12 Agency as Internal Control

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12.1 Introduction

Agency is often seen as a property of living systems, one which stems from a particular sort of functional integration that provides certain biological entities a special kind of causal power over themselves. Such self-control allows living systems or organisms to act freely and independently of their external environments (cf. Barandiaran et al., 2009; Moreno & Mossio, 2015). It allows them to take initiative, to change themselves, and to move themselves. In this chapter, we outline a view of agency that focuses on hierarchical structures, control, and how these relate to goal directedness. This view of agency is derived from our theory of goal-directed systems, what we call *field theory*. As will be seen, our view both deviates from and aligns with some common thinking about agency. In particular, we make some critical distinctions between pairs of words that are sometimes used interchangeably, especially control and determinism, and goal directedness and self-directedness, to get at our view of agency.

At the most general level, our position is that agential systems are a subset of the goal-directed ones. To show this, we begin Section 12.2 with an explanation of how goal directedness works under field theory. According to field theory, goal-directed systems have a hierarchical structure, consisting of a small entity that moves within and is directed by a larger field in which it is immersed. A paradigmatic case is sunflowers turning to track the sun throughout the day, guided by the light field emanating from the sun. Sunflowers may well be agents, but goal directedness is found in certain things that are clearly not agents. Something like a rock falling in a well is minimally goal directed on our view (discussed later), but it is not agential. In Section 12.3, we offer our positive view of agency. There we address the relationship between agency and goal directedness. We argue that systems with the right hierarchical architecture inside them have the capacity for agency. With internal hierarchical structure, agential control often becomes possible.

It has not escaped our notice that a seeming contradiction lies at the heart of our views of goal directedness and agency, given that elsewhere we have argued that goal directedness arises from fields that are external to the goal-directed entity. We address this seeming contradiction by highlighting the difference between goal directedness and self-directedness, and by contrasting our view with others in the

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literature. In Section 12.4 we turn to the concept of control to explain why determinism would not undermine agency. This leads to some of our final points, about the graded nature of agency, in Section 12.5 where we argue that degree of agency has to do with the number and depth of hierarchical structuring—that is, of fields—inside the agent.

12.2 Field Theory

This section provides a somewhat distilled version of field theory, providing just enough groundwork to give sufficient context for the following sections on agency.[1] Field theory makes sense of goal directedness by arguing that spatial fields, external to the entities they direct, are the sources of goal-directed behaviors. At the center of the view is hierarchy theory, as it has developed mainly in biology and philosophy of science.[2] At the most general level, what all of this work shares is the idea that physical systems are composed of multilevel hierarchies, where the notion of "hierarchy" roughly means that different entities show up at different levels of nestedness. Hierarchical organization is important in field theory because a core principle of the theory is that goal directedness takes place when entities at higher levels of organization influence those at lower levels of organization nested within them. Consider the goal-directed behavior that a dung beetle exhibits when it acquires an orb of dung. It moves away from the dung pile to escape other beetles who might steal it. To achieve this goal, the beetle needs to escape the pile without circling back to it accidently. Researchers who study dung beetles find its goal-directed tenacity impressive: "a beetle's drive to adhere to its set course is so strong that it sticks to its path regardless of obstacles; over stones, through bushes and grass, across the hand of an experimenter or in an experimental arena" (Dacke & Jundi, 2018, p. R993). It needs to move in a goal-directed way (where the goal is "away from the dung pile"). From the field theoretic perspective, when a dung beetle exhibits such goal directedness, it is because a higher-level structure, in particular the polarized light in the overhead sky, directs it. (The kinds of solar light that direct beetles often depend on the species of dung beetle in question.) In this hierarchical view, we call structures at higher levels "fields." So when a beetle engages in some goal-directed activity, such as navigating away from a pile of dung, according to field theory, it is able to do so because the larger field—the light in the sky—provides the beetle with direction.

There are several points to make using the salient case of the dung beetle. The first is that there is no need to attribute intentions, desires, or the like to the light from the sky. Others, like Dennett (1984), have made this point as well. To argue, as field theory does, that polarized light directs a beetle does not require the kind of metaphysical scaffolding found in traditional teleological externalism, which places some kind of intentional deity at the outer most rung of the hierarchy and uses hierarchical organization to will its own desired ends. Under field theory, goal directedness requires no intentionality.

