A Nascent Scientific Theory[1] of Culture

Ted Cloak 1/31/2020

ABSTRACT

The nascent theory (hereinafter "theory") is that cultural features, from children's gaits to world religions, are embedded in human nervous systems as neural images ("nimages") which act as goals for action. I attempt to show how this process works, how it evolved, and how it underpins culture and enables the evolution of culture.

INTRODUCTION

The purpose of this essay is to introduce anthropologists and others with a serious interest in anthropology to a naturalistic causal explanation for culture.[2] Anthropological essays explain (some of) what culture **does**; that is, putting together different forms of technology, social organization, warfare, folklore, religion, ideology, etc.[3] under various circumstances. This essay, on the other hand, explains **how** culture does that, driven only by the causal forces, principally the binding force known as electromagnetism, that enable all the features of living things including all neurobehavioral features. In other words, it explains in physical terms **what culture is and how culture works.**[4]

Moreover, every anthropologist, and anyone else who studies behavior and its outcomes, needs to understand how behavior-in-general works. Understanding the neurobiology of behavior leads easily and naturally to understanding the neurobiology of culture.

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[1] "Theory**": "**a plausible or scientifically acceptable general principle or body of principles offered to explain phenomena." "Nascent": "in the earliest stages of development." (Merriam-Webster)

[2] I'm a cultural anthropologist. I think culture is scientifically real, not just a concept borrowed from folk language by social scientists to generalize about some behaviors. In other words, In Daniel Dennett's (1995: 73-83) (Gregory 1995) felicitous formulation, culture is not a *skyhook*, it's a *crane*, because it evolved as a product of the animal nervous system and is thus grounded in neurobiology.

[3] "technology, social organization, warfare, folklore, religion, ideology, etc." These are the things that comprise many **dictionary definitions** of the **word** "culture".

[4] and thus provides a **scientific definition** of the **thing**, culture.

The neurobehavioral framework that works best is that discovered by William T. Powers, published in 1973 in his seminal Behavior: The Control of Perception, and now known as Perceptual Control Theory (PCT). PCT enables us to work out how behavior acquired more and more sophisticated capabilities, including culture, during its evolution; it is the basis of the theory which follows.[5]

Perception(s)

We start with a brief discussion of perception.

As you read these words, certain activity takes place in your central nervous system; neurons fire. As your eyes scan across the page, that activity subtly changes; different neurons fire and/or neurons fire at different rates. If you turn and look across the room or out the window, the change is more pronounced. For our purposes, that neural activity at any given moment is one of (your) *perceptions* at that moment.

You sniff. "Is that a skunk in the yard?" Perception = skunk odor. "No, it's a plant you smell." Perception = plant odor. Point: Perceptions take place in the brain, and they change with input from the senses and from elsewhere in the brain.

Make a "V for Victory" sign and hold it for a few seconds. Without looking, what is your perception of the position of your little finger? You had that perception, in your brain, before I called it into awareness. What is your perception of the tension of the muscle controlling the tip of your ring finger? You have that perception too, even though we can't call it into awareness. Perceptions take place in the animal nervous system at every level, and they change constantly through events both internal and external to the animal's body.

Images

Imagine some things.

- Imagine a coconut tree on a tropical beach.

[5] Comments and questions are welcome. Go to www.tedcloak.com and click on the Comments and Questions tab at the top, or send direct email to me at tcloak@unm.edu.

- Imagine a 1955 Chevy convertible rolling down Route 66.
- Imagine a hammer repeatedly striking a nail, driving it deeper and deeper into a fencepost.
- Imagine the odor of a new car interior, the "new car smell".
- Imagine the sound of emptying a box of glass bottles into a dumpster.
- Imagine a child riding on the back of a fish.
- Remember an incident – an embarrassing one, perhaps - from your high school days.

In each of these cases, in response to my written words, you are experiencing a mental *image*.

Features of an image:

- Images may be vague, partial, poorly defined. Visual images, for example, aren't always clear or accurate like photographs or film clips; they can be more like tenth copies of holographs, perhaps, except that their shapes shift as you try to focus on them.
- You can invoke an image voluntarily, but much more often they occur spontaneously, triggered by words, by perceptions, or by other images.
- Images can be manipulated, voluntarily or otherwise. They can be combined, overlaid, and changed, seemingly at will.

