past, we can infer, based on the argument that has just been given, that it would not. Perception without retention would be perception that is unconstrained by what was previously anticipated. But we have just argued that there can be no perception of possibilities without protention. Finally, Gallagher does consider whether there could be engagement with possibilities without a primal impression, and answers in the negative. "If there were only retentions, everything I experience would have just happened; we would be pure witnesses without the potential to engage" (§36).

Conclusion

« 12 » Gallagher's argument has far-reaching consequences. It is not so much the structure of time-consciousness that is enactive. Instead it seems to me that what Gallagher has shown is that cognition conceived in terms of enaction (across the board in all of its guises from "lower" to "higher-order cognition") has a temporal structure. Gallagher has found in Husserl a description of the temporality that is intrinsic to the self-organising processes that unfold as the agent dynamically couples to its environment in perception and action. He has shown how intrinsic temporality has its roots in life.

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Received: 13 October 2017
Accepted: 27 October 2017

What Is the Exact Directional Causality Between Affect, Action and Time-Consciousness?

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> Upshot • A triple schematic connection between affect, action and time-consciousness can be represented as follows: "affect → action (anticipation) → time-consciousness (protention)." Two questions are raised: what is the exact directional causality between these three phenomena? And does empirical evidence from the study of certain conditions where the time-experience, affect and action were shown to be transformed support the proposed connections? While psychiatric disorders show a similar schematic causation between these phenomena, this is not the case for meditation. One possible explanation of the inconsistency is the question of the interplay in affect between arousal and valence.

« 1 » The thread hat passes through the target article by Shaun Gallagher is the enactivist account of time-consciousness, understanding it in terms of action-oriented embodied phenomenology, consistent with Francisco Varela's constructivist approach. Specifically, the author claims that time-consciousness (the third part of the structure of the temporal-experience, the protention – which is an implicit anticipation of what is just about to happen) is tied to action (i.e., anticipatory behavior), which is closely connected with affect. In §25, the author writes:

> "Rightly noting that protention is not symmetrical to retention, Varela suggests that protention is closely connected with affect and action. If we think that the experiencing subject is always characterized by an affective disposition, then the idea is that one's disposition modulates protention. This idea finds application in considering certain pathologies that may involve the sense of agency."

« 2 » Thus, there are three phenomena – affect, action and time-consciousness – that seem to have a causal connection between them. But what is the exact directional causality between these three phenomena? And does empirical evidence from the study of certain conditions where the time-experience, affect and action were shown to be transformed support the theoretical connections?

« 3 » If we consider that Varela and Nathalie Depraz (2005: 74) refer to affect as "embodiment of readiness-for-action," then the first causal connection might be schematically seen as "affect → action." And when considering that "It is this active side of perception that gives temporality its roots in living itself" (Varela 1999a: 272), then the second causal connection might be schematically seen as "action → time-consciousness." Thus, theoretically, the schematic connections can be represented as follows: "affect → action (anticipation) → time-consciousness (protention)."

« 4 » The schematic connections can be put to empirical test by using the intentional binding paradigm as a measure of agency, as subsequently elaborated. The sense of agency (the sense that I am the one who is causing or generating an action) is a bridging empirical concept between action and time-consciousness, because it is associated with a subjective compression of time, such that causal actions and their effects are perceived as bound together across time (Haggard, Clark & Kalogeras 2002; Moore & Obhi 2012). This phenomenon is known as "intentional binding," and according to the influential "Comparator Model" it depends on sensorimotor prediction of action outcomes (Blakemore, Wolpert & Frith 2002). Specifically, an efference copy of motor commands is used to predict the likely sensory consequences of a voluntary action, and the match between these predictions and the measured sensory consequences promotes the feeling of self-agency, whereas a mismatch reduces it.

« 5 » Yet, the question arises – is the sense of agency a cause or a consequence of the subjective compression of time between actions and their effects? While more experimental work is needed to clarify this relationship, one hypothesis – aligned with the proposed schematic triple connection

– is that sense of agency is the cause rather than the consequence (Stetson et al. 2006), which aligns closely with Varela's view. According to this hypothesis, we expect that outcomes caused by our own actions will be temporally contiguous. Once we recognize that an outcome is dependent on our own behavior (high sense of agency), then a recalibration mechanism is activated, bringing these two events closer together in subjective time. This suggests that perception of time may be strongly modulated by prior expectancy, as applies to other perceptions (Moore et al. 2013). Importantly, empirical support for the connection "affect → action" was provided using the intentional binding paradigm: it was shown that negative emotional outcomes attenuate intentional binding for negative compared to positive or neutral outcomes (Yoshie & Haggard 2013).