What is goal directedness then? To answer this, field theory follows Nagel (1979), noting that all goal-directed phenomena, no matter how disparate, share two features: *persistence* and *plasticity*. In our terms, persistence is the tendency for an entity following a particular trajectory to return to that trajectory following perturbations that might have knocked it off course (McShea, 2012). And plasticity is the tendency for an entity to find that trajectory from a variety of different starting points. Recent work on insect navigation offers many biological examples of persistence and plasticity at work. A dung beetle leaves a pile of dung in a goal-directed way, to escape competition with other beetles in the same pile. It moves persistently in that it ultimately finds a path away from the pile despite obstacles that require it to deviate briefly back toward it. It is plastic insofar as it will move away from the pile regardless of where it starts.

Given these signature behaviors, persistence and plasticity, the question arises of how goal-directed entities are able to perform those feats. To answer this, field theory takes an engineering perspective, asking: what components are needed to make such goal-directed system work? On the one hand, certain mechanisms within the beetle are undeniably necessary. Without its visual systems, motor controls, neural pathways, etc., it would not have the capacity to move away from a dung pile. The relation between these internal mechanisms and the external fields with which we are concerned is addressed in greater detail elsewhere (Babcock & McShea, 2023b). In general, field theory is compatible with mechanistic explanations, with mechanism understood in an extended sense that posits physical upper-level fields alongside mechanisms. A beetle detects polarized light with the optic lobe of its brain, which connects to the brain's central complex. And the neuroarchitecture of the central complex is composed of "layers and slices." Some of these slices are interconnected with protocerebral bridges that transmit specific signals along neural pathways that direct behaviors. Researchers have even pinpointed the activity of certain neurons, which correlate with what they call "celestial snapshots" (Dacke & Junde, 2018). These neurons direct the beetle's motor systems when it follows a straight-line trajectory away from a dung pile. Notice the number of hierarchical structures in this description and notice how the arrow of directional influence goes from higher-level fields to lower-level mechanisms. The optic lobe sends signals to the central complex, which directs slices within it, and the slices in turn direct the protocerebral bridges, and so on. So the hierarchical architecture required by field theory seems to be in place. But something is missing: guidance. None of these mechanisms can provide any new information about where the dung pile is and which way to go to walk away from it. Only the external field of polarized light carries that information. To predict where a beetle will go, knowing facts about its neural anatomy will not help. One needs to know where the dung pile is and what is going on in the sky above it. Of course, knowing the properties of a field alone is insufficient to be able to determine whether a given entity will exhibit goal directedness when it enters the field. Answering that question requires understanding its internal mechanisms, in accord with modern mechanistic explanations. Therefore, field theory is an explanation of goal directedness as it is observed, but it offers no predictions regarding whether a given entity will exhibit goal directedness.

Now it is possible to imagine that dung beetles walking away from dung piles could direct themselves entirely from “within,” using only information that is built somehow into their neurons, and some who work in insect navigation argue for this view (see, e.g., Cheeseman et al., 2014). However, from a conceptual standpoint, if this was how navigation, insect or otherwise, worked it would be devastatingly fragile and unwieldy. Imagine if dung beetles had internal maps that were somehow hard-wired into their tiny brains and they had to use those maps to generate a route away from the dung pile. In such a case, any mismatch between the internal map and the actual layout of the environment could send the beetle off in the wrong direction. Another solution might be to program into the beetle’s brain the entire series of muscle contractions and footfalls needed to take it in a straight line away from the dung pile. But this system is also fragile, in that any encounter that knocks the beetle off course could irreversibly disrupt its trajectory away from the dung pile. In sum, it is hard to imagine how any internal mechanism could, by itself, produce the goal directedness we find in nature. And, Dacke et al. (2013) confirm what a field theoretic view anticipates. Dung beetles do not use internal mapping for guidance. They use polarized light in the sky, and when they are unable to detect it, they are completely lost. This has been demonstrated by placing headshields on the beetles, which obscured their overhead views. Beetles with the headshield are unable to navigate away from the dung pile. From an engineering perspective this comes as no surprise. Light from the sky is a field, and it is this field that gives the beetles the capacity to recover from errors and missteps, providing guidance no matter where they wander. It means that mistakes do not result in failure. It is just the kind of robust system that one would imagine selective processes would yield.

