Review of: "Doyle's Two-Stage Approach to Free Will: A Biophysics for Real Choice?"

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Edwards asks five salient questions in his discussion of Robert "Bob" Doyle's two-stage model of free will. Here are some suggested answers…

1. Is there genuine indeterminacy in the world?

Yes, and only one "genuine" source, quantum indeterminacy. Computer generation of pseudorandom number sequences can have an identical distribution (e.g., Gaussian) of numbers, but given a unique "seed" number, generated sequences would be identical, as Daniel Dennett ultimately accepted as a criticism of the free will model he proposed to libertarians in his 1978 book *Brainstorms* (which in his 40th edition he abandons and now accepts the two-stage model with quantum indeterminacy).

2. Can indeterminacy at a fundamental (quantum) event level show through at a biological scale in a way that could matter?

Yes, in his 2009 Nature article, "Is Free Will an Illusion," the German neurobiologist Martin Heisenberg showed that fruit flies and even single-celled organisms like bacteria exhibit indeterministic motions (bacterial chemotaxis). He wrote " The idea that animals act only in response to external stimuli has long been abandoned, and it is well established that they initiate behaviour on the basis of their internal states, as we do."

(Nature, vol. 459, 2009, p.164)

3. How could random events be programmed into brain function?

Brain function naturally evolved. It is not "programmed." The metaphors "man is a machine" and "brain is a computer" are helpful, especially in the design of artificial intelligence as we try to make digital computers as capable as humans, but they are limited.

Man is not a machine. The brain is not a computer. And although the brain/mind is processing vast amounts of information, it is not digitally processing data stored and retrieved by a central processor or parallel processors as computational cognitive neuroscientists assume. There is no "representation" in the brain like a display on a computer screen or a Cartesian "theater of consciousness."

Edwards' question 3 may be reframed as "where is quantum randomness located in the brain so as to generate the

alternative possibilities for thoughts and actions needed in the first stage of Doyle's model?"

The answer depends on *how and where information (knowledge) is stored in the brain*and later reproduced.

In Doyle's Experience Recorder and Reproducer model of the mind, information is stored in a "Hebbian assembly" of neurons that have been wired together.

A new experience fires a new assembly of neurons many of which may overlap with previously wired together assemblies. Consciousness takes more than a single neuron.

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In his 2005 article for the *Journal of Consciousness Studies*, Edwards asked "Is Consciousness Only a Property of Individual Cells?" Since a single neuron can have thousands of synapses, which many computationalists think might be equivalent to logic gates, a conscious experience in a neuron would contain only a kilobyte of information, far short of a typical experience. And there is no plausible mechanism for reading out and "processing" the digital data on a sequence of synapses.

If on the other hand an experience is contained in a Hebbian assembly of thousands of neurons, the information content would be of the order of a megabyte, and there would be possible connections to many different cortical and subcortical areas and nuclei throughout the brain, thus solving *the binding problem*.

4. Must all indeterminacy be random, as in Hume's claim that events are either determined or random, with no intermediate option, or does creativity, or novelty, involve a third way?

As Doyle's work in cosmology has shown, any event that creates new information (negative entropy) in the universe must generate equal or greater positive entropy to satisfy the second law of thermodynamics. That positive entropy must be carried away leaving the pocket of negative entropy. All biological systems do this. A deterministic physical system, by contrast, is said to conserve information, exactly as total matter and energy are conserved quantities. Some modern physical theories, for example black hole physics, claim that total information is a conserved quantity.

Creativity and novelty, new information in the universe, requires a two-step process analogous to Doyle's two-stage model of free will or the two-step process of Darwinian evolution. As Claude Shannon's theory of communication has shown, there must be many possible messages in order for a given message to communicate new information. In a deterministic universe, conserving total information, there is only one possible future with all messages determined.

See informationphilosopher.com/introduction/creation

5. What would an 'adequately determined choice' be – another name for a recognisable physical process or something other?

An "adequately determined" physical process is one that contains a large enough number of atoms and molecules to "average over" random quantum events. Most macroscopic objects can be treated with classical Newtonian mechanics.

This is similar to the “law of large numbers” in statistics, where predictions become more and more accurate the larger the number of samples. As Edwards correctly writes, “we have reason to believe that the behavior of these solid objects is explained by vast numbers of atoms working together.” (p.4)

Edwards provides a powerful example of the role of quantum randomness in the immune system, where a billion B lymphocytes must produce random antibodies to fight new infections. He says “There is no way of making an antibody by *instruction*.” This is to note that immunology was once thought to contain the complete instructions (that is to say all the *information content) needed to construct antibodies for all* possible antigens. Instead our immune system now includes a means of *creating new information* that will match (as a lock in a key) new foreign antigens never before seen by the immune system. Once a B lymphocyte locks on to a new antigen, it must clone itself to generate millions of duplicates to kill off the foreign antigen. This is not Darwinian natural selection, but a similar blind variation selective retention (BVSR) process known as clonal selection theory.

In his own answer to question 3, Edwards considers “how to set up (alternative) possibilities for choices in brains.” Doyle suggests we can find the suggested answer back in William James’ and his stream of consciousness or perhaps multiple simultaneous such streams, producing James’ “blooming, buzzing confusion” and demanding the agent’s attention to simply focus on one of those possible streams.

As the agent sees those varied experiences flash before him,he may instantly focus on one or he may more self-consciously consider them all and use his values and feelings to “adequately determine” his best option, as the second stage in Doyle’s two-stage model requires.

A further answer to Edwards question 2, "are events either determined or random," the answer is a combination of both, first a "Free" stage, then a "Will" stage.

Our thoughts and actions come to us *freely* (as James understood), and most of our decisions go from us *willfully*, adequately determined by our values and feelings, based on the ERR instantly reproducing those feelings in past similar and relevant experiences, simply by firing the old Hebbian assemblies.

Doyle's free will model and mind model are simple and straightforward compared to imagining digital computer processing in nervous tissue. Warren McCulloch and Walter Pitts 1943 article "Logical Calculus of Ideas Immanent in Nervous Activity," inspired by the machine-like *calculus ratiocinator* of Leibniz that would automatically prove all necessary truths, true in "all possible worlds," was a *tour de force* that drove the creation of working Turing machines and today's artificial intelligence.

But in Doyle's opinion, a much better computer parallel with human mental activity is the *large language model* in today's artificial intelligence. A chatbot reply to a question is prepared from pre-trained sequences of words with high transition probabilities from the sequence of words in the question.

Compare the experiences reproduced by the Experience Recorder and Reproducer. They are those which are stimulated to fire because the pattern of somatosensory inputs, or the thoughts in the prefrontal cortex, resembles the stored

experiences in some way, providing the brain/mind with the context needed to interpret, to find meaning in, the new experience and to provide options for our decisions.

See Doyle's article *Is the Mind a Natural Intelligence (NI) Large Language Model (LLM)?* https://informationphilosopher.com/mind/llm/

Also see these primary references to Doyle's free will model.

His book: Free Will: The Scandal in Philosophy is available as a free PDF download https://informationphilosopher.com/books/scandal/

His Information Philosopher website section on free will is…http://informationphilosopher.com/freedom/