# Open Peer Commentaries

## on Shaun Gallagher's "The Past, Present and Future of Time-Consciousness"

### Protention and Predictive Processing: The Wave of the Future

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**> Upshot** • Gallagher's main claim can be enhanced neurophenomenologically. In his 1907 lectures *Thing and Space*, Husserl argued that perception in general is enactive. Moreover, the neuroscientific theory of predictive processing connects neatly to a future-oriented phenomenology.

« 1 » Your flight is about to land. As you look out of the window, the ground rises toward you, its details more sharply etched with each passing second. Soon the end of the runway flashes into view, with stripes and skid marks streaking by. Suddenly there's a loud clunk and the plane shudders. Now you expect either a rapid deceleration as the plane rolls toward a stop, or a violent burst of excruciating heat and pain – a fiery death. The experience of the landing gear touching down with a bang is clearly very different under the two different expectations. These vivid anticipations – Husserlian protentions – modify the immediate sensory present, or what Edmund Husserl called the Primal Impression (PI). The primal impression (of landing) has no phenomenal features that are not already infused with the conscious anticipation of what is immediately to follow.

« 2 » Shaun Gallagher endorses Husserl's insistence that the temporal phases of protention, primal impression, and retention are each abstractions from a unified whole, rather than phenomenological isolates. But within the Husserlian tripartite sandwich, how thick is the primal impression? Gallagher develops the idea that the PI is as thin as can be, a mere theoretical boundary of protention and retention. (The arguments in the target article were also developed in Gallagher & Zahavi 2014). The infusion of protention underwrites Gallagher's push toward an enactive conception of protention and thus of temporality overall.

« 3 » Gallagher grounds his enactivism (as does Dan Zahavi) in the phenomenology of time, going first to Husserl's Time lectures from 1905, and Husserl's subsequent afterthoughts. But for Husserl's enactivism a richer source is his 1907 lectures on *Thing and Space* (Husserl 1997). Here we encounter the stirring idea that the consciousness of things and their environments is *essentially* compounded from combinations of sensation and bodily movement. For Husserl, the problem inherent in our awareness of objects and scenes is that the senses give us sequences of images (visual, auditory, tactile) dancing about without an organizing principle to make sense of them. In addition to these jumbled sensory inputs, however, we find another stream of sensation, that of our bodies in motion, sensations Husserl calls kinaesthetic (or nowadays, proprioceptive). Taken by themselves, the kinaesthetic stream is just as arbitrary as the sensory stream. But when these two streams are combined, they harmonize. Our kinaesthetic awareness serves to situate the points of view that ricochet through the sensorium, and thereby enable us to construct a stable world (Husserl 1997: §§48–57).

« 4 » The common example of this harmony of informational flows is the relationship between saccadic eye movements and the visual world (Husserl 1997: §48). As our eyes turn right, the retinal image slides to the left. We do not see a jumpy world, however, because the retinal slide is cancelled by afferent feedback from the muscles controlling the eyes. The result is a stable visual environment. In *Thing and Space*, Husserl works through an encyclopedia of variations of agents in interaction with static and moving configurations of objects and scenes.

« 5 » Time is essential to this understanding of perception, of course, since the world is built from the coordination of dynamical trajectories, but temporal *experience* emerges as constitutive of thinghood. Husserl notes that visual objects, almost without exception, always have parts that are hidden from view:

> "The thing, as given in perception, has more than the appearing […] front side […] and this 'more' lacks presentational contents. It is […] co-included in the perception, but without itself coming to presentation." (Husserl 1997: §16)

To see objects as things that can be distinguished from other things and to perceive them as enclosing wholes, we apprehend their back sides. But without direct sensory contact, how do we experience a hidden side as a surface with visible and tactile features that nonetheless do not appear? We can un-

derstand these obscurities as protentions, as predictions of what we will find when we circle the object, or turn it around:

> "The thing […] is in and with the stream not only of its actual changes but also of its possible changes, and the latter are indeed infinite, though firmly delimited." (Husserl 1997: §48)

These anticipated percepts will have the same dual flow as occurrent perceptions. We'll see (for example) that if we *move* a certain way, we'll *see* a certain image. In this way the tangle of impressions and movements resolves as a world of things in space.