This approach also plays out in a different context, among and within the cells of a developing multicellular organism. In an organism’s ontogeny, its cells behave teleologically, persistently and plastically moving in space, changing from one cell type to another, and changing their patterns of gene activation in ways that move the organism’s development forward. These behaviors are all mediated by processes within the cells that involve many different molecules, including the genes, but also myriad proteins, lipids, and other substances, all interacting mechanistically, and the proper function of these mechanisms is critical to the goal-directed performance of the cell as a whole. Significant deviations in them can send a cell on the wrong trajectory. So mechanisms are important. But they do not guide and cannot make informed “decisions” that are relevant to the embryo as whole. For the most part that guidance comes from outside the cell, from what are called “morphogenetic fields,” larger-scale gradients of biochemical substances, secreted in bulk by genes inside the cells, but present on a scale far greater than any single cell, enveloping many cells at once and directing their behavior (see Levin, 2012). When a given cell deviates by chance, it is the morphogenetic field that guides it, sending signals to the cell’s internal mechanism that nudge it back to the proper mechanical and biochemical trajectory. In all of this, genes are important, both in their role as components of cellular mechanisms and in their role as factories for bulk production of the molecules that constitute the fields. But they do not guide. Indeed, thinking about this from an engineering perspective, they could not guide.

Buried far down inside cells, along with the rest of the cell's mechanisms, they simply have no information at the proper scale, no information about the needs of the larger organism, no information about where the cell is supposed to go and how it is supposed to transform in order to contribute properly to the larger whole. The information must necessarily reside at a higher level.

12.3 Agency

So far we have not touched on agency. In this section we offer our positive account of agency, contrasting it with non-agential teleology. We then consider the views of agency presented in Sultan et al. (2022) and in Moreno and Mossio (2015) in an effort to illustrate some key points of agreement and divergence with our position.

The field theoretic view of agency comes from fully appreciating the scope of hierarchical structures. The most deeply nested systems, containing the most levels and the most complexity, are often organisms. Scientific practice indicates as much. It would be a challenge to enumerate all the subfields of biology that are dedicated solely to understanding levels that are contained "under the skin" of organisms, including the standard molecule, cell, tissue, organ, and organ system levels of course, but many other intermediate levels as well.

Taking this view entails an unconventional outlook on how agency and teleology are situated in relation to each other. As stated above, for sunflowers and for the falling rock, teleological guidance is external, with upper-level fields directing lower-level entities. But in agential systems, both the field and the contained directed entity lie inside the organism. It is fitting to call this kind of guidance agential, we argue, because both guiding field and guided entity are *parts* of the organism. When field-and-entity act, the causal arrow still points down, from field to entity, but since both lie within the organism, the resulting behavior is the organism's behavior. It is the organism directing itself.[3]

To see the logic of this view, contrast it with what we consider to be *non-agential goal directedness*. First, imagine a swimmer who moves away from a shore because they are caught in a rip current, an undertow. In this case, the external current is strong and carries them, directs their movement, away from shore even if the person swims against it. In such a case, like Hume's shackled prisoner, the person has lost some degree of their agency. They are, of course, an agent insofar as they might be able swim this way or that, at a very local scale when fighting the current, but if the current is strong enough, it will be to no avail. But, as field theory is a theory of goal-directed systems, its task is to determine whether the *particular* goal-directed behavior like "moving away from the shore" counts as an agential act. In the case of the swimmer, it is clear that their goal-directed trajectory away from the shore is out of their control. As an entity caught up in a field, they are goal directed, but in a non-agential way.

Now consider another person, on a beach with no rip current, who also moves away from shore but swims deliberately away in order to escape the noise from a group of kids playing in the surf near shore. Like the first case, what directs the person away from the shore is an external field, in this case the sound field emanating from the kids. However, in this case, there are also internal fields that govern movement, deeply nested hierarchical systems within the brain, perhaps a large-scale neural field corresponding to wanting peace and quiet, with a motor control center nested within it, and efferent neurons leading to muscle groups associated with swimming nested within that. When that person moves away from the shore to avoid noise, the parts responsible for their movement are their own parts. Their wants control their goal-directed movement away from the noise. Now notice that under field theory, both cases are teleological. And in both, the directing field is external, in a sense. In the undertow case, the rip current that does the directing is external to the swimmer as a whole. In the second case, the fields doing the directing—the brain states corresponding to wanting to avoid the noisy kids—are part of the person. This difference between the main sources of guidance is the key to agency. To the extent the fields that guide a person are mainly external, the person lacks agency. To the extent the fields that guide are mainly internal, they act as an agent.

