« 18 » Wittgenstein's forms of life and language games are networks of the coordinations of coordinations of conduct that can be seen as being operationally closed. To be a participant in a network means using a shared set of conventions for speaking about and listening to accounts of the experiences within our observer community.

« 19 » Certainty therefore is not something that *underlies* language or is discovered as a foundational substratum but is rather something that is experienced *within* the daily praxis of our joint enactments. Our living within our forms of life allows us to go on together with the awareness that we live without any solid foundation to our knowledge. Meaning arises from the self-sustaining interactions among participants in these networks. Understanding is to know how to participate in the praxis of the networks of conversations.

Oiling the hinge

« 20 » Anyone speaking outside of the consensual network system may be regarded as "unhinged." To avoid becoming unhinged we can follow Wittgenstein's advice to develop our understanding of events without the need – or the possibility – of absolute certainty. In this present historical moment of radical global economic changes and international political realignments, we feel the historical hinges that have grounded our global relationships in a reassuring pattern begin to creak, squeak, and start to be dislodged from their sustaining position. Thus leaving events open to chaotic swings and unbounded oscillations renders it difficult to attach new hinges in order to re-stabilize events (like trying to change a jet engine while the plane is still flying). Life itself has become unhinged, and this is another way of saying that the relations of organizational closure are being changed through destructive interactions in the ecosystem. Our stable ways of going on together shown by Wittgenstein have all been attacked systematically over the past ten years or more, starting with the deliberate destruction of our *patterns of speech* (e.g., politicians who describe what used to be called "truth" and "facts" as "fake news") as well as the destruction of our *coordinated actions* that previously constituted what Wittgenstein (1974: §162) called our "world-picture." The question now is whether our previous forms of life (which embodied unspoken certainties) can continue to create a meaningful level of shared doubt in our observer communities that could lead to a reconstruction of our ecosystem before it is too late. New forms of life will require new hinge certainties. Is the door going to fly off its hinges? For now, we are certain that we feel uncertain.

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Authors' Response
Uncertainty and Cognitive Ecology

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> Abstract • In our response to the commentators, we analyze uncertainty in the ecology of living and cognition. Specifically, we address the role of the brain, behavior and the natural as well as the cultural environment in the arising of uncertainty. We also reflect on questions of how uncertainty, in turn, affects the brain, behavior and the environment of the organism.

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Everything becomes uncertain when we act

« 1 » By breaking down uncertainty into its components, we might have fallen short of our main objective – to approach uncertainty systemically. So, if we were to answer the question of where uncertainty is – inside, around or beyond the organism – we would argue that it is in the organism's behavior. Behavior is a systemic term because it includes all of these possible dimensions of the organism's experience (bio-and neurophysiological, environmental and conceptual). Behavior is also inclusive, because all living creatures demonstrate behavior (to an observer). Unlike other organisms, the observer *as part of her own behavior* can find herself or another organism in uncertainty. Every behavior is a spontaneous, rather than pre-determined process that occurs in a structural coherence between the organism and its ecological niche.

« 2 » Nothing is uncertain when we are not in contact with our situation (e.g., when we are asleep or unconscious). Everything becomes uncertain when we act: we set off and engage in networks of processes whose outcomes cannot be determined by our be-

havior. As we say in §1 of our target article, we may fall ill or rise to the top. It does not depend on our behavior as such, rather it depends on the consequences of this behavior that can stretch beyond the domain of our interactions.

« 3 » A paradox arises: even though we behave to reach certainty, our behavior only increases uncertainty in us as an interactional system. It can be argued, in relation to Hugh Gash's Q3, that an (intuitive) understanding of this paradox can underlie many people's "belief in the unknown," belief in something they can never encounter, experience or predict, but something they can adapt to and even adopt (e.g., as part of mysticism or supernatural practices). Such a belief becomes a way of reducing uncertainty in the face of the unknown. Conversely, and no less paradoxically, a belief can become a skill that obscures more than it illuminates. Our efforts to embrace the limitations of our mind, such as failures to explain and predict something, can, in turn, be a source of biases and fallacies. Daniel Kahneman (2012) gave an example of stock-exchange traders in whose professional culture there is an illusion of understanding how things work in the stock market. Such an illusion gives a sense of skill and overconfidence, making one ignore doubt and uncertainty and think that others "just do not understand." In response to Gash's Q1, we posit that this example illustrates how we can impose our own reality on others in an attempt to be consistent with our own inconsistent reality.

