Dynamics, Agency and Intentional Action

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ABSTRACT

The complex systems approach to cognitive science invites a new understanding of extended cognitive systems. According to this understanding, extended cognitive systems are heterogenous, composed of brain, body, and niche, non-linearly coupled to one another. In our previous work, we have argued that this view of cognitive systems, as non-linearly coupled brain-body-niche systems, promises conceptual and methodological advances on a series of traditional philosophical problems concerning cognition, reductionism, and consciousness. In this paper, we discuss agency and intentional action in light of this view of cognition.

INTRODUCTION

Philosophical problems concerning intentional action, agency, volition and free will form a tangled knot. Just as with the hard problem of consciousness, most views on these problems tend to lead to dualism or eliminativism of one sort or another. For example, these views typically end with the idea that free will is either a force wielded by a homuncular agent or the idea that free will and agency are illusions. As many have noted, both sides tend to share Cartesian conception of self and action, more or less naturalized, and both sides tend to agree that reification of agency or its elimination are the only options. This conception includes the assumptions that action is caused by disembodied, internal representations (intentions, beliefs, desires, and reasons) wielded by

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agents, all residing in the head. Intentions are understood as prior to actions and are detached from behavior. We reject all these assumptions in favor of a dynamical account of intentional action and agency; an account that allows us to avoid the extremes of dualism and eliminativism about intentional action and agency. However, unlike many other extended accounts of agency and action, we argue that extending agency and action makes them less susceptible to reification or elimination, not more. We are certainly not alone in trying to tell this story, see for example Juarrero 2009 and 2010, and a collection of articles devoted to a more embodied, embedded and extended account of intentional action and agency (Grammont *et al.* 2010).

We follow the strategy set out by Ryle in *Thinking and Saying* (1979). There, Ryle wants to describe thinking in a way that is not reductionist, but still avoids inflating thinking into something mysterious, because «Reductionist and Duplicationist theories are the heads and tails of one and the same mistake» (Ryle 1979, p. 80)

> The specific notion of Thinking, which is our long term concern, has been duly deflated by some philosophers into Nothing But such and such; and duly reinflated into Something Else as Well. (Ryle 1979, p. 80)

We do not endorse Ryle's story about thinking, but we do agree with his contention that the right story about it must be neither reductionist nor duplicationist. We think the same is true of agency and intentional action.

In previous work, we laid out a story about cognition and conscious experience that is neither reductionist nor duplicationist (Chemero 2009, Silberstein and Chemero, forthcoming). Consciousness and cognition are not Nothing But brain activity, but this does not mean they are to be reified as Something Else as Well. In this paper, we extend that approach to intentional action and agency. Our claims about action and agency are based on a particular conception of conscious cognitive agents that we call extended phenomenological-cognitive systems. The first part of the paper is devoted to characterizing that account and the second part will unpack the implications for intentional action and agency.

EXTENDED COGNITIVE SYSTEMS

We have argued that, at least in some cases, cognitive systems are extended brain-body-environment systems (Chemero 2009; Silberstein and Chemero to appear). We are not alone in defending what is now often called ‘extended cognition’. But, as we will make clear below, our understanding of extended cognition is importantly different from most others. First, though, it is important to be clear on just what it is for cognition to be extended. To do so, consider a taxonomy offered by De Jaegher, Di Paolo and Gallagher (2010), concerning three ways in which features of the extra-bodily environment might be related to some cognitive phenomenon. First, the features might provide the *context* in which the cognitive phenomenon occurs, such that variations in the features produce variations in the cognitive phenomenon. Second, the features might *enable* the cognitive phenomenon, in the absence of the features, the cognitive phenomenon cannot occur. Third, the environmental features might be *constitutive parts* of the cognitive phenomenon. Only in this third case, when environmental features form constitutive parts of the cognitive phenomenon, is the cognitive system genuinely extended. (Note that De Jaegher *et al.* provide examples in which interpersonal social coordination plays each of these roles in social cognition, thus demonstrating that social cognition is at least sometimes extended.)