The above distinction between agential and non-agential teleological systems does not deliver our full account of agency. But it clarifies something that has sometimes been a source of confusion in understanding the commitments of field theory. "External" directedness can take place *inside* an organism, even entirely inside it, provided that the guided entities lie within the guiding field. This might be the case, for example, when the guided entities are motor control centers and the guiding fields are neural activation fields (i.e., wants, desires, motivations, etc.) that are larger than and surround them. So while terminologically the notion of "external" direction might seem at odds with the idea that it could take place "inside" an organism, there is nothing contradictory here. Organisms and some other systems are deeply nested, with many levels of entities within fields, all of them entirely under the skin. This clarification is critical, in that in conventional discourse on agency—and following Kant (see Gambarotto & Nahas, 2022)—the difference between internal and external has been central to agency (e.g., Walsh, 2015; see also Nahas, this volume). Our view does not fit neatly into this discourse. In conventional terms, our view counts as internalist in that agency arises from processes occurring inside the organism (under the skin), but externalist in that the causal arrow always runs downward from a field that is external to the guided entity, that is, in the case of complex behaviors, downward from a larger neural field to a smaller motor control center. We hope this obviates some of the critiques directed at our view (e.g., Vane-Wright, 2023; Deacon & García-Valdecasas, 2023).

So field theory is at least in principle compatible with certain internalist views of agency. Still, it differs in the way it sees the relationship between agency and goal directedness. Consider the relationship between *goal directedness* and *self-directedness*.[4] In the contemporary literature, there seems to be no general agreement on how these two align. On our view, goal directedness and self-directedness are both teleological, but not all teleological systems are self-directed. For example, as McShea (2023) has recently argued, certain kinds of evolutionary trends are teleological when they are directed by larger-scale ecological fields. The iterative evolution of flightless rails on the Aldabra atoll is a goal-directed evolutionary trend, a lineage that is persistently and plastically directed toward flightlessness. However, such trends have no agency as they are not self-directed. The direction comes from the island ecology, from a field outside the rail lineage.

Consider the simpler case of the rock falling in a well (discussed in Babcock, 2023). Contrary to conventional thinking, we consider this a teleological process, albeit only minimally teleological. Mayr (1988) agrees citing a rock falling in a well as a particular species of teleology, calling the process "teleomatic." Teleomatic processes are goal-directed processes that are driven by simple laws of nature, so simple that it is hard to see them as instances of genuine teleology. But under field theory, they are teleological for the simple reason that, clearly, they are directed toward an end. The rock is directed, by an external gravitational *field*, toward the bottom of the well. Leaving such cases out of the scope of teleological phenomena results in an impoverished understanding of teleology and goal directedness. But surely something is lacking in the falling rock, something that distinguishes it from the more impressively complex and internally motivated goal-directed behaviors of complex organisms. Field theory agrees. The rock, unlike the complex organism, has little agency. The rock is not *self*-directed. It is like the person caught in the rip current. Agency is self-direction, which in turn requires a set of internal nested entities-within-fields. Teleology is not enough.

Now, contrast the rock with an *Escherichia coli* bacterium climbing a food gradient. *E. coli* are used in several discussions of minimal agency and as examples of teleological systems (Barandiaran et al., 2009; McShea, 2012; Moreno & Mossio, 2015; Lee & McShea, 2020). Even though an *E. coli* bacterium is just a single cell, it has a nested hierarchy inside it. It has a multi-layered cell wall that surrounds the cytoplasm and in the cytoplasm is a genome. It even has a flagellum to propel it. On the field theoretic view, this hierarchical structure is teleological, consisting of upper-level fields directing lower-level mechanisms within it. The bacterium controls its flagellum. In contrast, the rock controls no part of itself. The falling rock is somewhat teleological. The bacterium is both somewhat teleological and at least somewhat agential.

The bacterium example points to a difference between field theory and what Moreno and Mossio (2015) call an "organizational account of agency" (see also Virenque, this volume). Both take a fairly expansive view of agency in which a bacterium climbing a food gradient counts as minimally agential. Also, both locate the source of agency inside the bacterium. The organizational view identifies closure and self-maintenance as key properties that confer agency. The field theoretic view also takes these internal processes seriously, and indeed, in principle, there is nothing inherent in the organizational account's notion of closure that conflicts with how field theory treats them. Of course, field theory describes them differently, pointing to the nested hierarchy of fields and contained entities, and the mechanisms that detect the food gradient and drive the flagellum.

So what distinguishes the two views? One critical difference is that Moreno and Mossio relegate the environment to the backdrop, to the role of triggering internal mechanisms. For them, "a 'taxis' is a movement of an organism triggered by a given feature of the environment, whose presence has some relevance for its self-maintenance" (Moreno & Mossio, 2015, p. 97). In contrast, field theory sees the environment as a source of guidance, of direction, for the bacterium, the source that the bacterium consults in order to know which way to go to climb the food gradient.