« 4 » The everything-is-uncertain-when-we-start-to-behave principle also implies the relevance of non-classical, non-binary logic to our reasoning about nature in general and the world as hypothesized by physicists, in particular. Rest and stability are as relative as certainty and understanding (or rather, moments of certainty and understanding). Therefore, we subscribe to Bin Liu's Q2 approach to constructivism in opposition to a classical (realist) conceptualization of experience that is based primarily on the concept of causality. The way we tend to think about relationships between and within things and processes, ignoring the fundamental factor of uncertainty, biases us and makes our worldview dysfunctional. In Druzhinin & Rakedzon (2024), one of us, along the lines of general semantics, explored such dysfunctional patterns of thought "inherited from" classical logic through/in our everyday (lay) language. For example, space is usually construed as a fixed emptiness to be filled (we say that we "occupy," "move into" or "take up" some space, are "contained" or "held" somewhere, etc.). In other words, we live on the *linguistic presumption of certainty*: we have a deep-rooted belief in the apriority of an external physical reality to which we bring uncertainty with our participation in it. However, Albert Einstein revolutionized physics, arguing that space is a plenum of multiple dynamics, a material-temporal curvature that is already in the making because of our participation in it. In other words, as observers who distinguish between items of physical experience, we always exist *in* and as *part of* uncertainty, no matter how we choose to describe it.

« 5 » In the spirit of Claudia Westermann's Q1 philosophical analysis, we also claim (§3) that Humberto Maturana's as well as John Dewey's core logic of experientialism is based on non-dualism. Upon this view, an object is a projection of the subject, the known is an extension of the unknown, knowing and not-knowing are two complementary rather than contradictory *behavioral aspects* of uncertainty.

Uncertainty, brain and environment

« 6 » Depending on the organization of a living being, its behavior can be sensorimotor, as is the case with animals, for example, and reflective (linguistic), as is the case with a human organism. Humans also demonstrate the "pre-reflective" type of behavior when automatisms in perception and thought lead to a lack of awareness of, and even accountability for, actions and choices. Therefore, in response to Ricarda Schubotz's Q1, we will maintain that "adaptive sensitivity" to different environmental components of the unknown and the unseen is displayed by organisms as adaptive and sometimes unconscious patterns of experience that have taken shape historically in the course of a mutual organism–environment development. Such patterns are an epigenetic factor, because an organism as much alters its environment by behaving this or that way as the environment alters (or better, has already altered) the organism's gene expression and bodily makeup in the long-term perspective. So, when we observe, in a bee's behavior, a striking capacity to take a beeline, the shortest possible route back to the hive, we should treat it as a behavioral example of co-adaptation between a bee's organism (e.g., its color and sunlight vision) and its ecological niche (e.g., flowers oriented towards the sun). When we say that we have a gut feeling or intuitive sense, it may probably mean that we feel or sense something before we even know, perceive or can reasonably explain it. This way of dealing with uncertainty may also be the result of a congruent change in our organism (e.g., emotion of fear) and its embodied environment (e.g., fearful situations): in the course of ontogeny our body may have developed reactive sensorimotor tendencies whose origin we cannot trace.

« 7 » However, behavior cannot be in the brain. Regarding Schubotz's Q2, we argue that prediction, anticipation and uncertainty at large are not functions of the brain or the result of neuronal processes determined by brain architecture:

> "There is no possibility of the operation of any process that could be legitimately called *anticipatory* […] If an observer sees an ordered process giving rise to some result that is surprising or admirable to him or her, he or she will not understand the dynamic architecture that gave origin to that result, he or she will invent a semantic notion to connect the different instances of the process in a way that he or she can accept. The notion or idea of an *anticipatory drive* is such a semantic notion under the form of *a priori* explanatory principle" (Maturana 2008: 19; emphasis in the original).

« 8 » Along these lines, we cannot claim that predictive processing, as emphasized in Schubotz's commentary, is constitutive of learning and that the brain deals with uncertainty. Upon a systemic view, the brain, body and environment of an organism are a functional unity in which uncertainty *observably* arises as a behavioral (manifestation of an) enabling constraint. Uncertainty does not constitute any of these three components in isolation. For example, the neurophysiological structure of an organism does not determine behavior (Liu §10), but limits behavioral options available to the organism to deal with the uncertainty of the organism–niche ecological unity.

« 9 » If behavior is not in the brain, it is in the environment, and it guides the history of organism–environment interactions. The environment appears neither before nor after, but together with, the behavior. For this reason, in response to Liu's Q1, we are convinced that uncertainty should be treated as an emergent rather than ontological feature of our lifeworlds in general.

Natural and cultural uncertainty

« 10 » In their insightful discussions of Maturana's biological-cultural philosophy, Rasmus Gahrn-Andersen and Ximena Dávila, independently of each other, raise the issue of nature–culture continuity. While Gahrn-Andersen is concerned about the explanatory distinction between nature and culture, which might cause a bias (§§1, 5), Dávila emphasizes the relational difference between the two existential factors of human life (§§19f).

