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News that Inspires

# Improvisation and the Quantum of Consciousness
## by Maria Popova

It is both thrilling and terrifying to be so reminded that we know ourselves only incompletely and the future not at all; that inside us dwell parts so unexplored as to be capable of surprising the conscious totality — parts drawing on some subterranean river of lore to make instantaneous decisions we never could have planned and did not anticipate.

Lurking in it all is the haunting intimation of the illusion of choice, gnawing at the fundament of the self: Who exactly is doing the deciding that surprises the decided-for?

And yet out of such confusion, such delight. We call these delightful and disorienting deviations from the script improvisation. Nowhere are they more impressive, or more illustrative of the broader paradoxes of the self, than in music.

That is what violinist Natalie Hodges explores in one of the most enchanting parts of Uncommon Measure: A Journey Through Music, Performance, and the Science of Time (public library) — her altogether fascinating inquiry into the poetic science of sound and feeling.

Composition 8 by Wassily Kandinsky, 1920s, inspired by the artist's experience of listening to a Wagner symphony. (Available as a print.)

She writes:

In improvisation, the generation of material is spontaneous, but it's never random. This in itself constitutes a paradox: If you can choose to play anything, with equal probability, what could make you choose any one thing — on the spur of the moment, blindly, trusting, without thinking about it — except chance? In other words, how can the spontaneous be anything but random; how can music made in a jolt of instinct, on a bolt out of the now, be endowed with a form that makes sense in time, as though it had been written and rewritten and practiced and memorized beforehand? And how, in making that first, most instinctive, most desperate decision, do we choose — if it really can be called "choosing," if we really choose at all?

Few things in life are more vivifying than a shimmering reminder that we can still surprise ourselves — those rare moments when the urn of the self cracks and out pours something more fully alive: truer than any narrative, more authentic than any performative personhood, unfettered from identity and expectation and all the other scripts we live by.

For all this perplexity, there is something incredibly liberating in improvisation — a sort of "unselfing," to borrow Iris Murdoch's perennially lovely term; something that provides, as Hodges puts it, "the feeling of easy self-suspension that in the best moments can accompany deep focus, the way that when you have to throw yourself into a task it becomes almost a way to abandon the self, almost a relief to leave the self behind."

She takes these questions to a Radcliffe lecture titled "What Choice Do I Have?" by the virtuosic Venezuelan pianist Gabriela Montero, who has stunned millions with her astonishing improvisations on musical prompts given to her by the audience. Out of a tiny seed handed by a stranger, a striking original composition comes abloom in real time, with no premeditation and no practice — a skill so natural to Montero yet so seemingly otherworldly that her brain became the subject of an fMRI study, the findings of which affirm physicist and jazz saxophonist Stephon Alexander's insistence that "it is less about music being scientific and more about the universe being musical."

To discern the neural correlates of improvisation, scientists observed Montero's brain under three conditions: playing scales, the most prescriptive of all musical structures; playing a memorized Bach piece; and improvising from an initial Bach prompt.

They found that the Default Mode Network — the same brain region which time in nature unlooses to make us more creative and which psychedelics shake up — lit up in an entirely different way when she improvised rather than playing from memory.

Improvisation, in other words, is our built-in remix rotor of consciousness.

Hodges writes:

[The Default Mode Network is] a sprawling system of functional connectivity between regions of the brain that, loosely put, modulates the many facets of the self. These include, to name a few, the medial prefrontal cortex, which controls decision-making, self-perception, and autobiographical memory; the hippocampus, which forms new memories; the angular gyrus, a center of perception and spatial cognition, a sense of oneself in the physical world; and the dorsal medial prefrontal cortex, responsible for thoughts about others and their relation to the self. During the scale and memory trials, these areas of Montero's brain lit up with interconnectivity, as though her senses of time and space and memory were all talking to one another, working together to re-create these tasks that, together, they had been preprogrammed to execute. But each time the researchers asked Montero to switch to improvisation, the light of that interconnectivity was suddenly, substantially dimmed. (In more technical terms, the interactions between those various regions were significantly and quantifiably reduced.) If the regions of the DMN, working together, represent a unified sense of self, upon which Montero draws when she is playing music she has learned in the past, the act of improvisation somehow disbands that cohesion, requires her to draw on something else.