The empirical basis for our arguments that environmental features are sometimes constitutive parts of cognitive systems is research in dynamical modeling in cognitive science. Dynamical models have been used in psychology for at least 30 years (since Kugler *et al.* 1980), and have since then been employed with increasing frequency throughout neuroscience and the cognitive sciences. In dynamical systems explanation, one adopts the mathematical methods of non-linear dynamical systems theory, thus employing differential equations rather than computation as the primary explanatory tool. Dynamical systems theory is especially appropriate for explaining extended cognition because single dynamical systems can have parameters on each side of the skin. That is, we might explain the behavior of the agent in its environment over time as coupled dynamical systems, using something like the following coupled, non-linear toy equations, from Beer (1995, 1999):

$$\frac{dx_A}{dt} = A(x_A; S(x_E))$$

$$\frac{dx_E}{dt} = E(x_E; M(x_A))$$

where A and E are continuous-time dynamical systems, modeling the organism and its environment, respectively, and $S(x_E)$ and $M(x_A)$ are coupling functions from environmental variables to organismic parameters and from organismic variables to environmental parameters, respectively. Although in everyday conversation, we treat the organism and environment as separate, they are best thought of as comprising just one system, U. Rather than describing the way external (and internal) factors cause changes in the organism's behavior, such a model would explain the way U, the system as a whole, unfolds over time.

In those cases in which cognitive systems are best characterized as non-linearly coupled brain-body-environment systems that receive a dynamical explanation, the cognitive system is extended. When the constituents of a system are highly coherent, integrated, and correlated such that their behavior is a nonlinear function of one another, the system cannot be treated as truly a collection of uncoupled individual parts. Thus, if brain, body and environment are non-linearly coupled, their activity cannot be ultimately or best explained by decomposing them into sub-systems or system and background. Hence, they are one extended system, with brain, body and environmental features all serving as constitutive parts.

We can demonstrate this with an example. First, a little background: Work this decade has shown that 1/f noise (a.k.a., pink noise or fractal timing) is ubiquitous in smooth cognitive activity and indicates that the connections among the cognitive system's components are highly nonlinear (Ding *et al.* 2002; Riley and Turvey 2002; Van Orden *et al.* 2003, 2005; Holden *et al.* 2009). Research on the role of 1/f noise in cognition has allowed a new (and improved!) way to address some central issues in cognitive science, including allowing experimental approaches to questions that were thought to be "merely philosophical".[1] For example, Van Orden, Holden and Turvey (2003) use 1/f noise to gather direct evidence showing that, in certain cases, cognitive systems are not modular; rather these systems are fully embodied, and include aspects that extend to the periphery of the organism. Van Orden, Holden and Turvey (2003, 2005, 2009) argue that 1/f noise found in an inventory of cognitive tasks is a signature of a "softly assembled" system sustained by *interaction-dominant dynamics*, and not *component-dominant dynamics*. In component-dominant dynamics, behavior is the product of a

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[1] See Stephen *et al.* 2009; Stephen and Dixon 2009; Dixon *et al.* to appear for some recent examples.

rigidly delineated architecture of components, each with pre-determined functions; in interaction-dominant dynamics, on the other hand, coordinated processes alter one another's dynamics, with complex interactions throughout the system. For example, when, as part of an experiment, a participant is repeating a word, a portion of her bodily and neural resources assemble themselves into a «word-naming device» (Van Orden *et al.* 2003, p. 346). Soft device assembly as the product of strongly nonlinear interactions within and across the temporal and spatial scales of elemental activity can account for the 1/f character of behavioral data, while assembly by virtue of components with predetermined roles and communication channels cannot. The key point for current purposes is that only when dynamics are component dominant is it possible to determine the contributions of the individual working parts to the overall operation of the system; in a system whose dynamics are interaction dominant, all of the system's parts are constitutive.

Finally, to the example: Dotov, Nie and Chemero (2010) describe experiments designed to induce and then temporarily disrupt an extended cognitive system, demonstrating that artifacts beyond the organism's periphery, can participate in the interaction-dominant dynamics of a human-tool system.