Nimages

Each image is caused by a specific brain action: a certain suite of neurons and synapses firing in a certain sequence.[6] The resulting images are "mental" phenomena, but the neural suites which, firing, somehow cause images, are of course strictly physical. For that reason, I feel justified in coining a word for the firing suites: "neural image" or, for short, *nimage*. An image is nothing but a manifestation, in awareness, of a nimage.[7] For our purposes here, however,

[6] As of today, no one can describe the exact neurological process that produces any specific image, but we do know that messing with the neurology can change or even cause a reported image.
[7] Nimages (may) cause images, but images don't cause anything; they are epiphenomena.

images are very useful because they provide us with windows into their underlying nimages.

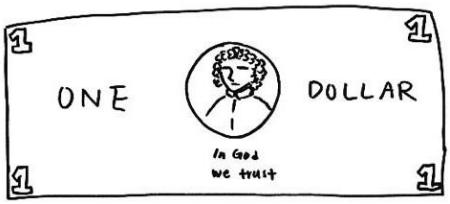
Although all nimages have the same general structural and functional characteristics, and every image reflects one or more nimages, not every nimage causes an image. In fact, at any moment, in your nervous system and mine, there are hundreds of active nimages, but only a tiny few of them are producing an image. Indeed, in any animal that has a nervous system and is alive, there is always a multitude of active nimages.

Nimages and perceptions: Perceptions may be quite detailed but are usually ephemeral; nimages are vague and general (like images) but are kept, more or less permanently, in the nervous system. Nimages may be "captured" from perceptions, in which case they usually preserve (only) the gist, or essence, of the source perception.[8]

Assuming you have stayed with me this far, okay, why do we animals have nimages? Of what use are they? What is their function? That is, what do nimages *do* that has caused the nimage apparatus to be retained and propagated by natural selection?

I'll tell you right away that nimages are an essential part of the nervous system. Without them animals, including you and me, would act like the robots attempting to feed Charlie Chaplin in *Modern Times,* apparently trying to do something but almost always missing.

[8] I think Epstein (2016) inadvertently illustrates the difference when he reports an ad hoc experiment he has used in his classes to attack representationism. He has an intern draw a U.S. dollar bill first from memory and then while perceiving a dollar bill. Here is the result:



From memory – image (nimage)

From "life" -- perception

I'll also tell you that I have no idea how nimages (or control systems, to follow) are physically realized in a nervous system, although serious progress is being made in that area (e.g., Shen et al 2019).

For that matter, what is the evolutionary function of a nervous system, of neurons in general? What are they for? Well when firing, neurons collectively enable muscular actions, by the animal carrying them, which change and/or maintain the animal's physical relation to features of its environment, and thus may allow it to avoid predation, obtain resources, and reproduce. They enable behavior or, rather, different behaviors for different situations. Without nervous systems, we animals would not be able to *do* anything. We would be utterly sessile, like mature barnacles, or flopping around at random, or just acting reflexively to touch or light or sound or temperature.

For example, consider a person reaching for a cup of coffee: The person checks the location of the cup and then a whole bunch of neurons and connected muscles fire, the person's arm rapidly and smoothly extends, and his fingers close around the cup handle. That requires an enormous amount of coordination among those neurons. They must have been programmed to interact like that, by natural selection over hundreds of thousands of years, and by trial-and-error learning over the individual's early life. Yet every coffee-cup situation is a little different. The person's position varies; the cup's position and orientation vary; the handle may be thicker or thinner; intervening objects may be present or absent. Some of those external factors may even change during the reach. The program must continually vary somehow to suit each actual case, for the movement to be smooth, swift, and precise.

The role of nimages in this process is to provide a *perceptual reference standard*: The animal activates a nimage and continually compares its current perception to the nimage, executing motor activity until the perception resembles the nimage. Thus, regardless of initial and intervening conditions, the result is the same: a perception approximating a nimage, {Hand Gripping Cup Handle}.

