Consciousness and the Decline of Cognitivism

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Introduction

This note examines some paradigms within cognitive science, in part through the lens of consciousness studies, a recent discipline which takes seriously the experience of having a mind. In particular, it discusses cognitivism and representationalism, and some challenges to them based on broader contexts than the individual. Much of this material comes from my experience as editor in chief of the *Journal of Consciousness Studies*, a position which guarantees a steady stream of interesting and unusual things to read. This version is still a draft, which simplifies many complex issues in the interests of brevity and readability.

Consciousness studies is a new, rapidly evolving, highly interdisciplinary field. Disciplines involved include psychology, philosophy, physics, sociology, religion, dynamical systems, mathematics, computer science, neuroscience, art, biology, cognitive science, anthropology, and linguistics. Even in the early 1990s, most scientists considered consciousness taboo, but now it is often presented as the most important unsolved problem in science. We will see that it opens windows on the mind from many other dimensions, from quantum gravity to evolutionary biology, and that an important emerging theme is the role of distributed collectivities. In particular, we discuss a web-based system for distributed proving and some of its foundations, including a study of values in mathematics, and a social, ethical theory of information. The paper concludes with a meditation on the groundlessness of distributed collective practices.

Cognitivism and Representationalism

Cognitive science arose in the early 1960s as a grand coalition of diverse disciplines, unified by a then exciting new vision of mind that identified cognition with computation, and the brain as the hardware on which it runs. This approach, often called *cognitivism*, can no longer claim the dominance it once held, although it is still very active. For our purposes, it is important to note that cognitivism is strongly focused on the individual as the locus of thought, and by implication, of all social activity[1]. This helps to explain the original composition of the coalition, which virtually excluded sociology and anthropology.

The lineage of cognitivism can be traced back to pioneering work of Norbert Wiener on what he called cybernetics [1], and to the Macy Conferences, organized from 1947 by anthropologists Margaret Mead and Gregory Bateson among others, to introduce systems theory to an influential interdisciplinary group. However, cognitivists generally ignore these antecedents, and instead cite the scalding review by the linguist Noam Chomsky [2] of Burhus F. Skinner's 1957 book *Verbal Behavior*. Skinner advocated behaviorism, a psychological theory which tried to ignore internal mental states. Chomsky argued that such states are needed even to process simple syntax. Another seminal cognitivist work, by George Miller, Eugene Galanter and Karl Pribram [3] proposed that human plans have the same structure as a certain simple kind of computer program. Early cognitivism

[1] A broader notion of cognitivism would hold that mind is rational, autonomous, selfish, and independent of body, world, and other people. Each of these is a deeply entrenched value of Western culture, as can be seen e.g., in the philosophy of Kant, and in the long-running fascination with automata, robots, monads, cyborgs, etc., as in the Golem legend, game theoretic models of behavior, and much else.

was based on formal logical representations of knowledge about the world (e.g., see [4], by John McCarthy, who coined the name "Artificial Intelligence"). This extreme form of cognitivism, which we may call "logical representationalism," is now overshadowed by non-representational schools, several of which are inspired by aspects of brain physiology.

An important contemporary strain of non-representational cognitivism is based on models for neurons, networks of neurons, and ultimately, brains. A classic 1943 paper by Warren McCullough and Walter Pitts introduced the first such model, in which neurons were either "on" or "off," i.e., firing or not firing [5]. These neurons are similar to the logic gates of computers, but are far simpler than real neurons. It has been shown that every Turing computable function can be computed by some network of such artificial neurons.

Ideas due to Donald Hebb [6] broadened this paradigm, and also brought it closer to real neural networks. These ideas include the following: connections between neurons become tighter the more they are used; neurons act in groups called cell assemblies; and cell assemblies are the basis of short term memory, but not long term memory. Although these only approximate the functioning of real neurons (which for example involve very complex chemical reactions), they have inspired significant engineering applications, such as character recognition, speech recognition, and face recognition. But because of the rough approximation, many researchers prefer to call their work parallel distributed processing or connectionism, rather than neural net modeling.