Participants in these experiments play a simple video game, controlling an object on a monitor using a mouse. At some point during the one-minute trial, the connection between the mouse and the object it controls is disrupted temporarily before returning to normal. Dotov *et al.* found 1/f noise at the hand-mouse interface while the mouse was operating normally, but not during the disruption. As discussed above, this indicates that, during normal operation, the computer mouse is part of the smoothly functioning interaction-dominant system engaged in the task; during the mouse perturbation, however, the 1/f noise at the hand-mouse interface disappears temporarily, indicating that the mouse is no longer part of the extended interaction dominant system. These experiments therefore were designed to detect, and did in fact detect, the presence of an extended cognitive system, one in which features of the environment are constitutive parts. The fact that such a mundane experimental setup (using a computer mouse to control an object on a monitor) generated an extended cognitive system suggests that extended cognitive systems are quite common. And note that because the system displayed interaction-dominant dynamics, it is not possible to separate any component of the system as playing essentially cognitive roles, while other components are mere tools. We will return to this example repeatedly in this paper.

EXTENDED PHENOMENOLOGY-COGNITION

In Chemero 2009 and, especially, Silberstein and Chemero to appear, we have argued that if features of the environment are sometimes constitutive parts of cognitive systems, it is attractive to view consciousness as being also partly constituted by features of the environment.[2] We claim that cognition and conscious experience are inseparable and therefore extended, and thus we often speak of 'extended phenomenological-cognitive systems'. In such systems, conscious experience is neither Nothing But brain activity, nor Something Else as Well (i.e., qualia). Because nothing in the claims we make about agency and action depends on the extension of conscious experience, we will not argue for extended consciousness in detail here. We will however use the phrases 'extended phenomenology-cognition' and 'extended phenomenological-cognitive systems'. We do so to differentiate our view from those of other proponents of extended cognition. One of the most important ways in which our view differs from others is that we embrace *antirepresentationalism.* In extended cognitive science, like the Dotov *et al.* experiments described above, non-linearly coupled animal-environment systems are shown to form just one unified, interaction-dominant system. The unity of such a system removes the pressure to treat one portion of the system as representing other portions of the system. Because the mouse and the object it controls on the monitor are constituent parts of the interaction-dominant cognitive system, there is no separation between the cognitive system and the environment that must be bridged by representations. So extended cognition invites antirepresentationalism. This antirepresentationalism is the key to the understanding extended cognitive systems as extended phenomenological-cognitive systems. As we will see below, it is also the key to the understanding of agency and action.

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[2] See also Rockwell 2005.

CHARACTERIZING EXTENDED PHENOMENOLOGICAL-COGNITIVE SYSTEMS

We propose that extended phenomenology-cognition is to be understood as a variety of niche construction, one in which the constructed niche is an animal's cognitive and phenomenological niche. In biological niche construction, the activity of some organism alters, sometimes dramatically, its own ecological niche as well as those of other organisms (Olding-Smee *et al.* 2003). These animal-caused alterations to niches have profound and wide-reaching effects over evolutionary time. Phenomenological-cognitive niche construction has its effects over shorter time scales – an animal's activities alter the world as the animal experiences it, and these alterations to the phenomenological-cognitive niche, in turn, affect the animal's behavior and development of its abilities to perceive and act, which further alters the phenomenological-cognitive niche, and on and on.

Following enactive cognitive scientists (e.g., Maturana and Varela 1980; Thompson 2007; Di Paolo 2009) and ecological psychologists (e.g., Kelso *et al.* 1980; Swenson and Turvey 1991; Kelso 1995; Chemero 2008), we take animals and their nervous systems to be *self-organizing* systems. The animal's nervous system has an endogenous dynamics, which generates the neural assemblies that both compose the nervous system and constitute the animal's sensorimotor abilities. These sensorimotor abilities are the means by which the animal's niche couples with and modulates the dynamics of the animal's nervous system. These sensorimotor abilities are coupled with the niche, i.e., the network of affordances available to the animal (Gibson 1979). See *Figure 1*. This yields three (approximately) nested self-organizing systems, coupled to one another in different ways and at multiple time scales. Over behavioral time, the sensorimotor abilities cause the animal to act, and this action alters the layout of the affordances available, and the layout of affordances perturbs the sensorimotor coupling with the environment (causing, of course, transient changes to the dynamics of the nervous system, which changes the sensorimotor coupling, and so on). Over developmental time, the sensorimotor abilities, i.e., what the animal can do, determines what constitutes the animal's niche. That is, from all of the information available in the physical environment, the animal learns to attend to only that which specifies affordances complementing the animal's abilities. At the same time, the set of affordances available to the animal profoundly influence the development of the animal's sensorimotor abilities. So we have a three-part, coupled, nonlinear dynamical system in which the nervous system partly determines and is partly determined by the sensorimotor abilities, which, in turn, partly determine and are partly determined by the affordances available to the animal. Also note that affordances and abilities are not just defined in terms of one another, but causally interact in real time and are causally dependent on one another in a nonlinear fashion.

