like - is dependent both on our intellect (or logical faculty, as Peirce calls it) and on human beings' prevalent tendency to seek to make meaning through intentionally driven and semiotically mediated interactions with the physical environment and other members of the community of interpreters.

Peirce, in his philosophy of science, adopts a strongly anti-Cartesian, skepticist perspective with regard to the basic preconditions it is that govern the evolutionary process of human enlightenment, and in his famous paper "Some Consequences of Four Incapacities Claimed for Man" (1868), he outlines four presuppositions of the dualistic tenets of Cartesianism that he believes have been neglected, and which need further investigation:

1. We have no power of introspection, but all knowledge of our internal world is derived by hypothetical reasoning from our knowledge of external facts.
2. We have no power of intuition, but every cognition is determined logically by previous cognitions.
3. We have no power of thinking without signs.
4. We have no conception of the absolutely incognizable.

Reality as we know it is constituted by known or knowable external signs that inhabit or populate the domain of thought. The self intersects with these semiotic chains and becomes open to rational structures of the universe. Insofar as the self attains self-awareness or self-knowledge it must do so through acts of comparison that work their way through the series of external signs and their fields of meaning. This brief explication of Peirce's criticism of Cartesianism is that of Robert Corrington, an American associate professor of philosophical theology, who in his book "An Introduction to CS Peirce, Philosopher, Semiotician and Ecstatic Naturalist" (Corrington 1993) examines Peirce's pragmaticist approach to nature, and discusses how Peirce's four critical statements relate to our basic conceptions of reality, and the concept of the self. In this essay I will draw to some extent on Corrington's explications of Peirce's thought, since I believe that closer examination of the relationship between human beings as sign-using, meaning-makers and interpreters and their natural environment within an evolutionary perspective is absolutely necessary for any investigation of the development of human consciousness. And, as mentioned, I will also base a considerable part of my discussion on work by Gerald Edelman which has a strongly biological and evolutionary oriented perspective on the most central issues in a discussion of the development of human consciousness. I will also bring in some of Michael Halliday's ideas on the role of language in the development of consciousness. Finally I shall introduce briefly my own perspective, which is firmly grounded in the above views, and also in the idea of the situatedness of evolving meaning and consciousness in interpretative communities bonded by the experience of human intersubjectivity. I will also mention some problems related to the growth of intersubjectivity in digitally mediated social fields of scientific discourse where such communities may already be developing at the present time.

Enlightenment and meaning

So what then, is meaning? In highly simplistic fashion we can, on the basis of the above discussion of ways and preconditions for attaining (and examining the issue of) enlightenment, differentiate between two rather different ways of looking at the concept of meaning:

1. a philosophical, metaphysically oriented approach: focused on the search for universals and attempts to explain the fundamental meaning of our existence in the universe.
2. a pragmatic or pragmaticist approach: focused on the study of the interaction between interpreting organisms and their environment, including the community of interpreters that these organisms are part of. The development of meaning or truth is seen as a continuum; a semiotically mediated process of communication.
In English we find a fairly clear distinction between the basic ideas of "mind" and "self-awareness". These two basic ideas represent two quite variant types of approach to the study of mind:

1. those related to the idea of internalised "states of mind", where the focus of attention is mainly on transitory conscious phenomena such as thoughts, ideas, opinions and meanings that are directly related to some context of situation or other.

2. those related to the idea of the process of "developing insight or awareness", where the focus of attention is on the developmental processes, evolution, ontogenesis, change and temporality and relations between interpreting systems or organisms and the dynamic open systems of the external world.

In the study of human behaviour we do not generally attempt to address the question of whether having consciousness or mind or not is possible for human beings. In many ways the phenomenon of mind is taken quite simply as a presupposition or "given" for all forms of scientific investigation, since it is absolutely necessary for all forms of thought and speculative or conceptual activity in human beings. Marvin Minsky has even gone so far as to say the "mind is what brains do" - which although being true in one kind of sense, is somewhat simplistic description. The general notion of "being" in the more existential sense of the word is conceptually tied to this particular presupposition. Descartes, for instance, takes mind for granted when he postulates "cogito ergo sum". The same kind of presupposition applies to research within the traditional natural sciences (for instance biology), and indeed the existence of mind seems not of very much interest as a point of discussion at all (except perhaps in relation to medical and legal aspects of certain kinds of brain damage) in the natural or social sciences. Increasing numbers of attempts have been made recently, however, to explain the phenomenon of mind or consciousness on the basis of human evolution and ontogenesis, and on the basis of empirically established biological, physical, neurophysiological and chemical facts. Later, I shall discuss some more in depth the work of one influential figure from the field of evolutionary and developmental neurobiology, Gerald Edelman.