The Control System[9]

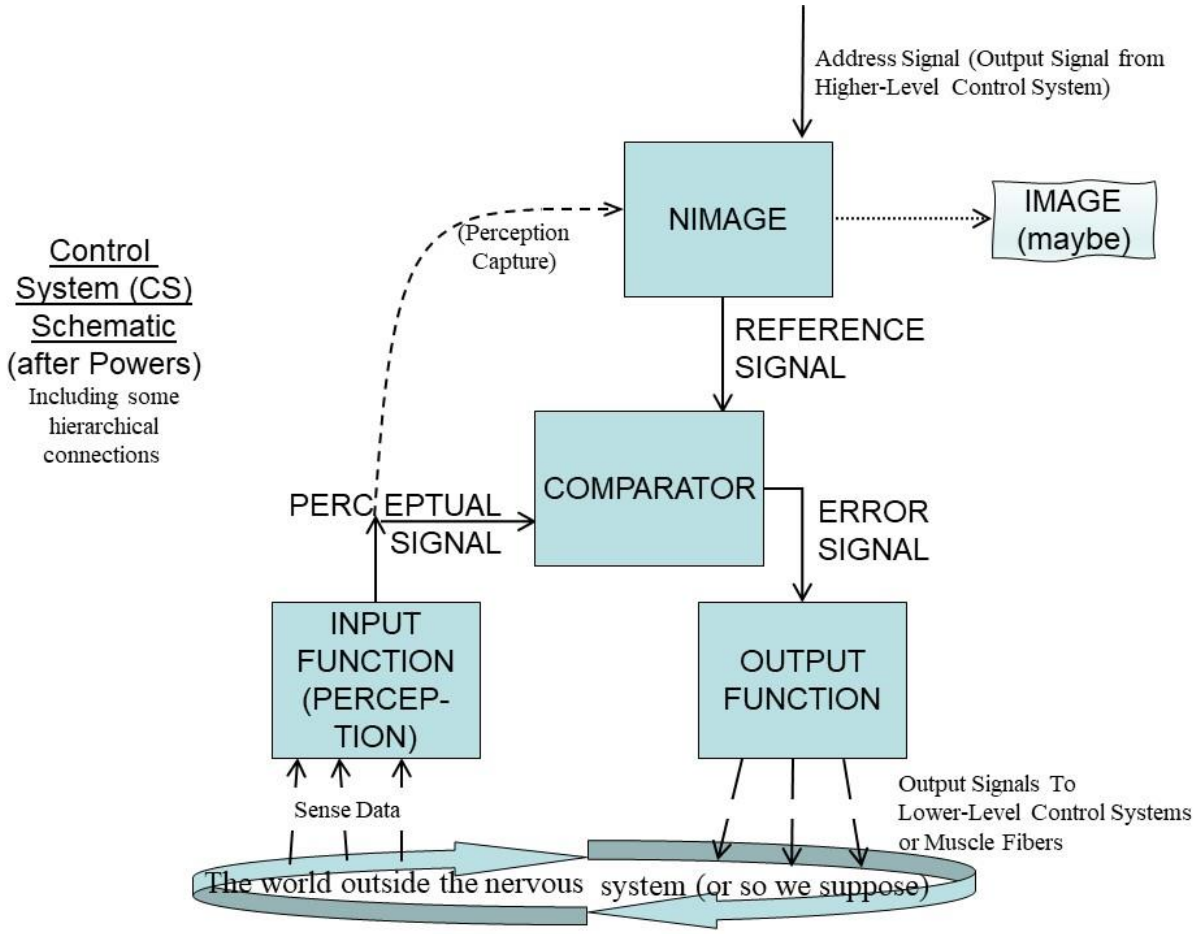
The nimage has that role because it has evolved with, and as part of, a *control system*, a larger suite of neurons which enables several functional elements (see the following diagram or, for an animated video, see Cloak 2015, Sec 2.3):

1. An input perceptual signal, from the animal's sensory apparatus.
2. A reference signal, from the nimage.
3. A comparator, which compares perceptual signal and reference signal and issues an error signal representing the difference between them, and
4. An output function which, receiving the error signal from the comparator, sends signals to one or more muscles,[10] causing them to contract and/or relax, presumably making some change in the system's environment that alters the input perception/perceptual signal, until the strength of the error signal approaches zero.
5. Then, later, should either input signal or reference signal change, the comparator will increase the error signal, and the process will resume.

[9] A word about the word "control": There are at least two uses of "control". Consider your household thermostat: In one sense, the thermostat controls your furnace: It switches the furnace on and off. In another sense, the thermostat controls the temperature of the room; that is, it maintains the room temperature between two preset values. * It's mostly in the latter sense that I use "control" in what follows.

*Actually, the thermostat controls the input from its temperature sensor. Imagine holding an ice cube near the sensor. No matter how warm the room becomes, the thermostat keeps the furnace running.