The significance of this difference becomes evident when we consider how each view would treat a bacterium that is *not* in a food gradient, one lacking any sort of external guidance. Inside the gradient, the bacterium undergoes a series of random tumbles followed by straight runs, taking longer straight runs when the food concentration is higher, moving it on average toward that higher concentration. Absent a gradient, the pattern of tumbles and straight runs continues but follows no particular overall pattern. In this circumstance, Moreno and Mossio would likely decline to think of its behavior as agential. The mechanisms that produce agency are in place, active, and powering the organism along its path, but they are not doing their job, which is to move the organism up any food concentration gradients that might be present. But when such a gradient is absent, those mechanisms are not, in that moment, contributing to the organism's self-maintenance.

In contrast, the field theoretic view sees the bacterium's behavior outside a food gradient as *more* agential. Unconstrained by a directing gradient it gets to do whatever it "wants." It goes wherever its internal fields and underlying mechanisms drive it. The hierarchical structures inside the bacterium, being less constrained by the outside, exercise greater control over the direction the bacterium takes. In our terminology, it has more agency than a bacterium in a gradient (see McShea, 2016; Babcock & McShea, 2023a). A bacterium directed by a gradient is still an agent, but once it is contained within the food field, the field gains some degree of directional control, constraining the behavior of the bacterium, *reducing* (or channeling) its agency. In other words, chemotaxis is a goal-directed process, but one that is governed externally and reduces the agency of a bacterium. Put another way, a person who lives outside the bounds of a political order and a set of laws has greater agency than someone who lives within a political regime with laws that direct the range of their behaviors. Being subject to external laws reduces one's agency. Which is not to say an increase in agency is always a good thing. The bacterium that remains outside a food gradient is fully agential, but it ultimately starves.

Some will notice a seeming contradiction here, arising from our earlier claim that agential systems are a subset of teleological ones, and that goal directedness is a precondition for and gives rise in some cases to agency. Because here we are giving a case where teleology reduces agency. The contradiction disappears when we see that it is only the goal directedness arising from hierarchical structures inside the organism that gives it agency. Everything changes at the organism boundary. There the logic reverses. Any external field that controls, and therefore restricts, the organism's behavior reduces its agency.

Another feature of the field theoretic view of agency that is entailed by the hierarchical structures and causal relations within a system is that nothing requires that an agential system be living, or part of a living system. Are there non-living agential systems? Our answer is emphatically yes, and one example suffices to make the point. Hurricanes form as warm wet air rises from the surface of the tropical ocean. Perturbations give rise to rotary motion, and that motion is stabilized and amplified by the bulk upward flow of air. Later in the process, the rotary motion produces a pressure differential that gives rise to an eye and eye wall with a region of relative calm in the middle. Taking the hurricane itself as our focal system, field theory tells us that it is directed from above by the huge external field of warm air rising off the ocean. That in itself confers no agency, or at least no more agency that the rock falling down a well. But when the eye and eye wall form, they are directed from above by the much larger field of rotary motion. Thus we have some degree of agency here. The hurricane as a whole directs the parts, the eye and eye wall, within itself.

It is valuable here to compare field theory with another view of agency that is present in the literature, that of Sultan et al. (2022), where "agency is a dynamical property of a system" (p. 5; see also Walsh & Sultan, this volume). We agree, arguing that in essence the dynamics between fields and mechanisms that compose a hierarchical structure are what give rise to agency. Further, both views place special importance on the environment, as in the example of the bacterium presented above. We also agree with Sultan et al. in disconnecting agency from any notion of intentionality or desire (cf. Aaby, this volume). But there are important differences. In particular, we see no reason why agency cannot extend to non-living systems. Sultan et al. (2022) state that an agent is able "to transduce, configure, and respond to the conditions it encounters" (p. 5). Hurricanes meet these criteria. They transduce warm air, using it for energy to form and maintain themselves. They can also be said to configure and respond to the conditions within themselves, using those conditions to generate an eye and an eye wall. Under field theory, in contrast to Sultan et al., agency is not a property unique to living systems.

In sum, our conclusions regarding agency align with parts of certain other views. Like some of those views, ours is fairly permissive, acknowledging agency not just in human intentionality but in simpler entities such as bacteria. However, our view differs in that we do not see goal directedness and agency as necessarily aligned. We also believe it is possible to locate some degree of agency in non-living entities. More generally, we see agency as arising from a particular relation between external and internal structures, as a function of how "control" is divided up between them. We turn to the issue of control in the next section.