Meanwhile, experimental neuroscience has uncovered even more complexities. For example, it is now known that much significant information is encoded in the rate of firing of neurons. Benjamin Libet showed that voluntary acts are preceded by a readiness potential (a gradual negative shift in electrical potential, as recorded at the scalp) about 550 ms before the action occurs, and about 200 ms before subjects record a conscious intent to act [7]. This has been argued to imply that consciousness is constructed well after the fact, and even that consciousness may be unimportant. Mirror neurons are another significant discovery. The Italian neurophysiologist Giacomma Rizzolatti [8] found that certain cells in monkey frontal lobes respond to specific actions, not only in the subject, but also when the subject observes another perform that same action. It has been suggested that this can help explain many puzzles, such as how we learn by imitation, or how we can put ourselves in the place of another, in order to outsmart them. To this list, I would add compassion, the capacity to empathize with others.

Critiques of Cognitivism and Representationalism

Searle's Chinese room argument [9] is a famous early attack on cognitivism; it is a thought experiment which challenges the idea that a program running on a machine can be conscious. Imagine Searle in a room with an input slot through which come texts in Chinese characters, a large rule book, and another slot through which you output Chinese text. He gets a text, follows the rules without understanding any Chinese whatsoever, and outputs some result. Perhaps some Chinese experimenters outside the room think he is very smart, but he does not understand anything that they are saying, and has absolutely no idea what is happening at the level of meaning. Searle argues that this demonstrates that even a program that succeeded in simulating consciousness could not be conscious. McCarthy [4] and many others have of course argued against this position, often by misinterpreting it.

Another serious challenge comes from work of James Gibson [10] on affordances, showing that many cognitive tasks are greatly simplified by using information already in the world, instead of relying on complex internal representations. Work in cognitive linguistics has shown that many basic metaphors rely on innate sensory-motor schemas [11]. Neurophysiology has found that the human visual systen involves more downward connections (from higher level areas to lower) than upward,

and recent work in machine vision has explored similar architectures, under the rubric "active vision;" one idea here is that perception is anticipated, so that only differences need to be processed, resulting in greater efficiency; results in experimental psychology also confirm that what we expect to see has a large effect on what we think we see. The sociologist Lucy Suchman [12] showed that plans as actually used have structure and execution very different from that postulated in [3]. Francisco Varela (1946–2001), Evan Thompson, and Eleanor Rosch (a biologist, a philosopher, and a psychologist) used empirical cognitive science to argue that cognition is necessarily embodied [13], rather than disembodied like a computer; they also drew on Buddhist philosophy to show how cognition is possible without a "self." Rodney Brooks of MIT built robots which demonstrate that logical representation of knowledge is not necessary for the embodied action of locomotion [14]. The anthropologist Edwin Hutchins showed that real world cognition is often distributed over individuals, rather than localized in a single individual [15], one example being navigation on large ships. There is also a growing body of work showing that, rather than cognition being rational and disembodied, emotion plays a central role [16]. All these developments are deeply inconsistent with cognitivism, though the significance of work done before about 1990 was generally not appreciated at the time.

Phenomenology is an area of philosophy that seeks to ground everything in the actual experience of human beings, i.e., it takes a "first person" experiential perspective, rather than "third person" scientific perspective. Important names here include Edmund Husserl, Martin Heidegger, and Maurice Merleau-Ponty. Heidegger considered implications of embodiment, including finitude and temporality, noting that we are historical beings, bounded in time, space, and ability [17]. Heidegger's notion of pre-understanding resonates with the notions of active vision and readiness potential discussed above; pre-understanding is a senstivity to situations, arising from the life-experience of a being. Many of these same themes also appear in the anti-cognitivist movement, especially the work of perhaps its leading philosopher, Herbert Dreyfus [18]. Another theme, also with origins in Heidegger and especially Merleau-Ponty, but developed by Hubert Dreyfus, is the phenomenological critique of representation, which draws on our experience with routine activities to argue that mental representations are not necessary for embodied action [19]. The work of Merleau-Ponty predates that of Gibson and Brooks, and although it is not experimental, it is empirical, since based on experience. Dreyfus also makes compelling use of work by Walter Freeman [20] connecting brain dynamics with chaos theory (in the rabbit olfactory system).

