The Two-Stage Solution to the Problem of Free Will

How Behavioral Freedom in Lower Animals Evolved to Become Free Will in Higher Animals and Humans

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Why Information Philosopher?

Information is neither Matter nor Energy.
But it needs Matter for Embodiment.
And it needs Energy for Communication.

I think of information as *immaterial,* a spirit…
Information is the mind in the body.
Information is the ghost in the machine.
Information is the soul in the flesh.

When we die, it's our *information* that is lost.

Why Information?

Information is the distinguishing factor that divides biology from physics and chemistry

No atom or molecule has a history of its experiences.

Biological organisms use information from their past to guide their future actions.

No species is more dependent on information than ours. Where does information come from?

The Origin of Information

We think the universe began 13.75 billion years ago in a state of equilibrium. Given the second law of thermodynamics, why isn't it still in equilibrium?

How can we be having this conversation and exchanging new information?

The answer is that we are *creative*. We can create new information because we are a vital part of a *cosmic information creation process*.

The Cosmic Creation Process

Information creation uses two branches of physics – quantum mechanics and thermodynamics.

Quantum processes form bound states of matter – fundamental particles, atoms, molecules, etc.

But thermodynamic entropy must be carried away from a new information structure for it to be *stable*.

This is the Ludwig-Landauer Principle

The Ludwig-Landauer Principle

In the process of quantum measurement, for every bit of information acquired, one or more bits of entropy must be carried away by the macroscopic measuring apparatus (Ludwig, 1953)

The change of one bit of computer data requires the computer system to absorb one (usually many more) bits of positive entropy (Landauer, 1961).

Creating information is always a measurement.

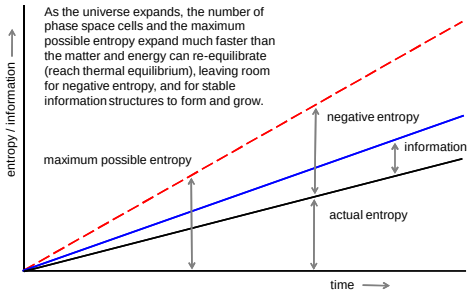
The Problem of Measurement

Von Neumann's "cut" or "schnitt" between the atomic and macroscopic levels happens at the moment *information* enters the world, with or without "conscious" observers.

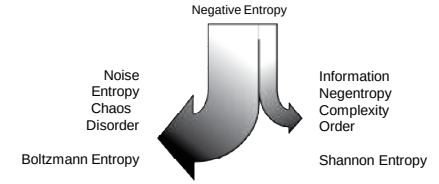
Unless there is a "collapse" of the wave function,
at least one bit of information acquired,
and at least one or more bits of entropy carried away,
there can be nothing for a "conscious observer" to observe.

How can information increase even as entropy increases?

The Layzer Principle



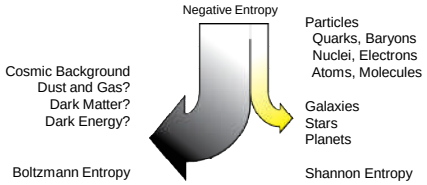
Information Flows



The Layzer Principle shows how entropy and information increase at the same time in the expanding universe. There are *two info/entropy flows*…

Note that in any process, the positive (Boltzmann) entropy increase is always at least equal to, and generally orders of magnitude larger than, the negative (Shannon) entropy in any created information structures.

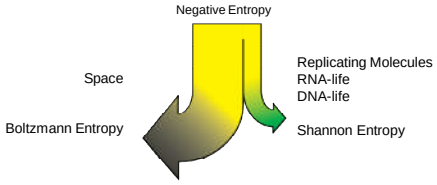
Info Flows in Cosmology



Note that the stable quantum mechanical systems and self-gravitating systems have extremely long lifetimes, thanks to quantum stability.

Although quantum processes break the *illusion* of a chain of causation and pre-determinism, the most important contribution of quantum mechanics is to provide stability against quantum and thermal noise.

