

The Curious Incident of the Dog and Predictive Processing

Drawing some Semiotic Consequences of the Allostatic Approach to Cognition

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Introduction

The question of this paper is whether allostasis and the practical logic of cognitive systems can be brought together to naturalize meaning and agency. I propose that meaning-making should be examined through an agent's anticipations, the execution of activity with available resources, and the effects that actually occur. The argument develops a connection between bodily regulation and an agentic account of experience; it is a theoretical proposal, not a report of an experimental test.

In living organisms, particularly those with complex brains, *allostasis* is regulation through anticipatory adaptation to change, including the allocation of energy needed to meet expected demands (Schulkin & Sterling, 2019). It is a means of achieving stability in the face of unpredictability (Schulkin, 2011b, p. 2). Concerning meaning-making, it has been said that “metabolism and other forms of energy regulation may be at the core of the human mind, regardless of whether a person is thinking, feeling or perceiving” (Barrett, Quigley & Hamilton, 2016, p. 1). Research on allostasis in the human brain converges on three insights:

“First, brains do not react to the world, but instead predict and then test their hypotheses against incoming sensory evidence. Their hypotheses constitute internal models of the body in the world... Second, a human brain's internal model (i.e., predictions) constructs all varieties of cognitions, emotions and perceptions, and guides actions, but the computational architecture for prediction did not evolve for these purposes... Third, these predictions cause changes in the body's internal systems” (Barrett, Quigley & Hamilton, 2016, pp. 1–2).

Thus, on this account, organisms with brains anticipate sensory events and prepare for them. These predictions seem to take the form of *embodied simulations* (Barsalou, 2008), involving inferences about the causes of sensory events and plans for how to move, or refrain from moving, the body to deal with them (Berthoz, 2000). This opens a connection with abduction (Pietarinen & Beni, 2021). Mismatches between predictions and incoming sensory information, from both internal and external domains, provide prediction errors through which anticipations can be tested and revised.

Beyond physiological and metabolic regulation, a related idea appears in Gregory's account of perceptions as hypotheses (Gregory, 1980)¹. Predictive approaches (Clark, 2015) have been developed for social cognition (Clark, 2016)², emotion construction (Barrett & Simmons, 2015), interactive alignment in language (Pickering & Garrod, 2011), event segmentation (Radvansky & Zacks, 2014; Stawarczyk, Bezdek & Zacks, 2021), social organization (Schulkin, 2011b; Saxbe, Beckes, Stoycos & Coan, 2020), and disorders such as depression (Barrett, Quigley & Hamilton, 2016; Neemeh & Gallagher, 2021). These approaches provide points of contact for the proposal developed here; their empirical findings do not, by themselves, establish a general theory of meaning.

For the comparison developed here, homeostatic feedback emphasizes correction of a deviation, whereas allostatic regulation emphasizes preparation for changing demands (Sterling & Eyer, 1988; Schulkin & Sterling, 2019). This contrast identifies different roles for anticipation and feedback. It does not require treating living organisms as either purely reactive or independent of sensory correction.

In this sense, *A Practical Logic of Cognitive Systems* (Gabbay & Woods, 2003, 2005), particularly the account of cognitive economies developed by John Woods (2013), offers a way to connect the use of limited resources with the pursuit of an agenda. According to Woods:

“An ecology is a dynamic system of interdependencies between organisms and their environments. An economy is an ecology for the production and distribution of wealth. A cognitive economy is an ecology for the production and distribution of knowledge. Economies of both kinds are subject to some quite general constraints. They define circumstances in whose absence the desired product is not produced or not as abundantly as producers would have wished” (Woods, 2013, p. 184).

Cognitive economies are constituted by cognitive systems. A cognitive system is

a triple X, R, A , of a cognitive agent X , cognitive resources R , and a cognitive agenda A executed in real time (Gabbay & Woods, 2005, p. 10).