[10] Or other effectors such as glands



Actually, in most cases the control system runs continually, as when the nimage calls for relative persistence rather than change. For example, you hold out your hand for some reason – to hold a cup, say. You are trying to control a perception of your hand keeping its position; in other words, you are trying to keep your perception of your hand matching your nimage {Hand Holding Cup Steady}. But gravity is trying to thwart you. As it pulls your hand down a little, your perceptual signal deviates from the match. Accordingly, your comparator increases the error signal to the output function, which sends signals resulting in muscular contraction opposing that gravitational pull. Even though the downward movement is still scarcely perceptible, it is resisted and the match is restored. This constant negative-feedback loop process continues until you decide to do something else with the hand/cup. Meanwhile, your hand and cup (appear to) remain steady.

In short, behavior exists to control perception; that is, to obtain and maintain perceptions which approximate nimages. Powers puts this even more strongly: Behavior *is*, in fact, the control of perception. **Indeed, how else could such complex actions be accomplished, with such speed and such precision, by animals in a universe in constant flux?**

Hierarchies of Control

Now, in truth, most perceptual control systems neither receive their inputs directly from sensory cells nor send their output signals directly to muscle cells. Instead, most control systems are intermediate modules in a *hierarchy* of control systems: Their nimages are activated or modified or adjusted by the output signals of control systems above them in the hierarchy, and their output signals similarly adjust the nimages of control systems below them.

Yes, nimages are adjustable! Look at one of the images suggested above or make up one of your own. You can put another child on that fish, or specify the kind of fish, or really do anything you want with that image, which of course means that you can voluntarily modify or adjust the underlying nimage. How evolution accomplished this and yet kept the whole behavioral system from flying apart frankly boggles the mind. But, in the event, it did. [11]

NOTE: Henceforth, our convention will be as follows: Expressions within wiggly brackets ({}) represent nimages and/or their associated control systems.

Now think about the {Hand Holding Cup Steady} scenario again. The output signal from that control system doesn't go directly to a muscle. Instead, it may go to adjust nimages of angular positions of joints: shoulder, elbow, wrist, perhaps fingers. Those nimages' control systems may in turn signal adjustments to the nimages of proprioceptions of the various muscles involved. {Hand Holding Cup Steady} is *using* the subordinate nimages' control systems to maintain its perception of your hand remaining still.

[11] At the lowest levels, output signals may act directly as the reference signals of subordinate control systems.

In turn, {Hand Holding Cup Steady} is itself subordinate to, say, a {Drinking from Cup} nimage/control system, which in turn is at the bottom of a hierarchy extending up through {Drinking Coffee} all the way up to {Stayin' Alive}.

Now suppose you decide to drink from the cup. {Drinking From Cup} now addresses {Cup Moving Toward Mouth} instead of {Hand Holding Cup Steady}. {Cup Moving Toward Mouth} adjusts {Elbow Joint Bending} and so forth. The smooth rapid accurate curvilinear movement of the cup is the result of constant mid-course correction of a host of hierarchically organized control systems.

Maintaining Equilibrium

Each control system runs as a negative feedback loop, maintaining an equilibrium. But since the nimage of each system is impacted by the output signal of other systems, and since the incoming perceptions are also constantly changing, that equilibrium is dynamic. Therefore, the whole organism is itself a machine in dynamic equilibrium. And, because each evolutionary moment has been governed solely by vagaries of the environment including the existing composition of the organism, over the eons organisms of every kind have accrued way too many moving parts, many of which must be kept in equilibrium or the whole thing crashes. Evolution, therefore, has resulted in redundancies and repair mechanisms which, in turn, has multiplied the number of moving parts. An organism is an engineer's nightmare. No engineer, not even God Himself, would design such a thing. The nervous systems of animals, of course, are no exception.

Nevertheless, obviously, the elements of each control system and the connections between them have been "designed" so well by genetic evolution and learning that their actions are quick and accurate and smooth, sometimes amazingly so. I say "obviously" because we don't expect a healthy mature organism to thrash about at random until it accidentally succeeds in matching perception to nimage.

Evolution of Control Systems

I suspect that early in the history of the animal kingdom, as actions became more than simple reflexes, an original primitive control system evolved, complete with nimage, and that that system served as a template/ancestor for the evolution and proliferation of nimages and their control systems and hierarchies.

In earlier and simpler species, every nimage/control system develops completely during ontogeny; in other words, each is entirely genetically programmed. Then, later, some nimages require shaping during and after ontogeny. Think of a kitten learning to {Be A Cat}, or a person practicing to {Be A Better Musician or Athlete}. In such cases the hierarchy of control already exists; for each system in the hierarchy, what's being shaped are the nimages of its subordinate control systems and/or the reference signals sent to them.