12.4 Determinism, Control, and Agency

One key to the field theoretic view of agency can be found in an observation by Dennett (1984). For some, agency is bound up with the problem of determinism versus indeterminism, with some seeing determinism as a threat to agency. How can a fully determined entity have any agency? Dennett (1984) argues that the issue is not determinism but control. There are several important ways in which we do not agree with Dennett's overarching theoretical commitments, particularly when it comes to adaptationism, but on this point we are in general agreement. His insight about control means that determinism, along with our ability to construct deterministic scientific models, is no threat to the notion of self-guidance that intuitively is central to any notion of agency.

Dennett's point is that determined processes are not equivalent to controlled ones. Consider rolling dice. A person who throws a pair of dice determines how they will land, meaning that the person's physical movements in rolling the dice—including the neural signals that activate the muscles, the force and twist imparted by the muscles, and the angle of the hand—would in a deterministic world decide how the dice will land. But, of course, the person has no control over how they land. Or, in our terms, none of the field-entity combinations inside the person can exert any control over what numbers will be showing when the dice come to rest. So even though the thrower sits at the start of the deterministic causal chain directing the dice to their final position, the thrower is not an agent with respect to the outcome. On the other hand, if that person *could* somehow control how the dice landed, their thinking and decisions about the dice might be fully deterministic, but the person would nevertheless have agency with respect to the dice. Control, not determinacy, is what imparts agency, even though controlled processes are determined ones by any normal accounting of a casual chain of events (see Dennett 1984, Chapter 1; Babcock & McShea, 2023a). Our claim is that, other things being equal, the goal-directed entities contained within an organism are largely under its control, that is, controlled by higher-level fields that are also within it. Notice that here "control" is understood in a broader sense than mere intentionality (see Dennett, 1984). "Control" in this broader sense is something that Dennett attributes to B. F. Skinner: "In the Skinnerian sense of 'control' we say that *A* controls *B* if and only if changes in *A* are reliably reflected or registered in changes in *B*" (Dennett, 1984, p. 59; emphasis in original). This is what we mean by "control" as well.[5]

Now we can see why a falling rock is negligibly agential, a bacterium has a degree of agency, and a bacterium in a chemical gradient has reduced agency. Because a rock has no significant internal hierarchical structure, it has no control. External fields completely control it. A bacterium has internal structure, i.e., hierarchical levels composed of upper levels fields and mechanisms within them, and so it possesses some control over itself. When a bacterium has no upper direction—i.e., when it is *not* in a gradient—the structures inside the bacterium have complete control, even though its behavior is aimless. Once it is in a gradient, the upper-level field now exerts some control over it. However, insofar as much of the total hierarchical structure remains within the bacterium, it retains some agency. Fields and the parts within them—fields and parts that in a real sense *are* it—are doing much of the controlling.[6]

We are now in a position to respond to the challenge posed at the beginning of this chapter: how is agency possible under the field theoretic account of goal directedness? Returning to dung beetles, if beetles are externally directed by polarized light would not this entail that they are not agents? Does not it mean that they mechanistically and passively respond to light emitted from the sky and therefore lack the kind of self-determination typically believed to be a critical component of agency? From this vantage point, it might have appeared as though field theory resembles genetic or biological determinism. All it does is switch the source of the determinism from the genes to external fields.[7] But this is not the case. Solar light directs the optic lobe, and that lobe directs the central complex, which directs neural slices, and at each level there is a causal interaction that is taking place. Some *A* inside the organism is changing some *B* inside the *A*. What is key is that most of these causes are happening inside the beetle, caused by fields and parts within the beetle. Most of the causation is controlled self-causation. Solar light determines the beetle's overall path, but the beetle is in control of the details of its movement. However, returning to where we differ with other views, a beetle that is not being directed by solar light has more control because in that case, all other things being equal, all of the overall causation takes place "under the skin" of the beetle. If its eyes are covered by the experimenter, the net result will be that the beetle's behavior becomes more aimless, but it then has greater agency as it gains more control over its movement. Control, not determination, is what confers agency.