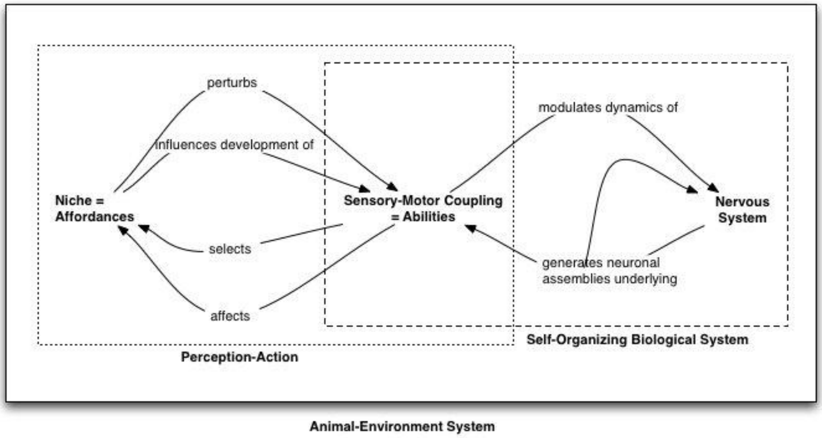

Figure 1

Understanding extended phenomenological-cognitive systems as genuinely phenomenological systems requires understanding affordances. Affordances are not independent properties of an animal's physical environment. They are irreducibly relational features of combined animal-environment systems, features that the animal perceives and uses to guide its action (Chemero 2003, Stoffregen 2003). The animal's behavioral niche, the set of affordances that it has learned to perceive and act upon, just is the environment as the animal experiences it. This underwrites a variety of *phenomenological realism*, or realism about the environment animals act in, think about, and consciously experience. Indeed, the entire system, including the environment as experienced, is required to account for and explain cognition. On this view, cognition and conscious experience are neither Nothing But brain activity, nor are they a dualistic Something Else as Well – they are the ongoing adaptive activity of the animal in its niche.

EXTENDED PHENOMENOLOGICAL-COGNITIVE SYSTEMS: PLASTICITY AND ROBUSTNESS

In order to more fully develop the idea that extended phenomenological-cognitive systems are multi-scale self-organizing systems, in this section we connect extended phenomenology-cognition to another recent topic in biology, the relationship between plasticity, robustness and autonomy in development.[3] Let us begin with phenotypic plasticity, wherein genetically identical individuals will frequently develop very different phenotypic traits when exposed to different environments or environmental conditions (Kaplan 2008). In general, a single genotype or genome can produce many different phenotypes depending on environmental and developmental contingencies. Phenotypic plasticity is just one example of the epigenomic processes in which various mechanisms create phenotypic variation without altering base-pair nucleotide gene sequences. These processes alter the expression of genes but not their sequence. In phenotypic plasticity, differential environmental conditions can lead to different phenotypic characteristics, but there are also cases where genetic or environmental changes have no phenotypic effect. *Robustness* is the persistence of a particular organism's traits across environmental or genetic changes. For example, in many knock-out experiments, a particular gene (or group of genes) known to be involved in the production of a protein or phenotypic trait is disabled, without disturbing the production of the protein or the development of the trait in question (Jablonka and Lamb 2005).

