11 Psychology Without a Mental-Physical Dichotomy

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1. The Mental-Physical Dichotomy and Mind-Body Problems

Is there a mental-physical dichotomy? Many people seem to think so—both the many and the wise, as Aristotle would say. Ordinary folk frequently distinguish mental health and physical health or the mental aspects of athletic performance and the physical ones. Likewise, many standard definitions of psychology claim that it is the science of behavior and mental processes,¹ where behavior comprises observable bodily changes in humans and other animals, and mental processes supposedly comprise the unobserved inner causes of those changes such as thoughts, feelings, and imaginings.² Even if those inner causes turn out to be identical to physical occurrences, psychology does not take an interest in them insofar as they fall under physical concepts, but only insofar as they fall under mental ones. The concept of mentality is thus used to carve out the special subject matter of psychological science, and implicit in that use is a distinction between mental concepts and physical ones. Implicit, in other words, is a mental-physical dichotomy.

Despite its ubiquity, the mental-physical dichotomy is associated with mind-body problems: persistent philosophical problems understanding how mental phenomena are related to physical phenomena. The problem of psychophysical emergence is an example. The physical universe, it says, is a vast sea of matter and energy that can be exhaustively described and explained in principle by physics. We nevertheless have capacities—the capacities to think, feel, and perceive, for instance—that cannot be described and explained in any obvious way using only the conceptual resources of physics. It can thus be difficult to understand how thinking, feeling, perceiving, and other mental capacities can exist in the physical universe, as the following claims illustrate:

- (1) We think, feel, and perceive.
- (2) We are composed of physical particles.
- (3) The properties of a composite whole are determined by the properties of the physical particles composing it.

- (4) Physical particles do not think, feel, or perceive.
- (5) No number of physical particles could combine to produce a composite whole that thinks, feels, or perceives.

Claims (1)–(5) are jointly inconsistent. Claim (1) implies that we can think, feel, and perceive, yet claims (2)–(5) imply that we cannot. The claims cannot all be true; at least one of them must be false, but it is not clear which is false, since there are good reasons to endorse each.³

The problem of emergence assumes that there is some type of categorical difference between thinking, feeling, and perceiving, on the one hand, and the kinds of facts that can be expressed using the concepts of physics, on the other. It and other mind-body problems assume that there is some more or less well understood distinction to be drawn between mental concepts, statements, facts, events, properties, or individuals, on the one hand, and physical ones, on the other.

Mind-body problems strike at the conceptual foundations of psychological science. They suggest that there is something conceptually problematic about the mental-physical dichotomy. If psychological science presupposes that dichotomy, then there is something conceptually problematic about psychological science. If the mental-physical dichotomy is somehow incoherent, or if it fails in some way to carve nature at its joints, then the questions psychologists ask, the theories they advance, and the research programs they pursue are all bound to be misguided in various respects—like the efforts of physicians whose approaches to health presupposed the four humors. Even if their efforts yield fruitful results, it will be difficult to understand exactly what those results mean: how they mesh with findings in correlative disciplines such as neuroscience and molecular biology, and what significance they have for a synoptic understanding of psychophysical subjects.

Not surprisingly, some philosophers have sought to reject the mental-physical dichotomy. According to John Dewey, for instance:

[T]he ‘solution’ of the problem of mind-body is to be found in a revision of the preliminary assumptions . . . which generate the problem.⁴

Consider likewise John Searle:

Both traditional dualism and materialism presuppose conceptual dualism . . . [Conceptual dualism] consists in taking the dualistic concepts very seriously . . . What I believe . . . is that the vocabulary [of dualism], and the accompanying categories, are the source of our deepest philosophical difficulties . . . [I]t would probably be better to abandon this vocabulary altogether.⁵

But Dewey’s and Searle’s proposals to reject the mental-physical dichotomy have not gained much acceptance. In fact, when it comes to stating his own

view, Searle himself makes use of the very dichotomy he takes to be problematic: mental states, he says, are both caused by and realized in physical states of the brain.⁶