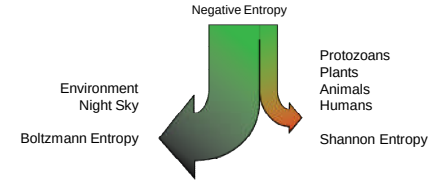
Sun-Earth Info Flows



Most of the negative entropy flow from the sun is wasted, passing the earth and lost to outer space.

A tiny fraction is captured by the earth, keeping us at a temperature comfortable for life forms to evolve.

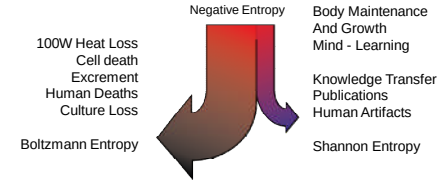
Info Flows in Biology



Every biological structure is a quantum mechanical structure.

DNA has maintained its stable information structure over billions of years in the constant presence of noise.

Info Flows in Humans



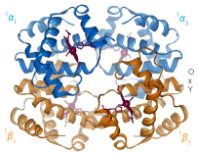
The stable information content of a human being survives many changes in the material content of the body. Only with death does human information (spirit, soul) dissipate - unless it is saved somewhere.

The total mental information in humans is orders of magnitude less than the information content and information processing rate of the body.

Information Processing in RBCs

100 million red blood cells die each second
x
300 million hemoglobin proteins in each RBC
x
100s of amino acids in each hemoglobin
=
100,000 terabytes of information per second

Hemoglobin protein



Every time a tRNA adds a new amino acid to the growing polypeptide chain it is a *quantum event*!

Free Decisions Create Information

Both short-term memory and long-term changes in your character (Bob Kane's Self-Forming Actions) create new stable information structures in your brain.

So quantum mechanics, including *both*
its short-term-indeterminacy
and its long-term stability,
is always involved in free will.

But can we reconcile quantum indeterminacy with freedom?

And can we convince the free will skeptics?

Most Books On Free Will Deny That It Exists

The Standard Argument Against Free Will

Logical philosophers (Ayer, Smart, et al.) like to say:

Either Determinism is True or Indeterminism is True.

If Determinism is True, We Are Not Free.

If Indeterminism is True, our Will is Random, they say, so we cannot be responsible for our actions.

They conclude that Free Will is *incompatible* with *both* Determinism and Indeterminism.

A Flaw in the Standard Argument

It is false that Free Will is *incompatible* with Indeterminism.

Indeed, free will requires some indeterminism to break the causal chain of determinism and is inconceivable without it (to paraphrase R. E. Hobart, *Mind*, 1934).

Let's look at *Incompatibilism* more closely, to see if we can correct this flaw in the Standard Argument.

Incompatibilism Corrected (1)

Free Will is not incompatible with real world Determinism.
But it is incompatible with *Pre-Determinism.*

Pre-determinism means that our actions are determined by causal chains from the ancient past long before our births.
(Peter van Inwagen's Consequence Argument, Galen Strawson's Basic Argument)

It is indeed true that if our decisions were *pre*-determined, They could not be Free. We could not do otherwise.

Incompatibilism Corrected (2)

Free Will is also Incompatible with any *Indeterminism that directly causes* a decision of the will.

If our decisions are random, they are not caused by our reasons and desires and we are not responsible.

(We exclude Bob Kane's "torn decisions," where the agent can be responsible if she has good reasons to go either way.)

Compatibilism Corrected (1)

Free Will is Compatible with what I call *Adequate Determinism,*
the everyday determinism of classical physics,
the Newtonian mechanics that we use to send men to the moon, with no concerns about quantum indeterminacy.

Adequate determinism provides the *determination* (but not pre-determination) of the will required for responsibility.

R. E. Hobart's 1934 Mind article was actually titled
"Free Will as Requiring Determination and Inconceivable Without It."