From that, trial-and-error or *operant learning* eventually evolved, comprising the actual creation of a subordinate nimage/control system. When the successful matching of an existing nimage (e.g., {Sweet Taste}) is preceded by a certain perception; e.g., seeing a ripe strawberry, that perception may be captured by the {Sweet Taste} nimage's control system and *accepted* as the nimage of a new subordinate {Seeing Ripe Strawberry} control system. That's how hierarchies of control are built. The organism already wants the sweet taste, and from now on wanting that taste makes it want to see a ripe strawberry. And so forth: That would be just one step in acquiring an entire strawberry-foraging hierarchy.

It took about three billion years of evolution to perfect that stage, yielding the behavior-acquisition capabilities of cats, octopi, dogs, pigeons, and our primate ancestors. Then, roughly between 20 and 50 million years ago, came *mirroring* (Gallese et al. 2011): An animal observing another animal behaving in a certain way activates that same nimage/control system in its own repertory.

The Emergence of Culture; Memes

Next came full-fledged *observational learning*, wherein an Observer animal, O, perceives an action (or action-outcome) by a Demonstrator, D, which is *not* already in O's repertory; creates and stores a pretty good facsimile of the nimage

governing D's behavior; and fits it into a perceptual control system.[12] (With repeated observations, O may replicate a whole hierarchy of D's nimage/control systems.)

Then, by plugging in and shaping existing images/control systems as subordinates, and/or by developing some subordinates by operant learning, O puts together the entire control hierarchy necessary to replicate D's action. O has thereby acquired some bits of *culture* from D: O's replicates of D's nimages turn out to be what, in the early 1970s, I called "cultural instructions" and Richard Dawkins famously dubbed *memes*.[13]

The spread of yam-washing and grain-filtering famously found in some troops of Japanese macaques comes to mind here, as do certain tool-making behaviors of chimpanzees.[14]

A great deal of human cultural acquisition occurs through observational learning. Memes for tool making and use are obvious examples. The clearest examples occur when D is unaware that O is watching or listening, as when children pick up facial expressions, gait variations, and linguistic elements characteristic of their group.

Cultural Evolution

A nimage isn't a meme until it's acquired by observational learning or verbally (below), but once it's a meme it can participate in the evolution of culture via natural selection: Like a gene, if its expression frequently enables its retention and propagation in its current surroundings,[15] a meme can achieve some degree of permanency there.

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[12] "Most human behavior is learned observationally through modeling: from observing others, one forms an idea of how new behaviors are performed, and on later occasions this coded information serves as a guide for action." (Bandura 1977:22)

[13] Note that the effort involved in cultural transmission is always done by O, but by D only in special circumstances. It's probably better to think of cultural acquisition rather than transmission. The world's champion acquirers and bearers of culture are, of course, human beings -- particularly the young.

[14] One argument for calling those infra-human examples "cultural" is that, at least at first, memes tend to spread rapidly within one local group but stop at group boundaries.

[15] That's the essence of my definition of Natural Selection (Cloak 1986).

The different natures of genes and memes make for great differences between the mechanics of genetic and of cultural evolution. To illustrate, imagine a troop of ground-dwelling monkeys, like macaques or baboons, who subsist mainly on roots. The troop has been joined by a monkey from a neighboring troop, as either a captive or a refugee. There are two versions of this story, a "gene" version and a "meme" version.

In the gene version, the new member is carrying a gene (really a version of a gene, an allele) not currently in the troop's gene pool. Let's say this "new gene", when expressed, modifies or replaces the nimage of a local plant.[16] The new member finds a mate. Now the tests of natural selection begin: Remembering that an organism is a functionally integrated whole, and that most genes have multiple phenotypic effects, do these matings produce offspring at least as viable as those produced by within-troop matings? If so, does the new nimage, on balance, enable its carriers to expand their diet? If so, the new gene may become established, and eventually fixed, in the troop's gene pool, as its carriers are better able to survive and reproduce than their non-carrying kin. We call such long-lasting change (genetic) "evolution".