There might be many reasons why philosophers—even ones like Searle—don't abandon the mental-physical dichotomy. An obvious one is that they have no alternative: they don't have a metaphysical framework that enables them to formulate their theories any other way. Dewey seems to be an exception. He suggests a framework that could provide an alternative:

The difference between the animate plant and the inanimate iron molecule is not that the former has something in addition to the physico-chemical energy; it lies in the *way* in which physico-chemical energies are interconnected and operate . . . Iron as a genuine constituent of an organized body acts so as to tend to maintain the type of activity of the organism to which it belongs. If we identify . . . the physical as such with the inanimate we need another word to denote the activity of organisms . . . Psycho-physical is an appropriate term . . . In the compound word, the prefix 'psycho' denotes that physical activity has acquired additional properties . . . Psycho-physical does not denote an abrogation of the physico-chemical; nor a peculiar mixture of something physical and something psychical . . . it denotes the possession of certain qualities and efficacies not displayed by the inanimate. Thus conceived there is no problem of the relation of physical *and* psychic. There are specifiable empirical events marked by distinctive qualities and efficacies. There is first of all, *organization* . . . Each 'part' of an organism is itself organized, and so of the 'parts' of the part . . . '[M]ind' is an added property assumed by a feeling creature, when it reaches that organized interaction with other living creatures which is language, communication.⁷

According to Dewey, organization or structure is an irreducible ontological and explanatory principle, one that concerns both what things are and also what they can do. He suggests, moreover, that what people think of as mental phenomena (thought, feeling, and perception) can be understood as species of structural phenomena. If he is right, then it's easy to see how mind-body problems could be avoided: structural phenomena are uncontroversially part of the natural world; mental phenomena are just species of structural phenomena, hence they must be uncontroversially part of the natural world as well.

What's needed to cash in on Dewey's idea is a metaphysic of organization or structure, one that squares the notion of structure with our best empirical methods, descriptions, and explanations, and that enables us to understand thinking, feeling, and perceiving as species of structural phenomena. In what follows I outline a metaphysic along these lines and explain how it enables us to make sense of psychology without requiring us to adopt a mental-physical dichotomy. That metaphysic endorses hylomorphism.

2. Hylomorphism: A Metaphysics of Structure

Hylomorphism claims that structure (or organization, form, arrangement, order, or configuration) is a basic ontological and explanatory principle. Some individuals, paradigmatically living things, consist of materials that are structured or organized in various ways. You and I are not mere quantities of physical materials; we are individuals composed of physical materials with a certain organization or structure. That structure is responsible for us being and persisting as humans, and it is responsible for us having the developmental, metabolic, reproductive, perceptive, and cognitive capacities we have.

The hylomorphic notion of structure is not the same as others that have appeared in the literature. It is not the same, for instance, as the notion of structure that has been operative in discussions of grounding in metaphysics.⁸ Nor is it the same as the notion that is operative in debates about scientific realism.⁹ Nor is it the same as the notion David Chalmers sometimes employs when he speaks of structure and dynamics.¹⁰

To help illustrate the hylomorphic notion of structure I'll use a simple example; we can call it *the squashing example*. Suppose we put Gabriel in a strong bag—a very strong bag, since we want to ensure that nothing leaks out when we squash him with several tons of force. Before the squashing, the contents of the bag include one human being; after, they include none. In addition, before the squashing, the contents of the bag can think, feel, and perceive, but after the squashing, they can't. What explains these differences in the contents of the bag pre-squashing and post-squashing? The physical materials (whether particles or stuffs) remain the same—none of them leaked out. Intuitively, we want to say that what changed was the way those materials were structured or organized. That organization or structure was responsible for there being a human before the squashing, and for that human having the capacities it had. Once that structure was destroyed, there no longer was a human with those capacities. Structure is thus a basic ontological principle: it concerns what things there are. It is also a basic explanatory principle: it concerns what things can do.