Some will consider this a step too far. Are we really arguing that an aimless organism has greater agency than one that is actively and successfully pursuing survival and reproduction by taking advantage of the affordances of the environment? If so, we would seem to be draining agency of some of its normative content. Seemingly, under field theory, greater agency is not necessarily a good thing. This is indeed part of our view, and not as a bullet we bite but as a virtue we embrace. Consistent with our thoroughly biological take on the world, agency is—like many other biological properties—most advantageous not in its most extreme form, but in some middle ground between extremes. Organisms thrive not in achieving complete self-determination, perfect agency, but in the release of some agency, in partial surrenders to the environment, in the interest of navigating it and drawing on its resources.

It is worth acknowledging that any scientific investigation of agency must confront what one might call the *deterministic threat*. If agency can be modeled deterministically, as field theory proposes, that deprives it of the freedom that intuitively lies at its core, raising the possibility that true agency is illusory. We have addressed the issue of freedom elsewhere (Babcock & McShea, 2023a). Our reply is, as argued above, that determinism is not relevant here, that what we really want out of agency is control, that field theory preserves control, and that successful modeling of agency simply bolsters our understanding of how it works.

12.5 Graded Agency

An upshot of this view of agency is that it shows that agency comes in degrees. The degree of agency roughly corresponds with the degree of nestedness and upper directedness within the agent. Generally, entities with fewer levels of internal nestedness have less agency than those with more, as more nestedness provides more places where causation can take place, and therefore greater control. So as internal hierarchies get more complex, other things being equal, the degrees of agency increase too. A dung beetle not only has deeply nested hierarchical systems inside it, but it also has other parallel hierarchical systems. So not only are the tools that it has hierarchically deep, but it also has more of them. It has some internal hierarchically organized system for guidance by polarized light, as discussed, but it also undoubtedly has another for steering around obstacles in its path. And others for detecting and responding to the odors of dung, mates, and presumably other features of the environment. Plus, it has the usual array of internal animal systems that direct growth, development, and repair, all of these hierarchically organized and goal directed, as well as a large repertoire of homeostatic mechanisms for controlling its internal physiology, each to some degree independent of the others (Figure 12.1). Our point is that each somewhat independent, internal, goal-directed system within the beetle adds another degree of control that the beetle has over itself. Each adds some increment to its agency.

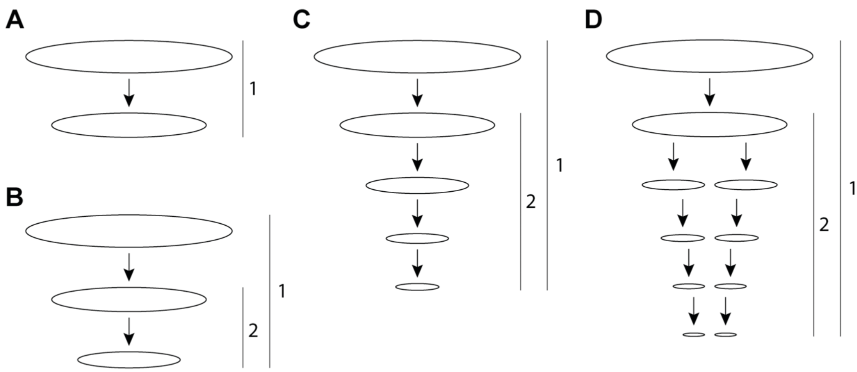

Figure 12.1 Degrees of agency. Ovals represent hierarchical levels in a system (bracket 1), and vertical arrows are causal, running downward from larger upper-level fields to contained lower-level entities. Importantly, for purposes of illustration, levels are shown as separate from each other, smaller underneath larger, but they should be understood to be contained, smaller within larger. In all cases, the top, largest oval represents a field in the environment, external to the goal-directed entity. (A) A system consisting of an upper-level external field (top oval) that directs (vertical arrow) a lower-level entity with no internal hierarchical structure of its own (bottom oval), like a rock falling in a gravitational field. The rock's trajectory is goal directed but hardly agential. (B) A case where the guiding external field (top oval) directs an entity (bracket 2) with shallow internal nesting (middle and bottom ovals). The goal direction delivered by the middle oval to the bottom oval occurs entirely within the entity, which makes the whole entity (bracket 2) somewhat agential. An example might be a bacterium following a food gradient. (C) A case in which the entity (bracket 2) is much more deeply nested internally, giving its various fields more total causal interactions, greater causal efficacy, more control over itself, and therefore greater agency. An example might be the control system inside a beetle that directs it away from a dung pile. (D) A system showing how hierarchical structures within an entity (bracket 2) can run in parallel producing yet more internal control, and therefore greater agency. Again, this might represent a dung beetle, but now taking into account more goal-directed processes than those involved in moving away from a dung pile.