In the meme version of our scenario, the immigrant monkey again possesses the nimage, novel to the host troop, of a plant with an edible root. Her searching for, obtaining, and eating that root attracts the attention of some (probably young) members of the troop.[17] Some of them may thereby create nimages similar to hers in their own nervous systems, or modify existing nimages to match hers. Some of them may complete the process lined out in "The Emergence of Culture", above. (I keep saying "some" and "may" to indicate the multiple selective factors at work in this whole scenario.) If so, the acquired nimage is now a meme. If, over time, this meme spreads throughout the troop, and endures for a reasonable length of time, at some point we can call the scenario an example of cultural evolution.

[16] The "new gene" could just as well be a local mutation; the subsequent process is the same.

[17] The monkey with the "new meme" could just as well be a local inventor; again, the subsequent process is the same.

On the other hand, a stranger nimage may pass all the tests to become a meme, spread rapidly throughout the troop or village or nation, and then just as rapidly fade from the repertory; that scenario wasn't evolutionary. The meme was only a fad. Think popular dance-steps.

Language and the Evolving Dominance of Culture

Without language, the highest level nimages/control systems are those genetically provided to meet basic physiological and social needs for survival and reproduction; e.g., {Stayin' Alive}, {Taking Care of Mate & Offspring}. Memes acquired by observational learning may be selected if they serve those nimages/control systems.

I'm sure you've noticed that the operation of each nimage/control system is, per Powers, goal-directed, the goal being to match a perception to a nimage through muscular action. Language lets us have goals that are more like the everyday usage of the term, including nimage/control systems even higher than the basic needs systems.

At some point during the evolution of language capability,[18] it became possible to describe perceptions; i.e., express them with utterances, like "(I see) a bird" or "(I smell) a rat". After that, it was an easy evolutionary step to describing *nimages*, which of course requires the hearer to re-create and save the nimage.[19] If the hearer *accepts* the nimage; i.e., incorporates it into a control system, it perforce becomes a meme, a goal for his/her perception.

Now, therefore, a meme can be anything a person can think of wanting to perceive[20] if he/she then describes it to another person and the other person accepts it. Opportunities for cooperation and competition increase greatly. Planning becomes possible: Gratification can be deferred more widely and much longer in time. Social groups can be much larger and much more cohesive.

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[18] about which I claim to know nothing, but it probably occurred before the Middle Paleolithic-Upper Paleolithic boundary, about 40 thousand years ago.

[19] This could be where people began to experience images (speculation).

[20] I think combining two or more dynamic nimages, letting them run together, and accepting or rejecting the outcome nimage fits well into D. T. Campbell's (1960) theory of creative thought.

Even more important, a complex system of tools, techniques, values, and social relations can spread widely as a collection of memes in interlocking hierarchies, adopted all together by an individual or even all/most members of a neighboring population. One might call such a collection a *supermeme*. Although supermemes continue to be shaped by the usual selection process, they often become dominant, in effect domesticating populations and their existing cultures. This happens when a supermeme's expression and its outcomes, becoming part of the environment, determine the further selection of memes and even of genes.

Verification and Applications of the Theory

I don't think this nascent theory is of the kind that can be tested by an experiment or a survey, although I hope someone will think of a way to do so. (There is a substantial scientific literature validating Perceptual Control Theory[21] from which I have borrowed extensively.) Rather, this theory is of the kind which, like evolution or string theory, can be validated only by proving itself useful in the development of the science it purports to cover. Cultural anthropology, for example, might benefit if fieldworkers sometimes focus on what informants try to perceive, rather than what they do (or say they do), and try to include multiple hierarchical levels in their analyses. Studying the Method of Levels would be a good way to start.

That last is not meant to suggest that my theory here necessarily refutes existing studies in anthropology or other behavioral science. On the contrary, as I've said in several places, it's intended to provide those sciences with an underlying causal explanatory basis, a need long recognized by anthropologists.[22]

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[21] **Perceptual control theory** . See, especially, Mansell and Carey, 2015.

[22] "Nor are the facts of culture history without bearing on the adjustment of our own future. To that planless hodgepodge, that thing of shreds and patches called civilization, its historian can no longer yield superstitious reverence. He will realize better than others the obstacles to infusing design into the amorphous product; but in thought at least he will not grovel before it in fatalistic acquiescence but dream of a rational scheme to supplant the chaotic jumble." Lowie 1920: 441.