Knowledge, belief and consciousness

Peirce, inspired by Alexander Bain, a Scottish psychologist (who was a close friend of the father of modern experimental psychology, William James), defines "belief" as some concept or idea which is suprescient and present in our consciousness, and which is so stable or "habitual" as a reaction to environmental stimuli that we are prepared to act on the basis of this. Peirce was not only concerned with consciousness however, he also believed that the unconscious was the place where most of our basic beliefs were located.

"Belief is not a momentary mode of consciousness; it is a habit of mind essentially enduring for some time, and mostly (atleast) unconscious; and like other habits, it is (until it meets with some surprise that begins its dissolution) perfectly self-satisfied. Doubt is of an altogether contrary genus. It is not a habit, but the privation of habit. Now, a privation of habit, in order to be anything at all, must be a condition of erratic activity that in someway must be superceded by a habit. [CP 5.417]

Knowledge, then, is a kind of belief capable of effecting intended actions vis-á-vis the world as we know it. The idea of intentionality or goal-directedness is central here. So too, is the concept of "habit".

"A practical belief may, therefore, be described as a habit of deliberate behaviour. The word "deliberate" is hardly completely defined by saying that it implies attention to memories of past experience and to one's present purpose, together with self-control. The acquisition of habits of the nervous system and of the mind is governed by the principle that any special character of a reaction to a given kind of stimulus is (unless fatigue intervenes) more likely to belong to a subsequent reaction to a second stimulus of that kind, than it would be if it had not happened to belong to the former reaction." [CSP 5.538]

Peirce makes a distinction between practical and theoretical belief, on the basis of the way in which habits are associated with these.

"But habits are sometimes acquired without any previous reactions that are externally manifest. A mere imagination of reacting in a particular way seems to be capable after numerous repetitions of causing the imagined kind of reaction really to take place upon subsequent occurrences of the stimulus. In the formation of habits of deliberate action, we may imagine the occurrence of the stimulus, and think out what the results of different actions will be. One of these will appear particularly satisfactory; and then an action of the soul will take place which is well described by saying that that mode of reaction
"receives a deliberate stamp of approval." The result will be that when a similar occasion actually arises for the first time it will be found that the habit of really reacting that way is already established. [CSP 5.539]

This implied relationship between belief, thought and action in interaction with the real world formed the basis for Peirce's pragmatic maxim, later adopted (but not, according to Peirce, fully understood) by both William James and John Dewey (who both were students of his) as the main guiding principle behind the American philosophical tradition of pragmatism. In his pragmatic maxim, Peirce states that:

"In order to explain the meaning of an intellectual conception one should consider what practical consequences might conceivably result by necessity from the truth of that conception; and the sum of those consequences will constitute the entire meaning of the conception." [CSP 5.9]

Even though the number of possible signs and interpretations or understandings of these signs by interpreters is in principle (and for Peirce, de facto) unlimited or infinite and not in any way bounded by temporal or spatial considerations, it is still possible for some of these continuous sign processes and intentionally produced sign relations to become so habitual (that is: so "stabilised" within our consciousness or unconscious that we come to accept them as "truths", standing for conventionalised causal relations having independent "meanings"), that they result in highly complex patterns of intentional behaviour, which have some kind of lasting effect on both the community of interpreters and on the environment in general.

The biological bases of consciousness

How does Peirce's idea of the "habituality" and basic dynamic nature of belief, doubt and knowledge coincide with insights from biological research into the evolution of human consciousness? In the following I have drawn on Gerald Edelman's book "Bright Air, Brilliant Fire", and particularly his critical postscript: "Mind without biology". Unfortunately time constraints do not allow me to go into detail about Edelman's grand theory of "Neural Darwinism" here, so my account will only be very superficial. Those who are interested in learning more about Edelman's theories are recommended to read his books which will be found in the literature list at the end of this paper.