[…]

The improvisation task in Montero's trial, the researchers found, resulted in decreased

connectivity between the regions of the DMN overall — a momentary fracturing of the self, a temporary dissolving of its margins consistent with Montero's assertion that she "gets out of the way" when she improvises, that she loses herself in the present, that she turns on the tap and lets the music flow.

Music, Pink and Blue No. 2 by Georgia O'Keeffe, 1918. (Available as a print and as stationery cards.)

What shines through these fractures in the conscious self is a different sort of memory — not the conscious kind for which the DMN is ordinarily responsible, tasked with recalling the past and anticipating the future, but a mental process that is both unconscious and conscious of itself, self-referential for the duration of the improvisation, a kind of time-out-of-time that, on the miniature timescale of the improvisational period, seems to remember the future: The researchers found that while Montero was improvising on the piano, her musical stream of consciousness remained "structured and cohesive," referencing patterns and building on motifs that had poured out of her unconscious mind earlier in the timeline of the improvisation — patterns and motifs laid down in anticipation of their future reference.

The implication is profound: Since consciousness is the experience of "existing with a body over time," improvisation quite literally opens up a different mode of consciousness that bends the arrow of time and taunts the second law of thermodynamics. The researchers called it "a form of embodied creativity," revealing the unconscious dialogue between the body and the mind whispered beneath the conscious mind's narrative about what is happening, what has happened, and what will happen.

With an eye to Saint Augustine's long-ago meditations on the secret chambers of memory, Hodges reflects:

Montero's, then, is a transcendent kind of muscle memory — not one to which her musicality is bound, but, rather, which she bends to her whim and will, memory that opens up an infinity of possibilities in the present… Improvisation, then, can be seen as an uncanny manifestation of deep memory itself: the creation of order out of disorder, a deep up-pouring from some dormant part of the soul; a confirmation that "the mind knows things it does not know it knows."

One of Arthur Rackham's rare 1917 illustrations for the fairy tales of the Brothers Grimm. (Available as a print.)

Hodges finds an analogue to improvisation's peculiar future-memory in the quantum physics concept of the path integral, derived in the 1940s by the polymathic physicist Richard Feynman — a musician himself, who understood uniquely that we are simply and dazzlingly "atoms with consciousness."

She writes:

The path integral calculates the probability that a given particle, occupying one position at a particular time, will end up at another position at a later time. The question seems simple enough, but it is complicated by the fact that quantum particles act as waves, and so their position, and the paths they take between positions, can only be described in terms of probability and not of fixity. Feynman's great insight? That a wave-particle intuits all the possible paths it could take through space and time, given the basic constraints on its movement — the time and position from which it starts, and that at which it ends — and then chooses one that is based on the sum of all those paths… an infinite number of journeys across the universe… These infinite paths add up, through the superposition of their amplitudes (some of which constructively add, others of which cancel one another in whole or in part), to yield the path of least action — kinetic minus potential energy, the energy of the particle's motion minus the energy it possesses due to its position — which is the actual path that the particle traverses. Thus it is as though the particle, in the singular instant when it commences its motion, intuits every path it could take and then sets off along the one it is destined to take.

[…]

Similarly, when Montero improvises, it seems almost as though she is remembering the future, entraining to something that doesn't yet exist. She intuits all the possibilities contained within a single theme, between its notes, inside its silences… and then picks one path to follow, plucks one shimmering thread from the tangle of possibilities and follows where it leads… She doesn't think or resist; she just does, leaning into the predestiny of form.

The body plays the score.

Complement with the fascinating science of how the interplay of spontaneity and self-control mediates our capacity for presence, then revisit physicist Paul Davies on why we can't remember the future with our default consciousness and Nick Cave on music, feeling, and transcendence in the age of artificial intelligence.