The more mediation that goes on, the greater the number of internal goal-directed subsystems through which a behavior has been screened, or the more causal work they do, the more the system's agency can direct its behavioral output. And so, given that a beetle does more internal controlling, has more goal-directed systems, its agency is fairly robust compared to that of a bacterium. But, when compared to the nuanced and expansive capacity of something like human decision-making, the dung beetle's agency pales. Many human behaviors rely on countless, complex internal hierarchies found within the brain that—if Hume is right—culminate in a large and sometimes noisy chorus of motivations, passions, intentions, or "wants." The complexity of the goal-directed systems guided by these wants leads to the capacities most typically associated with the heights of agency. The beetle can move forwards, backwards, and side to side. It can even regulate its internal physiology, feed, pursue mates, and so forth. But it does not possess the internal structures needed to turn a doorknob, thread a needle, or write an essay. Because humans have so many deeply nested internal hierarchies, the range of behavioral capacities available, and the specificity of those behaviors, is greater than what are available to a dung beetle. These systems afford humans greater control over themselves because more of the field-mediated direction that guides them takes place inside them.

An important caveat: under field theory, upper direction is closely connected with control, as discussed. But as Dennett (1984) notes, control is never complete, never an all-or-none phenomenon. A beetle controls its legs to some degree, a bacterium controls its flagella to some degree, and a driver controls a car to some degree. But sometimes a leg does not do what one wants it to do, just as a minivan does not give a driver the kind of control that a Porsche gives them, even though a driver might want it to. So we underscore the heuristic nature of the correlation we are invoking between the complexity of internal hierarchy and increased degrees of agency. Simply possessing many complex, internally nested systems makes high levels of agency possible, even likely, but does not guarantee it.

A final issue to address here: in this view, as we have said, everything changes at the boundary of the individual. But as the literature on biological individuality shows, it can be difficult to locate these boundaries. If, for example, certain insect colonies are to some degree organisms then looking for certain kinds of agency in a single insect might turn out to be a lost cause. For many behaviors, the colony may be the agent, and a given ant may be mainly a part in that colony's agency. More generally, in many cases, it is not obvious where to draw the line between internal and external, and where this is true agency becomes fuzzy and uncertain. But this is not a problem for field theory. A strength of the position on agency we have adopted is that it comes in degrees, accommodating the continuous variation we see among systems in degree of individuality.

12.6 Summary

We have argued for four main points. First, the field theoretic view makes an internal–external distinction, but that is not the same as the distinction between an organism and its environment. Hierarchical structures, consisting of entities and the fields external to them, exist across many levels, with many entity-field pairs buried down deep inside the organism. Second, teleological systems can be, but need not be, agential. The falling rock is marginally goal directed, but in lacking any significant internal hierarchy, it is negligibly agential. Third, in our positive account of agency we showed that it has to do with control. Agency is control of the self by the self, regardless of how deterministic the causes are. And fourth, consistent with the continuous variation we see in virtually everything, across both biological and non-biological systems, agency comes in degrees. Agency can be greater or lesser, with greater hierarchical structuring generally associated with greater agency.

Notes

1 For other work on the theory, see McShea (2012, 2016, 2023); Lee and McShea (2020); Babcock and McShea (2021, 2023a, 2023b); and Babcock (2023).
2 See especially the work of Feibleman (1954); Campbell (1958); Simon (1962); Salthe (1985); and Wimsatt (1994, 2007).
3 Downward-pointing causal arrows suggest what is conventionally called "downward causation," a phenomenon we embrace. But the controversies surrounding this notion are beside the point here, and to avoid engaging with them, we instead adopt the phrase "upper direction" (McShea, 2012, p. 665). Thus, a goal-directed entity is said to be upper directed, that is, guided by the larger field in which it is enveloped.
4 Our notion of self-directedness should not be confused with other positions that also see a connection between teleology and hierarchy, e.g., Gontier's "self causation" (see Gontier, 2023).
5 Raginksy (2023) has recently argued that a more liberal conception of control, where "control" is more akin to interconnectedness, which is found in a new behavioral approach, helps make sense of, and model, biological autonomy. There may be fruitful work to be done in exploring this new concept of control. Also see Bich and Bechtel (2022) for another position on how "control" might be understood in organisms.
6 Levin (2012) uses the term "control" when discussing the non-local influences found in the morphogenetic fields referenced earlier.
7 See Dennett (1984) for the classic case of "sphexishness," i.e., repeated behavior exhibited by *Sphex ichneumoneus* used as an example of genetic determinism.

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