This program is conceived as a naturalization of logic. I think a prior step would be fruitful: the naturalization of meaning (cf. Niño, 2019; Woods, 2019, p. 662). To that end, I propose replacing “cognitive” with “enactive” in the characterization of the system, and extending the economic account from the production of knowledge to the production of meaning. An enactive system comprises a real agent X , enactive resources R , and an agenda A pursued in real time. The agenda specifies a type of result that may be attained in different ways or may fail to be attained. I see this as a way of naturalizing the roots of meaning and examining the role of allostasis in human meaning-making.

If energy regulation involves anticipating demands and registering actual expenditure, anticipation is relative to an expected type of result. The concrete result³ can then be assessed and subsequent activity modified when necessary, for instance, when what occurs conflicts with what was anticipated. In Woods's naturalized approach, an agent similarly draws on resources such as information, strategies, and computational capacity to pursue a cognitive agenda. The actual pursuit deploys bounded resources, and the target may or may not be attained. If the mind is embodied and the body regulates its resources allostatically, the body-mind is, at a basic level of description, an indispensable

¹ Predictive coding can be used to model aspects of allostasis; the two terms should not be treated as synonyms.

² The computational and Bayesian formulations of this approach raise a question of psychological plausibility. Woods (2013) provides grounds for examining whether idealized computational requirements can be attributed to real agents. This concern is distinct from rejecting anticipation as such.

³ On the distinction between a type of result and a concrete result, cf. Short (2007, ch. 6).

resource for meaning-making. If concepts are embodied, they belong to the bodily resources we are disposed to use when a situation calls for their actualization.

To pursue an agenda is already to distinguish what is anticipated from what the agent actually does. I call the latter execution: the situated deployment of resources through which activity unfolds. Anticipation can guide this deployment, and execution can in turn require an anticipation to be revised. Taken together, anticipation and execution constitute realization. They need not form two separate stages, with anticipation completed before execution begins; their relation can be continually reorganized while the activity is under way.

A further distinction concerns the effects that actually occur. An agent can anticipate a result and execute the activity directed towards it without attaining it. Realization, considered together with its actual effects, constitutes what I call performance. In this sense, performance does not imply success. It includes what happens when a target is attained, missed, or accompanied by effects the agent did not anticipate. This is a distinction within the proposed agentic account; it is not a terminological equivalence with allostasis or predictive coding.

Consider putting an object on a sheet of paper to keep it from blowing away. Anticipating that the object will hold the paper and placing it there belong to the realization. Whether the paper stays in place, slides out, or tears concerns the actual effects. The placement can be carried out as intended while a stronger gust frustrates the target. Conversely, an unintended effect can arise during placement itself. Realization and effects therefore distinguish aspects of the event, without requiring all effects to wait until execution has ended. Allostatic regulation enters the account through the anticipation of demands, the deployment of resources, and the adjustments prompted by what actually occurs.

I would like to explore how this approach can explain dimensions of meaning-making in experience, including temporality, affectivity, inference, and intersubjectivity. The proposed extension requires attention to how anticipation and execution organize the deployment of resources, and how their actual effects bear on further activity. Calling an activity “allostatic” merely because it is goal-directed would leave that explanatory work undone.

Allostasis and Enaction in Experience

From a Husserlian point of view, the intentionality expressed in “I can” can be understood as a structure of anticipation. I take this anticipatory character to be allostatic insofar as what the agent can do depends on the resources available in the ongoing *situation*, understood in Dewey’s sense (1938), including her own body-mind. This brings us to enaction in Gallagher’s sense: action has a predictive component that cannot be detached from the current situation (Gallagher, 2020, ch. 1). It is online and ongoing, rather than detached from the agent’s current perceptual and proprioceptive situation (Gallagher, 2016, pp. 292–293; cf. Barsalou, 2016, p. 85). Here I understand enaction as an agent’s situated activity in pursuit of a target, drawing on items in her current environment that can become resources for attaining it, including her own body. This includes perceptual activity, through which an agent explores and makes sense of her surroundings.⁴

This connection does not settle the relation between allostasis and enactivism. In allostatic accounts, sensory input that conflicts with an anticipation can register as prediction error and contribute to its

⁴ This may seem a truism, but enaction is a hypostatic abstraction. If a real enactment is at issue, it is always possible to ask: whose enaction?

revision. Enactivist accounts may describe related adjustments in terms of attunement. The question is how these descriptions relate, and what each explains about the agent's activity.