For Example (1): Among humans where memes and hierarchies have become fixed in a small isolated population of hunter/gatherers or gardeners, the Darwinian interdependency among the memes in a collection may make the collection (appear to be) a functionally integrated whole, analogous to an organism: what anthropologists call *a culture*. Terms such as "ethos", "theme", "mores", and "pattern" have been employed to explain that integration. Such explanations would be improved, and could be confirmed scientifically, if usages of those terms were grounded via the language of memes and hierarchies.

For Example (2): High-level nimage/control systems like {Defending Our Village and Fields} could well have been instrumental in the evolution of settled agriculture, the "Neolithic Revolution". Indeed, the Neolithic itself might be examined and studied as an evolving supermeme.[23]

For Example (3): The political economy of a society or nation-state could be cast as the top meme of a supermeme. It could be very interesting to tease out the ways in which a political economy may have enlisted existing memes, and even supermemes, to serve it.

Takeaways and Further Work

1) Science is unitary: All causal explanations lead back to the physicists' basic forces of nature. Trying to scientify words or concepts from everyday language is risky. Too often such words and concepts, however carefully defined, turn out to be skyhooks instead of cranes (Dennett 1995: 73-83).
2) In the final analysis, both living things and human-made machines are mechanisms caused through the basic forces known to physics; nevertheless, they are fundamentally different in nature, because of the way they come to exist.
    - Like all artifacts, human-made machines are designed/planned from the top down, created according to goals (nimages) carried in somebody's nervous system. As a rule, because engineered, they are

[23] It appears that a supermeme might be a special case of a *memeplex*, as discussed by Blackmore (1999, *passim).*

subject to reverse engineering. They are special-purpose mechanisms.

- Living things, on the other hand, have none of those characteristics. Instead of top-down, they are the quintessence of bottom-up: trillions of unplanned, utterly goal-less hit-or-miss events over billions of years on the part of molecules, each subject to Darwinian "selection" by all the complexities of its environment. Efforts at reverse engineering, e.g. prostheses, don't even come close. Living things are all general-purpose mechanisms.

It is truly remarkable that only the latter process could have yielded the exquisitely controlled movements of earth's animals, including of course human beings.

3) The principal function of a nervous system is to mediate behavior.
4) William T. Powers' (1973) insight about perceptual control systems and hierarchies thereof provides the only known framework for a satisfactory scientific explanation of neuromuscular interactions mediating movement, tone, and posture; i.e., behavior.[24]
5) Memes are *nimages*, reference standards in perceptual control systems, which have been copied from one nervous system to another via

[24] Steven Pinker (1997, p. 11) came up with an excellent way of presenting the problem: "Controlling an arm presents a new challenge. Grab the shade of an architect's lamp and move it along a straight diagonal path from near you, low on the left, to far from you, high on the right. Look at the rods and hinges as the lamp moves. Though the shade proceeds along a straight line, each rod swings through a complicated arc, swooping rapidly at times, remaining almost stationary at other times, sometimes reversing from a bending to a straightening motion. Now imagine having to do it in reverse: without looking at the shade, you must choreograph the sequence of twists around each joint that would send the shade along a straight path."

But his solution/explanation, immediately following, is utterly lame: "The trigonometry is frightfully complicated. But your arm is an architect's lamp, and your brain effortlessly solves the equations every time you point."

First, has anybody, other than Powers, done any better than that?

Second, check my hierarchical PCT explanation of almost the same problem on pages 5-8. It's an analogue solution, not a digital one. You *never* stop "looking at the shade (cup)"; you keep your *perception* under constant control.

observational learning or verbal tuition. *Sometimes* they become units of culture, whereby they become natural targets for anthropological research.

6) Culture evolves through the natural selection of memes.
7) With the advent of language, culture has evolved into an incredibly powerful force.[25] It has enabled heretofore impossible material accomplishments, a mixed bag of social forms, and now a threat to the entire biosphere.

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[25] The supermeme idea (p. 14) is perfectly in line with Perceptual Control Theory, but I've skipped some analytic steps. For one thing, I've been treating a control system hierarchy as a linear, one-dimensional, phenomenon. Yet as the control system schematic on p. 7 indicates, Output Functions generally address more than one subordinate control system, so the hierarchies are in fact three-dimensional: High-level Perceptual Control Systems enlist several hierarchies in their service, and they proliferate downward like the roots of a tree. For another thing, each of the "tools, techniques, values, and social relations" underpinning a supermeme is a meme/nimage at the top of a hierarchy of its own. What shall we call them, and how shall we plug in existing concepts from behavioral and social science? Further analysis is clearly needed.

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-30-