When people think of structure they often think of something static such as the relatively unchanging spatial relations among atoms in a crystal.¹¹ But hylomorphists don't view structure so narrowly. Although we're free to call the sum of spatial relations among something's parts a 'structure' in some sense of the term, hylomorphic structures—the kind that, say, distinguish living things from nonliving ones—are not static spatial relations, but dynamic patterns of environmental interaction. They comprise programmatic sequences of changes over time, and often involve different kinds of changes under different kinds of conditions. The neurophysiologist Jonathan Miller brings out this idea of dynamic structure:

[T]he physical universe tends towards a state of uniform disorder . . . In such a world the survival of form depends on . . . [either] the intrinsic

stability of the materials from which the object is made, or the energetic replenishment and reorganisation of the material which is constantly flowing through it . . . The configuration of a fountain . . . is intrinsically unstable, and it can retain its shape only by endlessly renewing the material which constitutes it; that is, by organising and imposing structure on the unremitting flow of its own substance . . . The persistence of a living organism is an achievement of the same order as that of a fountain . . . it can maintain its configuration only by . . . reorganising and renewing the configuration from one moment to the next. But the engine which keeps a fountain aloft exists independently of the watery form for which it is responsible, whereas the engine which supports and maintains the form of a living organism is an inherent part of its characteristic structure.¹²

It is because of their dynamic structures—their abilities to impose structures on incoming matter and energy—that composite individuals (paradigmatically living things) persist one and the same through the constant influx and efflux of matter and energy that characterize their interactions with the wider world.

The hylomorphic notion of structure is close to the notion of organization that many biologists and philosophers appeal to. Here is one example taken from a popular college-level biology textbook—note the references to organization, order, arrangement, and related things:

Life is highly organized into a hierarchy of structural levels . . . Biological order exists at all levels . . . [A]toms . . . are ordered into complex biological molecules . . . the molecules of life are arranged into minute structures called organelles, which are in turn the components of cells. Cells are [in turn] subunits of organisms . . . The organism we recognize as an animal or plant is not a random collection of individual cells, but a multicellular cooperative . . . Identifying biological organization at its many levels is fundamental to the study of life . . . With each step upward in the hierarchy of biological order, novel properties emerge that were not present at the simpler levels of organization . . . A molecule such as a protein has attributes not exhibited by any of its component atoms, and a cell is certainly much more than a bag of molecules. If the intricate organization of the human brain is disrupted by a head injury, that organ will cease to function properly . . . And an organism is a living whole greater than the sum of its parts . . . [W]e cannot fully explain a higher level of order by breaking it down into its parts.¹³

This passage suggests that the way things are structured, organized, or arranged plays an important role in them being the kinds of things they are and in explaining the kinds of things they can do.

Consider likewise the remarks of some philosophers about natural organization. David Armstrong, for instance, says that, “a man is a physical

object distinguished from other physical objects only by the special complexity of his physical organization" (1968: 11). There is nevertheless a crucial difference between Armstrong's notion of organization and the hylomorphic one: Armstrong does not take the organization that characterizes living things to pose a challenge to physicalism, the claim that everything can be exhaustively described and explained by physics. Hylomorphists disagree for reasons I'll discuss in Section 5. For the moment, it's worth noting that many philosophers seem to concur with hylomorphists that biological organization poses a *prima facie* challenge to the explanatory completeness of physics. Among them is Philip Kitcher:

[T]o the extent that we can make sense of the present explanatory structure within biology—that division of the field into subfields corresponding to levels of organization in nature—we can also understand the antireductionist . . . claim that . . . the current division of biology [is] not simply . . . a temporary feature of our science stemming from our cognitive imperfections but [is] the reflection of levels of organization in nature.¹⁴

John Heil sometimes employs a notion of organization similar to the hylomorphic one as well: "the world presents us with endless levels of complexity and organization" (2003: 245). Heil explicitly rejects the existence of so-called higher-order properties—logical constructions expressed by predicates whose definitions quantify over other properties. He insists for good reason that these predicates do not correspond to genuine properties—roughly, to the causal powers things have. But if that it is the case, then it seems that the levels of organization he mentions cannot be mere logical constructs, and if that is true, it becomes difficult to avoid the conclusion that he is implicitly committed to organization being a real ontological principle—something like hylomorphic structure. It's somewhat surprising, then, that he does not embrace the hylomorphic view.