Together, plasticity and robustness imply that organismal processes have a fair measure of autonomy, in that organismal processes are maintained despite genetic and environmental disruptions. To account for the autonomy of the organism from both genetic and environmental changes, developmental biologists have called upon dynamical systems theory. The ongoing self-maintenance and development of an organism acts as a high-order constraint, which enslaves the components necessary to maintain its dynamics. Because of this, a developing system will have highly flexible boundaries, and will be composed of different enslaved components over time. This flexibility serves the autonomy of the developing organism, making it more likely to be viable. Autonomy is sometimes cashed out in terms of recursive self-maintenance.

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[3] See also Thompson 2007.

That is, some systems are autonomous in that they can maintain stability not only within certain ranges of conditions, but also within certain ranges of changes of conditions: they can switch to deploying different processes depending on conditions in the environment.

The same is true, we believe, of extended phenomenological-cognitive systems. The coupled, dynamical phenomenological-cognitive system is highly opportunistic, encompassing different resources at different times. To use the language of dynamical systems theory once again, the extended phenomenological-cognitive system can be characterized as a set of order parameters that enslave components of brain, body and niche as needed in order to maintain itself. This means that the boundaries of the extended phenomenological-cognitive system will change (sometimes very rapidly) over time. And, as in the case of biological autonomy, the flexibility of the boundaries of extended phenomenological-cognitive systems is crucial to their self-maintenance. Autonomy as we are describing it here is the maintenance appropriate relations among the nervous system, the body and the environment, i.e., the maintenance of affordances and the cognitive-phenomenological niche. Thompson and Stapleton (2008) call this “sense-making”.

> Organisms regulate their interactions with the world in such a way that they transform the world into a place of salience, meaning, and value – into an environment (Umwelt) in the proper biological sense of the term. This transformation of the world into an environment happens through the organism’s sense-making activity. Sense-making is the interactional and relational side of autonomy. (Thompson and Stapleton 2008, p. 3)

This sense-making is the activity through which extended phenomenological-cognitive systems learn about, think about, and experience the world. Indeed, it is the activity through which they have a world.

EXTENDED PHENOMENOLOGICAL-COGNITIVE SYSTEMS: ACTION AND AGENCY

Our view is that biological agents are best conceived as extended phenomenological-cognitive systems, and that extended phenomenological-cognitive systems engage in purposeful action. Indeed, it is better to say that the dynamical activity of extended phenomenological-cognitive systems *is* purposeful action. What are the consequences of this understanding of agency and purposeful action? We begin by pointing out that there are significant areas of agreement between our position and that of others who advocate embodied, embedded and extended accounts of agency and action. We agree that agents are not just a sequence of decision making conscious states. We agree that one should endorse causal and explanatory pluralism (Chemero and Silberstein 2008) when it comes to explaining action. We agree that actions are processes extended in space and time, and that agents who engage in actions are extended in space and time and include aspects of the surrounding environment, social and physical, past and present, and perhaps even future (Clark 2007, p. 107). These are the points of agreement; where we differ from other proponents of extended agency is far more telling.

The first place we differ from Clark, and most other proponents of extended cognition, is over the role of computation in explaining cognition. Indeed, the debate about extended cognition is just an in house dispute over how wide computational processes are.[4] Extended phenomenological-cognitive systems do not function by representing the environment; the system and the environment are inseparable, so there is no need for intervening representation. On the conceptions of computation that have been used by cognitive scientists, computation requires representation (Fodor 1981). So extended phenomenological-cognitive systems are not computational systems; on our view, unlike many others who discuss extended cognition, cognition is not computation.