Edelman puts forward two central theses about consciousness:

1. Consciousness (mind) must be understood on the basis of insights from empirical biological research, particularly research into the evolution and development of the human brain

2. Consciousness is intentionality

He claims that the laws of physics as they are currently formulated today do not account for consciousness, and consequently cannot illuminate the relationship between consciousness and the evolution and ontogenesis of the human brain. Neurological research has uncovered enormous differences at the microlevel in the way individual brains are structured, and there is a complete lack of symmetry in the developmental trajectories of individual neural pathways and complexes of synaptic networks in each individual brain. The laws of physics attempt traditionally to describe nature as asymmetrical - as following certain rules with discrete causal relationships between its most elementary units. But even when we operate with theories of probability and relativity, there is still the problem of symbolic representation and human intentionality (the capability of referring to things or beings outside of oneself) to take account of; every physical law must necessarily be formulated symbolically (by means of language or some other semiotic system) on the basis of observations and interpretations made by human beings with intentionality. The mathematician John van Neumann, with basis in Heisenberg's Uncertainty Principle, has demonstrated that precise measurement of the position of subatomic particles at any given point in time is not possible, since the level of precision of the instruments chosen and set up by the observer will tend to cause the wave-function to "collapse" just at the very moment the measuring instrument and the particle in question interact to give a definite measurement. The wave function [\( \psi \)] in the Schrödinger waveequation is a linear combination of functions describing all possible outcomes of the measurement, and when a measurement is made, the wave-function collapses or "projects" onto one of the possible outcomes. When a dynamic process like this is projected to one state ("frozen" in time and space to a discrete value), it ceases to be dynamic, and therefore changes character. Wigner has claimed that the wave particle collapses as a result of the intervention of the consciousness of the observer (a view I would tend to support), since the observable phenomena (the measurement) is only actualised when the observer becomes conscious of it.

The Danish physicist Niels Bohr attempted to solve this problem by saying that there is in any case no ultimate or deep reality. All measurements belong to some particular context of observation, so this means that the
measurement one gets is at any time is precisely the one would would tend to get given such a context of measurement, particle state, apparatus and observer. The Copenhagen interpretation is the position taken by most physicists who use the theory, since it gives both the psychological and the biological aspects of the development of consciousness. Although physics is able to provide the necessary bases for biology, it does not concern itself at all with biological structures, processes and principles in the human organism, especially those of the brain. Edelman goes so far as to compare Penrose's theory with an explanation given by a schoolboy in an answer to an examination question asking him to provide the chemical formula for sulphuric acid, and who does not know it, and instead writes an elegant description of his dog Spot. What is lacking, says Edelman, is a scientific, biologically and evolutionary based, description of the structures and functions of the organism (particularly those of the brain) that are bound to the development of consciousness. This requires a theory of consciousness that can encompass ontogenetic and evolutionary processes at the morphological level of the human organism.

Edelman also argues that Roger Penrose, who claims in his own version of quantum theory that the problem of consciousness will be solved whenever one constructs a satisfactory enough quantum theory, is not sufficient to explain intentionality, since it ignores both the psychological and the biological aspects of the development of consciousness. Although physics is able to provide the necessary bases for biology, it does not concern itself at all with biological structures, processes and principles in the human organism, especially those of the brain. Edelman goes so far as to compare Penrose's theory with an explanation given by a schoolboy in an answer to an examination question asking him to provide the chemical formula for sulphuric acid, and who does not know it, and instead writes an elegant description of his dog Spot. What is lacking, says Edelman, is a scientific, biologically and evolutionary based, description of the structures and functions of the organism (particularly those of the brain) that are bound to the development of consciousness. This requires a theory of consciousness that can encompass ontogenetic and evolutionary processes at the morphological level of the human organism.

If we study ecological and environmental variation, and the various ways in which animals and human beings categorize their sensory perceptions, it seems highly unlikely that the physical and social world that we experience would be able to function as a tape for a Turing machine (a machine that can execute any kind of algorithm or mathematically formulated procedure without being aware of doing so). As he succinctly puts it: "The world, though constrained by physics, is an unlabelled place."

Philosophers of language such as Hilary Putnam and John Searle have also criticized theories that compare the brain and human thought processes with computers, are inadequate, since all formal operations (including manipulations of abstract logical symbol systems) may be performed without taking account of the meaning of these symbols. The human genome (that is the complete set of genes belonging to a human being), says Edelman, is not sufficient to specify explicitly (for instance algorithmically, syntactically or procedurally) the synaptic structure of the developing human brain. His own and other research into the evolution, development and structure of the brain has shown that individual brains exhibit a staggering degree of structural variation at all levels of organization, and that these variations are tied to the personal history and development of each individual, and to the interactions of the organism with the natural and physical environment. The behaviour of living organisms is also enormously individuated and diversified at the biological level, and this is true whether or not it is possible to speak of them being capable of registering and reporting for others subjective experiences, in the way human beings can by the use of language and other semiotic systems.