The notion of organization—of, say, the biological organization that distinguishes living things from nonliving ones—does not come for free, at least not if we endorse *ontological naturalism*, the idea that when it comes to determining what exists, empirical investigation—paradigmatically science—is our best guide.¹⁵

Ontological naturalism can be understood as the conjunction of a broadly Quinean thesis about ontological commitment with a broad empiricism. The broadly Quinean thesis maintains that we are committed to all the entities postulated by our best descriptions and explanations of reality, and the broad empiricism maintains that our best descriptions and explanations of reality derive from empirical sources such as the natural and social sciences. Suppose we take the natural-language sentences in which our best descriptions and explanations are formulated and reformulate them in a quantifier-variable idiom the way Quine (1948) suggests. In that case, says

the Quinean thesis, we would be committed to the existence of all the entities needed to make those descriptions and explanations true.

Ontological naturalism puts pressure on philosophers like Heil who invoke a notion of organization or structure. Ontological naturalism implies that if our best empirical descriptions and explanations posit various kinds of organization or structure, then we have good *prima facie* reason to think those structures exist. Those descriptions and explanations thus make of us a serious ontological demand. The most straightforward way of meeting this demand takes empirical claims about structure at face value. It says that structure really is an irreducible ontological and explanatory principle, and this is what makes descriptions and explanations that appeal to structure true. This straightforward realist approach to structure is the one favored by hylomorphists. From their perspective, philosophers like Heil and Armstrong try to use talk of organization or structure without paying the necessary ontological bill. But what exactly is involved in paying that bill? What exactly is hylomorphic structure?

The concept of structure is primitive or basic within a hylomorphic framework: it cannot be defined in terms of any categories that are more basic. The only way of defining a framework's basic concepts is, as Kit Fine says, "to specify the principles by which [they are] governed."¹⁶ The remarks about structure surveyed earlier gesture toward some of those principles. Together, they specify some of the theoretical roles that structure is supposed to play. Structure can be defined as what plays the following roles:

Structure matters: it operates as an irreducible ontological principle, one that accounts at least in part for what things essentially are.

Structure makes a difference: it operates as an irreducible explanatory principle, one that accounts at least in part for what things can do, the powers they have.

Structure counts: it explains the unity of composite things, including the persistence of one and the same living individual through the dynamic influx and efflux of matter and energy that characterize many of its interactions with the wider world.

In what follows, I'll outline a notion of hylomorphic structure that plays these roles.

3. Powers, Composition, and Emergence

The past decade has witnessed a resurgence of interest in hylomorphism. Kit Fine, Mark Johnston, David Oderberg, Kathryn Koslicki, Michael Rea, Anna Marmodoro, Robert Koons, Simon Evnine, and myself have all articulated hylomorphic views to be added to those attributed to thinkers of the past such as Aristotle, Aquinas, Leibniz, and Merleau-Ponty.¹⁷ Among these

hylomorphic theories, naturalistic ones, such as those defended by Mike Rea and myself, claim that hylomorphic structures are powers.