« 6 » A good model to empirically test the proposed relationship is schizophrenia, a condition in which modulation of affect, and problems in anticipatory experience, agency and time-consciousness were found (Gallagher 2000; Gallagher & Varela 2003; Jeannerod 2009). Patients with schizophrenia show an absence of predictive action binding (Voss et al. 2010), as well as deficits in sensorimotor prediction, in alignment with the Comparator Model (Moore et al. 2013). According to the Comparator Model of agency, experiences of passivity in patients with schizophrenia can be explained by impaired sensorimotor prediction during voluntary action. This impairment is said to lead to a faulty mismatch between the experienced and expected sensory consequences. As a result, patients experience a reduced feeling of self-agency for their movements. It is noteworthy that schizophrenia also entails an impairment in temporal estimation, towards longer perceived durations (e.g., Volz et al. 2001). In terms of affect, a recent meta-analysis of experience-sampling studies indicate that people with schizophrenia consistently report more negative and less positive emotion than healthy control participants (Cho et al. 2017). Thus, in schizophrenia patients there is evidence for negative valence, reduced sense of agency, and slower time-flow, supporting the following schematic connection: "↓ positive affect → ↓ agency → ↑ time estimation" (arrow down means decrease, and vice versa).

« 7 » Another condition in which modulation of affect and problems in anticipatory experience and time-consciousness can be found is depression (Gallagher 2012). Both phenomenological and experimental studies show that depressed subjects have a slowed experience of time-flow and tend to overestimate time (Gallagher 2012; a recent meta-analysis in Stanghellini et al. 2017). Phenomenologically, the sense of agency in depression is reduced (Slaby, Paskaleva & Stephan 2013). Negative emotions obviously pervade, although the proportion between sadness (i.e., negative valence with low arousal) and anxiety (possibly negative valence with high arousal) varies between patients (Liverant et al. 2008). Thus, in depression, as with schizophrenia patients, there is evidence supporting the following schematic connection: "↓ positive affect → ↓ agency → ↑ time estimation."

« 8 » While the schematic connection "↓ positive affect → ↓ agency → ↑ time estimation" generally applies in cases of psychiatric diseases, this is apparently not the case in meditation. Mindfulness meditators generally show, as a trait, increased positive and reduced negative affect compared to non-meditators (Berkovich-Ohana & Glicksohn 2015; Farb, Anderson & Segal 2012). Building on the schematic connection found in psychiatric conditions, this anticipates a heightened sense of agency, and shorter time estimations. Indeed, as a trait, mindfulness meditators seem to exhibit a stronger sense of agency, manifested by a stronger intentional binding compared to non-meditators (Lush, Parkinson & Dienes 2016) (but for contradicting findings see Jo et al. 2014). Specifically, meditators showed a larger shift in the timing of an outcome toward the intentional action that caused it, argued to reflect improved metacognition of motor intentions (Lush, Parkinson & Dienes 2016), in alignment with the fact that meditation is an exercise in metacognitive processes, and that mindfulness meditation practice involves awareness of the causal connections between different mental states, including intentions and their outcomes (Gunaratana & Gunaratana 2011). Yet conversely, the state of deep meditation seems to involve phenomenologically a reduced sense of agency (Ataria, Dor-Ziderman & Berkovich-Ohana 2015), aligned with some philosophical accounts of Buddhist practice (Hyland 2014). Thus, the current empirical evidence is scarce and ambiguous.

« 9 » Now, turning to time-consciousness, the expectation of shorter estimates of time interval is indeed met by Peter Lush, Jim Parkinson and Zoltan Dienes (2016), who report a shorter estimate of the time interval between an action and its outcome in meditators. Yet, this contrasts with ample evidence that mindfulness meditators experience an "extended now," based on reports of a slower subjective passing of time (Berkovich-Ohana, Glicksohn & Goldstein 2011; Wittmann & Schmidt 2014), and a relative overestimation of durations (Droit-Volet, Fanget & Dambrun 2015; Kramer, Weger & Sharma 2013). Thus, in meditation the results show "↑ positive affect → ↑ agency (but still controversial) → ↑ time estimation."

« 10 » The inconsistency in the schematic relationship between different conditions presented above shows that, currently, the relationships are not well understood, and more theoretical and empirical work is needed to clarify and better articulate the causal connections. A possible direction for further investigation is a finer-grained account of affect, as its subcomponents are known to have varying effects on time-consciousness, as subsequently briefly shown.