Post-Cognitivist Trends

The decline of cognitivism has inspired a return to naturalism, the study of cognition as it actually occurs in living human beings, and in particular, a shift towards neuroscience and evolutionary biology. The original coalition of cognitive science shows signs of fracturing. Among several competitors, *neuro-reductionism* is perhaps the most dominant. It has had important successes, but it also has important unresolved problems. For example, the biologist Francis Crick famously wrote, "You're nothing but a pack of neurons" [21] in parody of Lewis Carroll. But most people, including most scientists, and even most neuroscientists, feel there is much more to human life than can be seen at the level of neurons.

Certainly we can find "neural correlates of consciousness," i.e., patterns of neural activity that correlate with various conscious experiences, such as visual perception. But it remains unclear that such correlates can ever explain the nature of consciousness. A narrower version of this challenge is to explicate qualia, which are the qualitative aspects of consciousness, e.g., "how it feels" when one is happy, or when one sees the blue of the sky. David Chalmers introduced an influential distinction between the "easy" and the "hard" problems of consciousness studies:

> The easy problems are those of finding neural mechanisms and explaining cognitive functions: the ability to discriminate and categorize environmental stimuli, the capacity to verbally report mental states, the difference between waking and sleeping. The hard problem is that of *experience*: why does all this processing give rise to an experienced inner life at all? While progress is being made on the easy problems, the hard problem remains perplexing.

One approach to bridging this gap is to postulate that consciousness is some form of emergent activity of the brain. A familiar example of an emergent property is the liquidity of water, which arises from a sufficiently large collection of water molecules at an appropriate temperature. Searle is an eloquent advocate of the view that consciousness is an emergent property of matter [22].

Neuro-reductionism has been especially successful in studying perception, and this has inspired some interesting speculations, for example, on the neural bases for art, as in articles by Semir Zeki, Vilayanur Ramachandran & William Hirstein, and others in [23]. However, many critics have complained that vital cultural aspects of art are ignored in neuro-reductionist analyses [23].

An important problem in neuro-science is to determine the modularity and plasticity of the brain and the mind. Studies have found brain locations associated with many mental functions, but other functions have been shown to be non-local; recent work has also demonstrated physical brain change associated with learning, even relatively late in life. There is strong support for the modularity of many unconscious perceptual processes, and for the non-modularity of many higher level conscious processes. Whether there is a language module, as claimed by Chomsky, has become increasingly doubtful, and there is also a growing consensus against his claim that language emerged suddenly "out of the blue."

There have been proposals to merge phenomenology and neuro-science, such as the neurophenomenology of Francisco Varela [24], and even proposals to reformulate science based on phenomenology. We can expect to see more of this, because consciousness provides many interesting phenomena that demand explanation; for example, it is ineffable, open, fluid, non-local, temporally thick, and involves qualia and a sense of self. Moreover, the emphasis on time in phenomenology resonates well with many issues and results in neuroscience.

Physicists have not been shy to speculate about the relevance of quantum mechanics to cognition, and in particular to consciousness. This is not surprising, since the two have long been linked by John von Neumann's augmentation of Neils Bohr's "Copenhagen interpretation" to say that the consciousness of an observer is needed to "collapse" the probability distribution associated to the wave function to a single state, when an experiment is performed. Roger Penrose, instead of explaining quantum mechanics with consciousness, seeks to explain consciousness with quantum mechanics. His view is stimulating but disappointing, since the major conclusion is that some as yet non-existent physics (namely quantum gravity) is needed [25]. He also argues against cognitivism, based on a Platonist philosophy of mathematics, in which abstract mathematical objects are just as real as chairs, trees, and people.

Distributed Collective Trends

An important general trend in cognitive science, perhaps even the most important recent trend, is away from individual cognition and consciousness, and towards distributed collectivities. For example, biologists are applying socio-biology and evolution to cognition, though most results are speculative, e.g., about the possible co-evolution of language and the brain. An interesting exception is the evolution of morality, as illustrated in a brilliant collection edited by Leonard Katz [26]. Since Darwinian evolution selects for survival, it seems a mystery how unselfish traits could win out over selfish traits. This mystery can be resolved by looking at the evolution of groups

rather than individuals, though the authors in [26] suggest many different ways that this might occur, and apply many different techniques, including economics, and computer simulation of the survival of small groups under various models of cooperation and competition.