Compatibilism Corrected (2)

Free Will is also Compatible with some *chance*,
the *Limited Indeterminism* that is required for the generation of new ideas.

Indeterminism provides *alternative possibilities*, one of which can be selected by a will that is *adequately determined* by our reasons, motives, and desires.

The Two-Stage Model for Free Will

In 1884, William James, reflecting on Darwin's evolution, bravely proposed *chance* as creating alternative possibilities for action and ambiguous futures.

"What is meant by saying that my choice of which way to walk home after the lecture is ambiguous and matter of chance?...
It means that both Divinity Avenue and Oxford Street are called but only one, and that one *either* one, shall be chosen."

"I have no hesitation whatever in holding firm to the Darwinian distinction even [in mental evolution]". There is "spontaneous variation in the brain," from which the brain selects.

The Two-Stage Model for Free Will

Since William James, Henri Poincaré, Arthur Holly Compton, Karl Popper, Daniel Dennett, Henry Margenau, Robert Kane, Alfred Mele, myself, and most recently Martin Heisenberg have discussed two-stage models. They all include:

Stage 1) Alternative possibilities generated by chance.

Stage 2) An adequately determined evaluation of those alternatives resulting in a willed decision.

First chance, then choice. First "free," then "will."

"Free Will" as first "Free," then "Will."

Freedom arises unpredictably from the creative and indeterministic generation of alternative possibilities, which present themselves to the will for evaluation and selection.

The Will is causally determined by our reasons, desires, and motives - by our character - but it is not *pre-determined*.

John Locke separated free from will. "I think the question is not proper, *whether the will be free*, but *whether a man be free*."

What If We Had Just One Stage?

Determinist philosophers say an *action could not have been otherwise*, given the "laws of nature" and the "fixed past," the exact circumstances immediately preceding the decision.

Decision

Fixed Past | Future

This is because the decision is a single point in time.

We Need Time To "Do Otherwise"

In our two-stage model, the decision is a process with a temporal sequence, first "free," then "will."

Decision

Fixed Past | Generate Possibilities | Evaluate Alternatives | Future

Our thoughts *come to us* freely.

Our actions *go from us* willfully.

We Can Even Have "Second Thoughts"

Note that our decision is not determined once we generate the alternative possibilities.

If our evaluation finds the alternative possibilities unacceptable, and if time permits, we can always generate more creative ideas.

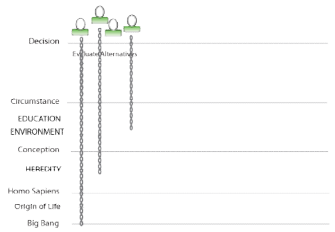
Decision

Fixed Past | Generate Possibilities | Evaluate Alternatives | Future

Think again!

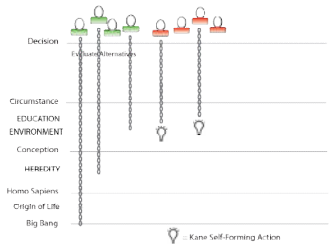
Multiple Causes in the Global Workspace

Bernard Baars' audience in his Theater of Consciousness ≈
Dan Dennett's functional homunculi with their causal chains



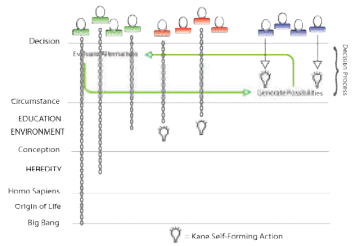
Multiple Causes in the Global Workspace

Bob Kane's Self-Forming Actions add their own causal chains



Multiple Causes in the Global Workspace

The Cogito Model adds new alternative possibilities,
- after the Circumstance and before the Decision



What's Better About The Cogito Model?

Previous two-stage models could not locate a single quantum event in the brain or synchronize it to make a decision free (uncaused) yet provide agent control.

The Cogito model does not rely on a single quantum event for each willed decision. That would make the decision random.