« 11 » Beyond any doubt, for us humans, culture has already become an extension of nature and the line between the two is too vague to draw. We may be described as creatures living in a cultural nature or natural culture:

> "Our human nature is not therefore a 'natural nature.' Rather it is a humanly constructed nature which is generated through languaging conventions. It places us radically and finally across a distinguishing boundary from all else that is not 'human.' We may imagine ourselves thus located inside a sandwich filling which is 'being in language.'" (Boxer & Kenny 1990: 210)

> "[S]ocial organization permits individuals to combine their efforts in ways that produce results […] that could not be produced by any individual […]. This kind of effect is ubiquitous in modern life, but it is largely invisible […]. Every other thing I can see from my chair […] is necessarily the product of group rather than individual activity." (Hutchins 1995: 175f)

« 12 » With this continuity in mind, we cannot but mention a point of nature-culture departure on the basis of which we identified cultural and biological components of uncertainty. This point of departure is, as Dávila put it, a *historical* difference. An environment or behavior can be called (genuinely) natural if they are *primordial* and intrinsic to the organism's *constitution*, i.e., they provide biological constraints (processes arising from within the embodied organism) that enable biological adaptation and viability (survival or conservation of the organism within its own boundaries). Such a factor of naturalness is important in light of evolutionary biology (Kravchenko 2026). By nature, a human (linguistic) behavior is orientational – occurring from within lived experience in relation to a particular component of the environment and triggering an immediate response. The development of culture (a totality of artifacts, social and institutional practices), cultural skills (written language) and domains (literature, science) brought about the transformation of the ecological niche into a "world on paper or on screen" and evolved into a different mode of behavior and thought.

« 13 » As a result, what Gash Q2 refers to as two distinctive cognitive styles, impulsivity and reflexivity, may be two patterns of behavior evolutionarily derived from our primordial nature and its cultural extension. Daniel Kahneman (2012) presents these styles as two systems (fast and slow thinking) that guide our decision-making. If we look at an angry person coming up to us, our first reaction will be to expect some angry words and build up to an immediate defensive action. In this natural situation of uncertainty, we have a biological, here-and-now threat to which we have to respond fast. However, if we see an angry message on our smartphone, we do not have to respond fast, because nothing threatens our survival. This cultural-technological situation of uncertainty requires a cultural (cultured) behavior – reflection and careful choice of words (or their absence). The problem is often that in our daily life these two types of situations fail to be distinguished and the two types of behavior happen to be enmeshed. Thus, the perception of uncertainty becomes distorted.

« 14 » Vincent Kenny's reflections on groundlessness and foundationlessness (§6ff) are further confirmation that our cognition, enabled and constrained by uncertainty, needs certainty anyway. Just like our body needs ground to stand on and make us feel safe, we need an epistemological foundation of existence for whatever we encounter in our experiential world. This ground is an imaginary retroactive construction, because it results from our reflections on our prior experience and previous uncertainties, something that we cannot (fully) know, because prior experience is not constituted by its further explanation (Druzhinin 2025: 45).

Patterns of uncertainty?

« 15 » Finally, we would like to address Westermann's interesting Q2 about what might be termed "grammar of uncertainty" – patterns of language that we use to orient ourselves and one another to uncertainty as a starting, presumptive condition of our living in this language. Westermann's examples and references to the non-typological categorization of experiences as more dynamic than language may suggest echoes the linguistic discontinuity between the "biological" verb and "cultural" noun: "Every entity, thing or process that we distinguish is the verb or dynamic of doings that the noun with which we name it obscures" (Maturana, Dávila & Ramírez 2016: 667). It appears that nouns are a linguistic way of being certain about the world of the uncertain. Through nouns we seem to arrest the flow of life. They are a still-life version of our living. Yet, we live by them (and around them) because they are part of our language. Linguistic patterns of stillness, sameness, symmetry, and allness are further examples of such deep illusions of perception and thought that can be called "cognitive traps" (Druzhinin 2025).

« 16 » What about patterns of *un*certainty? We hypothesize that the category of irreality including grammatical markers of counterfactual thinking (conditional statements from the past-time perspective) provides such a resource. Irreality creates a frame of reference in which we become uncertain about the world of the uncertain (Druzhinin & Lavrova 2024). By wondering about how things would be had something not happened, we leave everything that happens open to change and possibility. We are beginning to construe our experience in terms of alternatives and relational ambiguity through the very grammar of this construal. We are beginning to experience uncertainty and live in it all over. The moment we engage in counterfactual grammar, not only we but everything around us becomes uncertain. Counterfactual grammar is the

language of uncertainty. In this language we construct narratives that intrigue and illuminate (e.g., counterfactual movies, books, stories). What is in this grammar? When we choose the past tense, we are already offering several accounts of a situation (e.g., "I just *wanted* to add something" can mean either "I still want" or "I no longer want"), while "if" brings the conflicting interpretations to our focus of attention and "would" enables us to project the alternative interpretation into a scenario. Through such a grammar we can add a question mark to everything that we live in language.

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