The latter is an example of work in an emerging field called *artificial life*, which builds computer simulations of communities to study phenomena such as language learning, and the collective emergence of syntax (though the models of language used are rather primitive); [27] is an early survey of artificial life.

An approach which is becoming popular, sometimes called "second person," is to relate the consciousness of individuals to society. One example is the cultural-historical approach, in the tradition of philosophers Giambattista Vico, Wilhelm Dilthey, and John Stuart Mill, and also of the more recent Russian activity theory of Lev Vygotsky, Alexander Luria and others. The promise of second person approaches is to transcend the problematic relationship between mind and body; debates here often parallel those in consciousness studies, and important syntheses like the cultural psychology of Michael Cole [28] are emerging. The actor-network theory of Michel Callon, Bruno Latour, and others [29, 30, 31] also has related concerns, emphasizing interaction among a heterogeneous collection of distributed resources, including both human and non-human "actants." A key slogan here is "Follow the actors," which means to take seriously whatever the actants take seriously. Ethnomethodology [32, 33] requires an even more radical approach, in which analysts must use the same concepts and methods that members do.

David Bohm is a physicist who developed novel versions of quantum mechanics, having philosophical interpretations that involve information and consciousness. Bohm argues forcefully for the interconnectedness of all reality, and claimed that consciousness is enfolded into every aspect of reality; this is perhaps a kind of ultimate in distributed collective practice!

Based on a fine-grained linguistic analysis of mathematical discourse, both written texts and videotapes of informal discussions [34], Joseph Goguen has proposed a radical reformulation of the notion of proof, in which the *values* of provers are made explicit, along with their important role in structuring proofs[2]. These values include perceived mathematical significance, mathematical difficulty, and degree of existence[3]. In their integration of substantive with evaluative material, real proofs are more like the narratives of personal experience studied by William Labov [35] than they are like computer programs. These and other insights were used in designing the Kumo system for distributed cooperative proving over the web [36]. On-line demos of this system can be sampled via its URL, `www.cs.ucsd.edu/groups/tatami`.

It is a not-so-open scandal that the fields of information technology, information science, etc. have failed to provide (or adopt) any notion of information that is sufficiently precise to serve as a basis for building technical systems, and at the same time can take sufficient account of the crucial social aspects which determine whether or not a system will be successful with its users; e.g., see [37] and other discussions in the area of computer science called requirements engineering. This has motivated a social theory of information that emphasizes values, through relations of accountability of that tie information to the value system of a particular social group [38]. A basic definition in [38] builds on ideas from semiotics and ethnomethodology, to say that

> an item of *information* is an interpretation of a configuration of signs for which members of some social group are accountable.

[2]For example, [34] demonstrates that values (surreptitiously) assigned to mathematical objects when they are introduced play a key role in resolving later abbreviated references to them, e.g. in pronouns like "it" and "that," as well as in more complex phrases.

[3]This might sound strange, but it arises naturally, e.g., in the language of proofs by contradiction in which one assumes something exists in order to show that it does not exist.

This approach was another inspiration for the design of Kumo [36], and we also see it as a promising approach for studying distributed collaborative practice in general. One source of coherence in distributed collective practice is shared values, and some prior work in requirements engineering [37] has shown that values can be revealed by examining the work of interaction, especially discourse, asking questions such as who does it, how is it described, by whom, under what circumstances, and with what intermediation. Techniques used here include participant observation (being trained to do the job, and recording the training sessions), and analyzing jokes and stories, based on structures that have been described by Harvey Sacks [39] and William Labov [35]. Similar techniques have been used in extracting implicit values from user interfaces to computer systems in [40].

Coemergent Arising and Groundlessness

There is a natural tendency to try to ground distributed collective practice, e.g., in individuals, groups, media, interaction, coherence, or values. Such attempts should be resisted. None of these categories are natural and pre-given; they are all facets of our particular culture's way of dividing up experience. Moreover, groups, media, interactions, coherence, and values are all achievements, which arise together through work, which of course is also an achievement.