Gibsonian affordances are widely accepted in enactivist approaches. I propose that an allostatic account can explain how an agent selects and deploys resources in a particular action. A floor may afford walking, a wall may afford leaning, and a cliff may afford climbing. But what determines which possibility matters here and now? If Jeffrey hates Johnny and meets him, does Johnny's face afford "slapability"? Gallagher's discussion extends affordances to skills and forms of life (2020, p. 10), so the question also concerns the relation between an available possibility and its actualization. Within the account proposed here, Jeffrey pursues a target in a situation: his attention, emotional regulation, and decisions may lead him to take an aggressive course of action. Johnny's face becomes the target, and Jeffrey's hand a resource for the intended slap. The action depends on the agenda and the resources deployed, as do walking on the floor or leaning against the wall. Coupling between an agent and an environment does not alone explain why a particular item becomes relevant to that agent's current pursuit. This is the explanatory task I assign to the allostatic account. It does not require identifying allostasis with every commitment of enactivism. Gallagher (2016, pp. 285, 295) considers enactivism as a philosophy of nature; its relation to particular scientific hypotheses requires further argument.

Temporality

Living organisms have their own rhythms. Circadian cycles and hormone release, for example, involve anticipation of energetic needs. Neural processing also operates at different timescales in the primate cortex (Chen, Hasson & Honey, 2015). Human experience raises a further question about the felt passage of time. Neemeh and Gallagher (2021, pp. 195–196), drawing on Varela, distinguish elementary neuronal processes on the scale of 10–100 milliseconds, temporal integration on the scale of approximately 0.5–3 seconds, and longer narrative timescales. These are dynamically related scales, not fixed durations for every event. Their account relates the experienced present to temporal integration and to the Husserlian interlocking of retention and protention. Protention can, for the present comparison, be understood as anticipation: what follows may fulfil or disappoint the sense of what was about to occur. In perception, the flow of sensory material bears on that anticipation. This is the relation to hypothesis-testing that matters for the argument here.

Perception can involve a close alignment between the unfolding act of experiencing and the event experienced. In mental time travel (Soteriou, 2018), dreaming, or mind-wandering (Domhoff, 2018), those temporalities can diverge. Remembering a film may take seconds; watching it may take hours; the events it represents may span years or millennia. The duration of the act, the experienced unfolding, and the time attributed to its object need not coincide. Acceleration, slowing down, reversal, ellipsis, and the embedding of one event within another exploit such differences. Narrative twists depend in part on how an unfolding sequence fulfils or overturns an anticipation. The claim concerns the organization of experience; it does not identify narrative duration with a fixed neural integration window.

The distinction also applies to perception. An agent looking for a familiar face in a crowd anticipates what she expects to see; scanning the crowd and adjusting her gaze belong to execution. Together, these aspects constitute the realization of her perceptual activity. Recognition, failure to find the person, or mistaking someone else for her are possible effects; the realization together with its actual effects constitutes its performance. These effects can modify anticipation while the search continues.

The distinction also applies when perceptual activity proceeds without deliberate search or explicitly formulated expectations.

Affectivity

If the mind is embodied, affectivity is also embodied. On the account considered here, affective responses to the current situation depend on anticipatory bodily regulation. Lisa Feldman Barrett's theory of constructed emotion develops this connection by treating interoception in explicitly allostatic terms (2017a, 2017b). The "body budget" involves deploying autonomic, hormonal, immune, and other resources in anticipation of demands (Barrett & Simmons, 2015). Interoception, made available to consciousness as affect, is thus relevant beyond episodes categorized as emotions. Related work concerns object perception (Barrett & Bar, 2009), emotion words (Gendron et al., 2012), and categorization (Barrett, 2017b). In this framework, interoception and affectivity are integral to the account of allostasis (Barrett, Quigley & Hamilton, 2016).