Moreover, the view of extended cognition as wide computationalism (Wilson 1995, 2004; Clark 1997, 2007) treats extended cognition as synonymous with *distributed* cognition. For example, in the ur-example of wide computation, the resources used to carry out long division are distributed among multiple separate components: a human brain, visual system, and motor system, along with the chalk and chalkboard on which the problem is written. The computational processing is distributed among these separate components, and the system like this would exhibit component-dominant dynamics as a whole. In contrast, extended phenomenological-cognitive systems are extended, but they are not distributed in the way Clark suggests. As we saw with the Dotov *et al.* study described above, the non-linear nature of extended phenomenological-cognitive systems, their robustness and their plasticity all imply that the systems are softly assembled, exhibiting and

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[4] See the papers collected in Menary 2010.

sustained by interaction-dominant dynamics, and not component-dominant dynamics. The soft assembly is the product of strongly nonlinear interactions within and across the varying temporal and spatial scales of extended phenomenological-cognitive systems. It is driven by order-parameters in a higher-dimensional state space that both determine the expanding possibilities for the system as a whole and constrain the degrees of freedom of the more basic components in order to maintain the system as an autonomous, self-organizing unity. Because of (1) the time scale differences in the components' interactions and the dynamics of the whole system, and because (2) the same dynamics of the whole is often realized by multiple components (i.e., the system exhibits self-similarity at multiple spatial and temporal scales, which can be detected as 1/f noise), the system as a whole has a significant degree of autonomy from its components. The point is that extended phenomenological-cognitive systems are autonomous systems that are made up of components, but have dynamics that are not determined by the components (i.e., the dynamics are interaction dominant). This is in contrast with wide computational systems, which have component-dominant dynamics.

This difference between extended phenomenological-cognitive systems, which are extended but not distributed, and wide computational systems, which are distributed, is important to the discussions of agency and action. Taking cognition to be distributed, as it is in wide computational systems, makes agency ripe for elimination. Clark, for example, says

> what we really need to *reject,* I suggest, is the seductive idea that all these various neural and non-neural tools need a kind of stable, detached user. Instead, it is just *tools all the way* down. (Clark 2007, p. 111)

Clark also frames the debate in terms of the following dilemma: agency and action are just "tools all the way down" or they require a neural, functional center of consciousness, a central *self* relative to whom all neural, technological resources are mere tools (Clark 2007, p. 113). Clark is not alone in framing the state of play in this way. Ismael, for example, argues that we are forced between either a self-representation playing a causal role or mere input-driven self-organization; that is, real self-governance versus mere self-organization (Ismael 2010). The extended phenomenological-cognitive systems conception of agency and action shows that this is a false dilemma. The agency of extended phenomenological-cognitive systems is neither Nothing But tools nor Something Else as Well (a reified self-representation). Moreover, because agency in extended phenomenological-cognitive systems inheres in a single (extended, but non-distributed) system with interaction-dominant dynamics, it is natural to claim that this system, as opposed its tools, is responsible for the action. The agency, like the system, might be extended, but it is not distributed.

An important question, though, is whether this sort of agency, which does without a Something Else as Well, is genuine agency. It is. Following Barandiaran, Di Paolo, and Rohde (2009), we take it that agency has three necessary components: the agent must be an identifiable individual; the agent must do something; and there must be norms governing what the agent does. We can see this by, once again, considering the Dotov *et al.* experiment. In the experiment, an extended phenomenological-cognitive system composed of (parts of) a person, a mouse, and computer display was brought into being and then temporarily disrupted. This system does compose an identifiable individual: the system as a whole behaved as an individual, as is indicated by its having measurable 1/f noise at the interface between the person and the mouse. This 1/f noise was a feature of the system as a whole, rather than a feature of any of its components. The system did something: the video game that was played had a goal state, and the extended phenomenological-cognitive system's activity was aimed at bringing that goal state into being. Finally, it was apparent whether the person-mouse-monitor system was successfully attaining the goal state, and when the mouse disruption made attaining that goal state difficult or impossible to achieve, the character of the system's activity changed such that the 1/f noise disappeared. That is, the system's activity was governed by norms, and the system's behavior changed when it was not achieving those norms. This extended phenomenological-cognitive system displays the necessary characteristics of genuine agency.