The source of randomness in our model is the ever-present quantal and thermal noise that affects the creation, storage, maintenance, and retrieval of information in any information-processing system. (James's "blooming, buzzing, confusion")

Random Quantum Events in the Brain?

Molecular biologists are skeptical about quantum indeterminacy in the brain-mind. Neurons are macroscopic objects with the order of 10^{20} atoms. How could one atom affect anything?, they ask.

Apart from the fact that there are trillions of quantum events in the brain every second, we can also note that biological systems have evolved to the quantum limit. An eye can detect a single photon. A nose can smell a single molecule.

The brain has found an evolutionary advantage in quantum indeterminacy and thermal noise.

Creativity and Free Will

Normally random noise is the enemy of information, but it can be the friend of freedom and creativity.

Alternative possibilities are the source of human creativity. They make us the authors of our lives.

We normally suppress the creative noise.

We are perhaps most free when we dream, when we are imaginative, when we are creative.

On Giving Compatibilists What They Need

Given the stark choice between determinism and indeterminism, compatibilists understandably choose determinism, so that their decisions are "determined" by evaluations of their reasons, motive, and desires, in short, by their character.

The Cogito Model provides all the "determination" of the will the compatibilist wants and needs, but none of the "pre-determinism" that threatens agent control.

But can compatibilists accept the *limited indeterminism that* we have in quantum physics and the real world?

The Problem of Luck

Compatibilists complain that indeterminism means chance which means that the thoughts that *come to us freely* must be simply a matter of luck.

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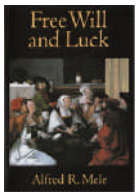
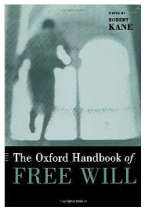
Al Mele has written the book on Free Will and Luck.



The Problem of Luck Solved

Fortunately, Bob Kane has solved the problem of luck.

Kane has shown that as long as an agent has good reasons for choosing *either way*, her choice can be made randomly and she can still claim moral responsibility for her actions.



And in the Cogito Model, we can always have reasons.

The Connection with Biological Evolution

1) Indeterminism in the form of luck, chance, randomness, or noise is always the source for the spontaneous variations, whether in biological evolution or what James called "mental evolution."

2) But unlike biological evolution where nature does the selection, in behavioral freedom it is the organism itself that "purposefully" does the selection.

So how do we get from Heisenberg's behavioral freedom in lower animals to free will in humans?

How Behavioral Freedom Evolves To Free Will

Instinctive selection - by animals with little or no learning capability. Selection criteria are transmitted genetically.

Learned selection - for animals whose past experiences guide current choices. Selection criteria are acquired through experience, including instruction by parents and peers.

Predictive selection - using imagination and foresight to evaluate the future consequences of choices.

Reflective (normative) selection – in which conscious deliberation about values influences the choice of behaviors.

Quantum Mechanics and Free Will

Quantum mechanics contributes more than just indeterminacy to free will.

It provides the stable information structures that the will uses to recruit and manage the indeterminacy.

The Logical Situation

Pre-Determinism is False.

Adequate Determinism is True.

Limited Indeterminism is True.

On Compatibilism and Incompatibilism

Free Will is ***Incompatible*** with *Pre-determinism* and with *Indeterminism* in the Choice itself (*excepting* Bob Kane's "torn decisions") .

Free Will is ***Compatible*** with a *Limited Indeterminism* and with an *Adequate Determinism* (*i.e.*, determination by reasons, values, and desires).

Comprehensive Compatibilism?

Bob Kane has suggested this model be called *Comprehensive Compatibilism* because it is Compatible with *Both…*

the *Adequate Determinism* we need for *determination* by reasons, values, and desires

and the *Limited Indeterminism* we need to generate *alternative possibilities*.

Reconciliation?

David Hume reconciled human freedom with determinism as he could understand it.

Our two-stage model reconciles freedom with the indeterminism of quantum physics.

The answer to our question is that Science *Is* Compatible with Our Desire for Freedom.

Thank you.