Just as temporality involves different scales, affective life includes distinctions among core affect (valence and arousal), emotions, feelings, sentiments, and character traits. An allostatic account invites us to ask how anticipatory bodily regulation contributes to these different phenomena, without assuming that it explains them all in the same way. The theory of constructed emotion also proposes accounts of depression (Barrett, Quigley & Hamilton, 2016), chronic pain, and anxiety (Barrett, 2017a, ch. 10).

Anticipation can also be considered at the level of bodily action. In grasping, the hand prepares for the expected shape of the object (Berthoz, 2000). The anticipated result helps organize the deployment of bodily resources before contact, while the encounter with the object allows adjustment. This provides a concrete connection between anticipatory regulation and the agenda–resource relation developed above.

Inferentiality

There is a distinction between consequence-having and consequence-drawing. Consequence-having concerns logical relations, as in classical propositional calculus or first-order logic. Consequence-drawing concerns the exercise of inferential skills by real agents in real time (Woods, 2013). Actual inference is situated and limited by available resources. Those limits alone, however, do not make it allostatic. The connection I propose concerns how an agent anticipates what matters to her inquiry, allocates resources accordingly, and adjusts her activity in light of what she finds.

Consider Doyle's "*Silver Blaze*" and the curious incident of the dog. When Inspector Gregory asks Sherlock Holmes whether there is any other point to which he wishes to draw attention, Holmes replies: "To the curious incident of the dog in the night-time". Gregory responds: "The dog did nothing in the night-time". Holmes replies: "That was the curious incident". Gregory does not initially treat the dog's silence as something requiring explanation. Holmes makes it relevant by considering what would normally have happened under a different circumstance. Their difference lies in the expectations brought to the inquiry; the anecdote does not show that Gregory's cognition is generally devoid of anticipation⁵.

⁵ In a certain sense, the idealized Holmesian case cuts across the usual distinction between System 1 (autonomous) and System 2 (engaging working memory) thinking (Evans, 2021). Both remain bounded by available resources: bounded rationality is, after all, rationality for real agents. Heuristics can perform well under uncertainty (cf. Gigerenzer, 2021, p. 63). Where they guide anticipation and the adjustment of activity to its outcome, they can be examined within the allostatic account proposed here.

Holmes's reasoning depends on a defeasible expectation: a watch-dog would normally bark at a stranger entering the stable at night. Given the dog's silence, familiarity with the visitor offers an explanation. The absence of barking becomes evidence through this expectation; it is not informative in isolation, and other explanations would need to be considered if the circumstances supported them. The example therefore brings together an anticipated consequence and an explanatory hypothesis about its absence. It illustrates how a resource can acquire evidential relevance within an inquiry. It does not by itself establish a physiological mechanism of allostasis. Holmes's predictive capacity is an idealized case of a broader cognitive and bodily capacity: he is skilful, *but his resources* remain limited.

The same distinction helps with the dog's silence. Holmes executes an inquiry by attending to a reported absence and drawing an explanatory inference. Its performance also concerns what the inquiry brings about: the hypothesis may guide further investigation or lead it astray. Producing an explanation remains distinguishable from achieving the target of the inquiry, even when the inference is competently carried out.

Ginzburg's "evidential paradigm" (2013) situates anticipatory skills in a broader history: inferring weather conditions or promising places for hunting and foraging can matter to survival. Such skills also contribute to the projects, plans, and goals of ordinary life. Their relevance to an allostatic account lies in the adjustment of activity and resources to anticipated circumstances.

Intersubjectivity

In social life, a common target is to modify another agent's agency, for instance, by getting her to do something. Requests, favours, and many uses of verbal language exemplify this. Our vulnerability and dependence on others provide a more basic case: without others, we could not have survived. In interaction, interventions can be reciprocal. Each agent's conduct modifies the situation in which the other anticipates and acts. From an allostatic perspective, this invites an account of how agents affect one another's regulation of resources.