« 11 » Affective states are generally agreed to bear two phenomenal features; the one is bodily and the other mental (reviewed by Lambie & Marcel 2002). These can be called "arousal" (extent of bodily excitation) and "valence" (a subjective feeling of pleasantness or unpleasantness). The empiric connection between affect and time-experience shows differential effects for the two sub-components of affect. There is accumulating evidence for an arousal-induced temporal distortion, namely that when the level of physiological activation decreases/increases, the internal clock varies in accuracy (Droit-Volet & Gil 2009; Glicksohn 2001). However, the exact direction is less clear, as a strong arousal level had different effects on the participants' time judgements as a function of their affective valence. In high-arousal conditions, unpleasant pictures were overestimated, whereas pleasant pictures were underestimated. Inversely, in low-arousal conditions, unpleasant pictures

were underestimated and pleasant pictures overestimated (Angrilli et al. 1997; Droit-Volet & Gil 2009). This opposite direction of the valence effect as a function of arousal suggests that two different mechanisms are triggered by arousal levels: an attention-driven mechanism for low arousal, and an emotion-driven mechanism for high arousal (Droit-Volet & Gil 2009). This raises the possibility that the interplay in arousal-valence, and possibly also attention, is the cause of the inconsistencies in empiric evidence shown above.

« 12 » To conclude, a schematic causal relationship between affect, action and time-consciousness was proposed and put to empirical test. While psychiatric disorders show a similar schematic causation between these phenomena, this is not the case for meditation. One possible explanation of the inconsistency is the question of the finer-grained effect of the interplay between arousal and valence.

« 13 » As a response to the target article, I outlined some interdisciplinary aspects by searching for exact causality that can be empirically tested and integrated. The empirical inconsistencies presented here draw the scientific attention back to the importance of affect in Varela's account of time-consciousness, suggesting that while current work mostly focuses on understanding the role of perception and action, more work is needed to consider the role of affect and its sub-components.

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Received: 18 October 2017
Accepted: 19 October 2017

The Transcendental Character of Temporality and the Buddhist Contribution to Time-Consciousness

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> Upshot • Enriching the parallel between transcendental phenomenology and enactivism, I briefly discuss the compatibility of the Buddhist perspective with Gallagher's contribution to time-consciousness. Grounded in his meditative practice and heartfelt engagement with Buddhist philosophy, Varela de-constructed representationalism and its underpinning metaphysical dualism, building up the generative concept of enaction. His approach has been deeply inspired by Madhyamika Buddhism, which describes time-consciousness as that double illusion that frames phenomena as either becoming or permanent.

« 1 » Shaun Gallagher's target article, centered around Francisco Varela's continuation of Edmund Husserl's work on time-consciousness, elaborates on the embodied approach pioneered by Varela. The rigor of this analysis starts with the definition of Husserlian distinguishable-yet-inseparable moments: retention, primal impression, and protention. Then, towards the conclusion, the author intertwines them with an enactive approach to temporality, based on the mutual interdependence of such a threefold structure of time-experience. The precision and clarity of Gallagher's article leave almost no space for critiques, re-enhancing a neglected theme in contemporary literature. Even though time shapes our lives with both intense and empty moments, it recedes ephemerally from our analysis, as we try to catch its essence. The implications of the target article retrieve classical unadulterated philosophical questions and deserve some further considerations.

"Knife-edge" present transcendental deconstruction

« 2 » Gallagher's article sets the stage of the "knife-edge present" deconstruction from its very beginning (§2): "Consciousness must in some way grasp more than the punctual now." Then, in his enactivist account of time-consciousness (§§29–36), Gallagher points out the interdependency of primal impression, retention, and protention: "Our experience of the present is always dynamic […] in such a way that a focus on any one of the three components in isolation runs into an abstraction" (§29). Considering each factor *per se* reciprocally presupposes the other two factors in a circular way: "[I]f primal impression is part of the structure of the living present, it is itself structured in its relations to retention and protention" (§33). This brings Gallagher to discuss time-consciousness's phenomenological "fractal character": as each block is acknowledged, it collapses into the "following." As we grasp a primal impression based on protention, it ends being held in retention, and so on; retention dissolves into protention, as "every living is living *towards*" (Husserl 1991: 313).

« 3 » Nowadays, Immanuel Kant's philosophy finds little attention with respect to this theme. In Kant's framework, any fact, to become meaningful, must match our *a priori* structure, which in turn predetermines it (Kant 1990). Given that the transcendental structure constitutes only selected aspects of the phenomenal world, time as an inner form of intuition cannot become the direct object of our conscious attention. Nonetheless, we perceive and conceive of things only insofar as they unfold in time. Husserl relied on Kantian refined conception, considering time neither as an objective fact existing in the world nor as a private, subjective projection. He inherited from Kant the view that both spatiality and temporality are a priori empty intuitions permeated by sensorial, a posteriori ones. Kant argued that the properties that we can assign to the object are nothing but the very preconditions for knowing the object itself, overturning the relationship between the knowing subject and the experienced object. However, he did not formulate a phenomenological reduction of time-consciousness, as Husserl did.