EXTENDED PHENOMENOLOGICAL-COGNITIVE SYSTEMS: INTENTIONAL ACTION

We have explained how extended phenomenological-cognitive systems can be agents, and can act purposefully. We have, so far, said nothing about how they might have *intentions* or act intentionally. In *intentional action*, an agent's intention is said to cause action. Given our goals, it is essential that intentional action be neither Nothing But behavior, nor Something Else as Well. So intention must not be merely causally prior to the action but must somehow correspond to the intentional structuring of action, without being something over and above the action. The question that arises is how can physical processes instantiate intentional action of this sort? The outline of the correct answer to this question can be found in Juarrero's pioneering application of dynamical systems thinking to intentional action and agency (Juarrero 1999, 2009, 2010). Juarrero argues that beliefs, intentions, reasons, and the like are not the efficient causes of action. Instead, they act as context-sensitive constraints, and serve as final or formal causes of action. This is possible, she says, because «mental phenomena should be describable mathematically as neural attractors» (Juarrero 2010, p. 265). Intentions in particular are described as «higher-dimensional, neurologically embodied long-range attractors with emergent properties» (Juarrero 2010, p. 267). And more specifically, intentions are «soft-assembled context-sensitive constraints operating as control parameters» (Juarrero 2010, p. 268). These intentions constrain the activity of the system, so that the action comes about. Although Juarrero does not use the exact same language that we do, what she is describing is the activity of softly assembled, self-organizing systems that display interaction-dominant dynamics. Thus we agree with Juarrero that intentions are best understood as control parameters, which are both composed of the system's components and also act as constraints on the activity of those components. This allows intentions to play a role in the generation of action without being identical to the system components and without being anything over and above the system.

There are, however, important differences between our view and Juarrero's. First, while she does stress that the environment gets folded into cognitive processes that are not just in the brain (Juarrero 2010, p. 265), we think that she is too closely focused on the brain and "self-organized neural states". Second, Juarrero's view is representationalist:

> A self-organized neural state is representational and symbolic if its central features are given not by the configuration's intrinsic physical properties but by the *information* it carries. (Juarrero 2010, p. 264)

Finally, and most importantly, we worry that Juarrero's view leans too much toward the elimination of intentions. The second and third of these differences in approach stem from the first. Because Juarrero takes intentions to be self-organizing neural processes, the parameters that govern their organization are independent of the environment and the rest of the body. (That, after all, is what it is to be *self*-organizing.) Because of their independence from the environment and the rest of the body, there is pressure to treat them as representing the body and environment. And, given Juarrero's laudable wish to avoid reifying intentions and other mental entities, she ends up explaining the connection between these context-sensitive neural constraints and action by a body in an environment in a highly deflationary fashion, suggesting classical probability theory as a good analogy for such constraints (Juarrero 2010, p. 260). On this analogy, your intention to get a cup of coffee right now impacts your action the same way that the laws of probability influence the outcome of a coin toss. This strikes us as going beyond Nothing But, all the way to Nothing.

The solution here, of course, is to reject Juarrero's neural focus by taking intentions not to be self-organizing neural attractors that constrain the activity of the body, but rather to be order parameters of self-organizing extended phenomenological-cognitive systems that act as constraints on components of extended phenomenological-cognitive systems. This is perfectly in line with the way that constraints are discussed in physics, allowing them to be kinematic, geometric, or topological constraints, including various kinds of symmetries, or even boundary conditions. These constraints are features of a system that can impact the behavior of the system, and whether one wishes to call this impact formal cause or final cause, it is above all lawful and dynamical. These non-reified intentions genuinely constrain the activity of system without being something outside it.

CONCLUSION

We have been making the case that agents are extended phenomenological-cognitive systems, composed of a changing collection of components of the brain, body and niche. These systems exhibit interaction-dominant dynamics, so it is impossible to separate out the contributions from individual system components; this means they are extended, but not distributed. These systems are genuinely agents and engage in intentional action. Their intentions are order parameters that constrain the activity of system components, but do not act as efficient causes. These agents do not pop into existence (emerge) from complex brain dynamics, already armed with powers of intentionality and will. Rather, agent and environment are co-dependent sides of the same coin. In other words, sense-making and agency go hand in hand. It is built into this conception of things that cognitive agents consciously experience the world in terms of their abilities and goals. Given this, there is no special mystery of how meaningful behavior could be possible. We are extended phenomenological-cognitive systems, which is to say that we are not brains in vats in representation-mediated contact with the environment we want to act in, somehow; instead, we are meaningful action.

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