This is an instance of the Buddhist notion of *pratityasamutpada*, which in Sanskrit is literally "dependent arising," often translated as codependence or coemergence. Found in the earliest teachings of the Buddha, and developed further by Nagarjuna, Vasubandhu and others, this is the notion that nothing exists by itself, but instead, everything is interdependent, or more precisely, everything arises together with other things. This is similar to the Western notion of "hermeneutic circle," which has ancient origins in classical Greece and in various mystical traditions, but has been especially developed in more recent times by Schleimacher [41] and Heidegger [42]. All this seems to provide a far more promising approach to understanding the phenomena of consciousness than cognitivism, though it does so in part by suggesting a different notion of what it might mean to "understand consciousness."

This kind of coemergence has the important consequence that no ground can be found for any form of consciousness, and hence in particular, no ground can be found for distributed collective practice. The groundlessness of the human condition is discussed in depth by Keiji Nishitani [43], in an approach that strongly influenced [13]. Nishitani points out that much of the history of Western thought can be seen as a progressively refined questioning of absolutes. Among the responses to this questioning, two extremes are identified: nihilism, which is absolute relativity; and absolutism, which is the denial of the questioning. Such absolutism may take the form of dogmatism, fundamentalism, or extreme reductionism. Moreover, there tends to be an unstable oscillation between these two extremes, a condition which Nishitani calls[4] the "field of nihility."

However, based upon his experience with Zen meditation, Nishitani says there is a "middle way," which avoids both extremes and the oscillation, by accepting groundlessness as a basis for being. The experience of groundlessness, and a path based upon it, have been described in many religious traditions, using phrases such as "dark night of the soul" and "cloud of unknowing." Results of practicing this middle way are said to include openness, compassion, and harmony with nature; it is also said that one experiences greater joy, strength, and peace. (It is interesting to speculate that mirror neurons might provide a partial explanation at least for compassion.)

This middle way is suggested in [13] as the way forward for cognitive science. Here, I wish to suggest that it might also make sense as a way forward for the study of distributed collective

[4] Actually, this phrase was chosen by the translator Jan Van Bragt; a usual English translation of the underlying Buddhist notion is "relative emptiness," as opposed to the deeper and more creative understanding reflected in the more familiar notion of (absolute) emptiness (*sunyata* in Sanskrit).

practice, enabling a path of cumulative knowing that accepts the results of scientific research without succumbing to scientistic reductionism. Indeed, I feel that such an approach is implicitly embraced by many in this field, including [38], the goal of which was to find a "natural ethics," based on human nature, free of dogma (religious or philosophical), and free of self-interest (whether of individual, family, nation, or any other category). This is perhaps similar to the "planetary thinking" advocated in some late writings of Heidegger [17]. It can be argued that our earlier list of discoveries that count against cognitivism also serve to support such a view.

If we believe quantum physicists, our "current ultimate" reality is something like an "entangled heterogeneous emergent and co-evolving distributed collective," and since the same buzzwords could be applied to our apparently emerging, but by no means new, alternative to the cognitivist paradigm, I would like to caution against reifying it into some new ontology or "underlying reality," as the physicists have tried to do. Instead, I would consider our discussion as a cautionary tale against the various strands of the cognitivist position, as well as an antidote to the extremes of absolutism and relativism. This paper is not another absolutist attempt to find a firm foundation or solid ground on which to base further speculations; it is also not an attempt to deny the possibility of making sense of social phenomena, or the existence of human values. Instead, it proposes a kind of open space of collective possibilities, within which many different kinds of discourse can occur at many different levels of granularity, including of course political discourse.

Moreover, it should not be thought that merely denying the absolutist simplifications of cognitivism will solve any of the hard problems of living in heterogeneous distributed collectivities. We live in a time when weapons of mass destruction are proliferating, and reglional conflicts are escalating, while the population continues to grow and the environment continues to degrade. It is far from clear whether the human species will survive. But I would like to think that we might have a better chance with a groundless consciousness that avoids the distorting postulates of cognitivism, as well as the scylla and charybdis of absolutism and relativism. If we can find a groundless sociology that is consistent with such a perspective, perhaps it would help us to build and live in worlds that better support compassion and equinimity.

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