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Philosophers of language such as Hilary Putnam and John Searle have also criticized theories that compare the human mind with computers by amongst other things pointing out that psychological states of mind including propositional attitudes (like believing that, desiring that, etc.) cannot be described by the computational model (Putnam) and that purely syntactical models are insufficient for dealing with semantic content, which is a basic characteristic of human minds (Searle). Semantic contents involve meanings, and a syntax does not itself deal with meanings. We cannot individuate concepts and beliefs without reference to the environment. And no organism can have intentional states if it lacks subjective experiences. Consciousness as intentionality (the ability to refer to things of the world, which cannot themselves refer) is irrevocably tied to the subjective and intersubjective experiences of individual organisms. Computers lack such experiences which are by nature unpredictable and cannot be fully programmed or predicted by computational models.

Putnam says that meaning is interactional. Interactions between human organisms and the physical and biological environment necessarily play a central role in determining what the meanings of words in fact refer to for speakers or communities of speakers. This means that no a priori inclusive descriptions of how meaning is produced are really possible in terms of any kind of procedural model. The biological environment, like the human organism, is opened up, and comprises many levels of dynamic open systems with non-determinable ability to, or tendency to self-regulated development and change towards greater levels of complexity. Since each individual brain develops, and is structured by, the organism’s behaviour and interactions with this environment, the body of the organism will also come to play an important role in determining meaning. For human beings to learn what things mean, they must develop and grow in a society and use language to create meaning by moving among, and communicating with others.

The patterns of nervous system response to the environment (in Peircean terms, “habits”) depend on the individual history of each system, because it is only through interactions with the world that adequate response
patterns are selected. This is true on the individual developmental level and also on the evolutionary level. Variation because of differences in personal experience occurs not only between different nervous systems, but also within a single system across time. This means that there is extensive individual variation in cognitive mapping systems, which are also represented at the anatomical level of organization. Not only are there considerable fluctuations in the borders of such maps over time, but also the variability of maps in adult animals depends on the signal input at any given time. This is a strong argument against extreme functionalist models of internal representations which claim that representations have meanings independent of the ways in which they are instantiated.

This problem also touches so-called neural network models, since most present models of this type are not self-regulating at the physical and structural level. "Someone" - for instance a programmer - must construct by programing on a computer new configurations of these networks since they cannot regulate this process by themselves. The "learning" that occurs in neural networks is therefore instructional, not selective, to use Edelman's terminology.

Edelman also takes to task cognitive and linguistic theories of meaning, such as those that attempt to deal more or less exclusively with issues of semantics and mental representation. These models are inadequate for coping with the problem of consciousness as intentionality. In order for it to be possible for us to refer to something outside ourselves it is necessary for any formal representations we might have developed to become intentional in some way or other. But in order for this to happen, it is necessary for the system that performs such a transformation or translation to have both "awareness" and a "self"; that is, a biologically based, individuated subjective experience of its own situatedness in a world of being. No computer (at least not the kind of computers we have around today) has the least possibility of having this kind of experience.