« 6 » The world is thick with things, and thus is saturated with protention. Where then is the primal impression? I concur with Gallagher's conclusion that to be impressed in any way already enfolds expectations. No experience is primal. Husserlian phenomenology fully converts expectation into action, and thereby creates for consciousness a world.

« 7 » As the above suggests, I think Gallagher is on solid phenomenological ground in his valorization of protention, more solid even than his exposition would suggest. In a Varelian vein, we can also strengthen Gallagher's protentive push with an appeal to contemporary cognitive neuroscience.

« 8 » One theme of much recent cognitive science and neuroscience is predictive processing (PP; for example, Friston 2005; Friston & Stephan 2007; Hohwy 2012; Hohwy 2013). Andy Clark summarizes its main claim:

> "To perceive the world is to meet the sensory signal with an apt stream of multilevel predictions. Those predictions aim to construct the incoming sensory signal 'from the top down' using stored knowledge about interacting distal causes." (Clark 2016: 6)

« 9 » One traditional view of perception suggests that the world drives a cascade of feature detectors from the bottom up (or from the periphery inward). PP upends this picture. Instead, it imagines a cascade of predictions from the top down, where each "higher layer" projects its best guess for the future into the layer below, where it inhibits congruent inputs. What propagates upward then is an error signal, the mismatch (if any) between the predicted and the incoming neural signal. That error signal is used to adjust the predictions for the next round.

« 10 » Neural conduction takes time, so both the traditional bottom-up scheme and PP have straightforward temporal implications. Simply stated, bottom-up processing *follows* a stimulus; PP, being predictive and top-down, *precedes* the stimulus. Since the predictive signal inhibits the matching input, it seems that the downward-propagating information is mainly running ahead of the incoming stimulus, and more or less replaces it. The error signal, on the other hand, follows the input, just as in the traditional bottom-up scheme.

« 11 » These temporal divisions of labor suggest intriguing phenomenological analogies. PP describes systems in which the detailed model of the perceptual world is protentive. Such systems live in the world of their imagined futures until rudely contradicted by stubborn error. The error signal, meanwhile, encodes a just-past; its content is most like retention. And, just as the target article suggests, nothing remains of a bare "primal impression."

« 12 » This strikes me as an attractive alignment. The seeming (illusory) plenum of the perceived world is a complex assumption, and we ride the wave of this future. However, the barebones PP sketched is still tightly bound to the phenomenal immediate present, as its predictions run just ahead of inputs, and error signals just behind. As predictions range further into the future, their reliability rests on intermediate predictions. This cascade of intermediate anticipations co-occur with present perception but they must be kept in their proper temporal order. Thus, PP leads to a picture of the present perceptual moment as a compound of expectations, ordered by their time of expectation. This temporal penumbra of predictions is analogous to Husserlian protention.

« 13 » The proposal that PP structures neural computation in alignment with Husserlian temporality can be contrasted with similar ideas in the work of Varela (especially Varela 1999a). As Gallagher describes (§§18–26), the centrepiece of Varela's account is the transient cell assembly (Varela 1999a: 273), a distributed network of active neurons bound temporarily by synchronized oscillations. These assemblies are stable only for brief periods, moments whose durations comprise the "integrative (or '1') scale" of neurodynamics. Varela conceptualizes these complex patterns of oscillation as points in a trajectory through a high dimensional neural-activation space. Each trajectory is unique, and is quasi-stable long enough to embody a fringe or tail of retentional information.

« 14 » As Gallagher mentions, protention (in Varela's analysis) is not simply "retention in reverse," but an "affective disposition" (§25). Varela's full proposals are too elaborate for consideration here, beyond noting that he stresses the concreteness and specificity of retentional content, contrasted with the openness of protention. According to PP, however, it is the predictive content that is most elaborate, while retention emerges primarily as error. Both Varela and the PP theorists face a parallel challenge: How in the tumult of neural activity is the *structure* of temporality to be embodied? We navigate the temporal landscape with great precision. How that temporal field of view is organized by the brain is still more conjecture than science.

« 15 » Meanwhile, from two directions, the phenomenological and the neuroscientific, I am inclined to join Gallagher in his push for an enactive temporality. Neurophenomenology continues to be the wave of the future.

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