Beyond survival, coexistence involves expectations about others' behaviour, shared goals and intentions, and the observance of rules and norms. Tomasello (2009, 2014, 2016, 2019) examines the development of cooperation in infancy and its evolutionary background; Planer and Sterelny (2021, pp. 181–184) discuss the importance of cooperative activities with delayed returns in human evolution. Self-regulation can thus be situated within networks of interpersonal regulation (Sbarra & Hazan, 2008). When coordinated activity depends on anticipating others' contributions and regulating resources accordingly, it can be approached in terms of social allostasis, adaptation, well-being, and flourishing (cf. Schulkin, 2011a). As Schulkin puts it: "The motivation to form meaningful contacts is essential for development and for life" (2011b, p. 3).

Intersubjectivity also enables the formation of common ground. Signs, objects, and places, as well as languages, discourses, rituals, and ideologies, become available to those who participate in it. Signs acquire a sociohistorically grounded significance that is not exhausted by their use in a particular enactment. Through learning, we incorporate them among our resources. When an agent pursues a target in real time and deploys available resources, including signs, their actualization contributes to meaning-making. In the terminology proposed here, the actualization of significance constitutes signification for the agent and affects the attainment, or non-attainment, of her target.

Allostasis, Meaning Making, and Semiotics

Meaning-making is a complex, dynamic phenomenon with different levels and functions. Agents produce it and are responsible for it. They typically do so within events and projects whose organization involves temporality, affectivity, and intersubjectivity, as well as causal and motivational relations.

I would like to advance the following claim: an allostatic account can contribute to the naturalization of meaning within a cognitive and enactive economic approach. Enaction involves anticipating oneself and others as inhabiting a future situation (cf. Pietarinen & Beni, 2021, p. 505). The relevant resources include the agent's body and the possibilities of coupling it with the surroundings. Insofar as meaning-making is anticipatory, situated, goal-directed, and resource-bounded, the enactment of signs, objects, and places is bounded in corresponding ways. Semiotic theories should therefore *reconsider what is anticipated in interpreting and producing signs or other cultural items*. One item can serve as a paperweight, an action figure, or a memento of the person who gave it to us. These meanings are grounded differently, and some uses can fail: the item may be too light to hold the papers down. In a Peircean spirit, anticipated practical effects help explain why a resource can matter to an agent. Significance concerns the possibilities of meaning available through that resource; signification concerns its effective actualization in situated experience. To describe that actualization, I distinguish how anticipation and execution constitute a realization from the effects through which its performance can be assessed. A resource may be meaningful in the activity even when the intended effect fails to occur.

This proposal also raises a question about the “extended mind” (Clark & Chalmers, 1998). A football team can act in a coordinated way towards a collective goal, such as winning, and towards sub-goals, such as defending in a zone or preparing a long counter-attack pass. Its cognition and action are distributed and bounded: each agent acts in relation to collective expectations and individual responsibilities. A successful pass can depend on that coordination. I would distinguish this distribution from attributing meaning-making to the ball or to other resources in their own right. Calculators, computers, and signs can possess attributed significance without thereby being agents of signification: balls do not score goals in the sense in which players do. They are resources within cognitive systems and agentive situations. This distinction expresses the agentive position defended here; it does not, on its own, refute the different claim that external resources can be constitutive parts of a cognitive process. That question requires a further argument about the relation between an agent and the resources she uses.

Allostasis, with its emphasis on anticipation and the need to assess its fulfilment, has affinities with classical pragmatism (cf. Schulkin, 2015). It offers a route for investigating the Deweyan continuity of life, mind, and meaning. The proposal is that the distinction between realization and performance can help articulate that continuity in cognitive semiotics: anticipation and execution organize the pursuit of an agenda, while the effects that actually occur provide grounds for assessing and modifying that pursuit. Establishing its explanatory reach requires examining how these relations operate in particular cases of meaning-making.

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