**Systemic functional linguistics and consciousness**

The Australian linguist and semiotician, Michael Halliday, originator of systemic functional linguistics, is, like Edelman, also concerned with the role of language in the development of human consciousness, and also with the ways in which the language of science carries on an ongoing dialog with nature. Language is an essential condition of higher-order consciousness. As he says: "When we want to exchange meanings with physical or biological nature we have to process information that is coded in very different ways, and that may need to go through two or three stages of translation before we can apprehend it." (Halliday 1987). Halliday stresses continually that language and grammar are as much a product of evolution as we are ourselves; the lexicogrammars of all living languages are continually evolving, and are thus evolved systems, not designed systems; language is not something separate from nature, but an essential part of being human. "These natural languages then, sufficed to enable us to interpret both facets of our wider environment, the social order and the natural order; these were, after all, constructed by generalizing and abstracting from the micro-environments in which language had evolved all along." (Halliday 1987). Language as a social semiotic contributes to the construction of the self, by simultaneously construing and enacting close interpersonal relationships between human beings. And without the interpersonal metafunction enacted in language as an evolving human semiotic, there would be no culture. "The grammar not only construes; it also enacts - or again, human beings enact, in the forms of their grammar, their "interpersonal" (intra-species, inter-organism) relationships. Systemically, in this interpersonal metafunction, the grammar constitutes both society, and through society, the individual self; instantaneously, the grammar enacts dialogic roles and the ongoing personification of "I" and "you." (Halliday 1992). From early infancy language impinges in a number of ways on the construction of the social order, mediating the dialoguethat in itself builds upon the intimate personal relationships that have developed between a child and its caregivers. The efficacy of this "language for loving and caring rather than for knowing and thinking" is not judged referentially (except when the intimatesphere of communication breaks down in pathological cases); "language creates society; but it does so without ever referring to the processes and the structures which it is creating" (Halliday 1987). Halliday, like Edelman, refutes all attempts to reduce language to communication code, or the brain to a computer. The brain is more comparable to a rapidly growing jungle than to a computer.

Neither Edelman nor Halliday are at all averse to the idea of using computer simulations to investigate the development and nature of naturally occurring systems and emergent natural phenomena, such as language and consciousness. They are merely deeply respectful of the true enormity of the task of modelling and thereby creating artificial conditions and artifactual systems that will even begin to touch the surface of the multivariate levels of complexity of organization, and the continuous, dynamic nature or diachronicity (Coppock in press(a)) of naturally occurring, self-regulating systems of all kinds. As Edelman points out: "Computers are not appropriate models of brains, but they are the most powerful heuristic tools we have with which to try and understand the matter of the mind." (Edelman 1992). While he at the same time asserts that "artifacts with higher
order consciousness would have to have language and the equivalent of behaviour in a speech community. A great deal still need to be understood about the organization of linguistic memories, and a quick solution to this problem does not seem likely. For now we can relax in the knowledge that, so far, we remain the only known systems with linguistically based higher-order consciousness, and competing artefacts a long way off.” (Edelman 1992)

Postscript

Elsewhere (Coppock in press (b)) I have argued that one possible way of learning more about how technological mediation of human communication affects the use of language and the ways in which human beings interact in the development of interpretative scientific communities is through many more ethnographic, phenomenologically oriented studies of developing discourse, interactional and textual norm systems in computer-mediated communication systems in different kinds of virtual environments such as distributed text-based multi-user dialogues. Where such emergent, digitally mediated social fields seem to differ most from real life processes of the same kind that the present time is in the relative richness of the range of signification devices available to the participants while they are interacting and constituting the social fields of the emergent culture of the virtual environment. The relative lack of richness of the language code (mainly written language simulating oral forms of communication) and the unavailability of other semiotic systems such as non-verbal communication, intonation, olfaction and tactile communication available to participants in such virtual environments is however attributable first and foremost to the present "closed" or "limiting" nature of the mediating medium offered by the technology of the system, not to the communicative potential of the dynamic opensystem of language and the or the sociocultural habitus brought into the scene of interaction by the human participants. One of the more interesting aspects of these, and other kinds of technologically mediated virtual environments is, aside from their obvious potential and a means of scientific collaboration and discussion in the longer term, that all the ongoing process of meaning making are not only being produced, but are also capable of being documented (logged in real time) at the perogative of the participants themselves at the same time as they are taking part in producing it. Researchers who participate in the development of such virtual social worlds, while at the same time being interested in studying their ontogenesis and evolution, is in many ways in a privileged position, having a unique opportunity to document and study his or her own subjective process within the emergent social semiotic.

Such studies may also serve to throw light on what, in my opinion is one of the most difficult problems of all to explain scientifically, and presumably also to model and create artificially, even taking account of the leaps and bounds that we are witnessing within the fields of evolutionary neurobiology and systemic functional linguistics, namely the very human experience of intimacy and closeness which we have come to label as intersubjectivity; that sudden shock of recognition of the "other as other" that human beings still seem able to experience from time to time when two gazes meet. I believe we still have very much more to learn with regard to the ways in which computer-mediated, or even simulated forms of interpersonal communication impinge upon the establishment, growth and maintenance of deeper, lasting interpersonal and social relationships that, when all comes to all, are the very basis for the establishment and growth of any kind of interpretative community, and thus also a prerequisite for the further evolution, not only of science and technology, but also of the human race.

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