There are many competing theories of powers in the literature.¹⁸ Elsewhere I've argued in favor of a version of the identity theory of powers—the kind of theory defended by C. B. Martin and John Heil.¹⁹ The identity theory of powers claims that properties are essentially dispositional; each essentially empowers its individual possessor to interact with other individuals in various kinds of ways. A diamond's hardness empowers it to do a variety of things—to scratch glass, for instance. We describe this power-conferring role in many different ways. We say that the diamond is hard, that the diamond is able (or has the power or potential or capacity) to scratch glass, or that the diamond would scratch that mirror if raked across its surface. These different vocabularies create the impression that there are different kinds of properties: dispositional and categorical (or qualitative). According to the identity theory, however, these vocabularies describe the very same properties; they just represent different ways of conceptualizing those properties—ways that make explicit or leave implicit the various theoretical roles those properties play. Dispositional descriptions such as 'The diamond would scratch that mirror if raked across its surface' bring out the roles the diamond's hardness plays as a power. Nondispositional descriptions such as 'The diamond has a tetrahedral arrangement of carbon atoms' bring out the property's role as a stable manifestation of the power the carbon atoms have to be arranged tetrahedrally. The one property is thus simultaneously both a stable manifestation of a power and a power itself, both an actuality and a potentiality.

The identity theory of powers claims that powers are essentially directed toward their manifestations. This directedness has led some philosophers to draw analogies between dispositionality and intentionality.²⁰ Intentional mental states are said to be directed at things. My desire is essentially a desire *for* something, my fear is essentially a fear *of* something. Something analogous is true of powers; they are essentially powers *for* various manifestations. The property of fragility, for instance, is essentially directed toward breaking. Likewise, just as my desire can remain unfulfilled and my fear unrealized, so too a power can remain unmanifested. A quantity of table salt has the power to dissolve in water, but it might never actually be dissolved, and a fragile vase might never actually break.²¹

The identity theory also claims that powers are manifested only in specific circumstances and typically only in conjunction with individuals that have reciprocal powers—what Martin calls 'reciprocal disposition partners'. Powers can be manifested both actively and passively: both in the ways individuals affect things and in ways they are affected by them. In general, powers are manifested only when individuals with reciprocal powers are conjoined in the right circumstances. Water, for instance, can exercise its power to dissolve things only in conjunction with things that have the power to be dissolved by it.²²

In addition, the same power can manifest itself differently in conjunction with different disposition partners. To use Heil's example: a ball will roll on a hard surface on account of its roundness, and it will make a concave depression in a soft surface on account of that same roundness. The same property, the ball's roundness, manifests itself in different ways in conjunction with different disposition partners. Likewise, the diamond's hardness empowers it to scratch glass and also to scratch jade, and the batter's power to hit a baseball 400 feet also empowers him to hit a bigger, heavier softball 300 feet.

Hylomorphic structures are powers to configure (or organize, order, or coordinate) things. What sets hylomorphic structures apart from other powers is that they cannot exist unmanifested. They are manifested essentially. Structured individuals are essentially and continuously engaged in configuring the materials that compose them. I configure the materials that compose me, and you configure the materials that compose you. Our continuous structuring activity explains our unity and persistence through the dynamic influx and efflux of matter and energy that characterizes our interactions with the surrounding world. This is what it means to say that *structure counts*: it explains the unity of composite things.

The hylomorphic view of composition is similar to Peter van Inwagen's.²³ Van Inwagen presents his view as an answer to the Special Composition Question: under what conditions do many things compose one thing? Van Inwagen's answer is that composition happens exactly if the activities of physical particles constitute a life. This implies that something qualifies as a part only if it is caught up in a life.²⁴ The expression "caught up in a life" is one that van Inwagen borrows from the biologist J. Z. Young.²⁵ Van Inwagen explains with an example:

Alice drinks a cup of tea in which a lump of sugar has been dissolved. A certain carbon atom . . . is carried along with the rest of the sugar by Alice's digestive system to the intestine. It passes through the intestinal wall and into the bloodstream, whence it is carried to the biceps muscle of Alice's left arm. There it is oxidized in several indirect stages (yielding in the process energy . . . for muscular contraction) and is finally carried by Alice's circulatory system to her lungs and there breathed out as a part of a carbon dioxide molecule . . . Here we have a case in which a thing, the carbon atom, was . . . caught up in the life of an organism, Alice. It is . . . a case in which a thing became however briefly, a *part* of a larger thing when it was a part of nothing before or after . . .²⁶

What exactly is a life? Van Inwagen's descriptions of lives stay largely at the level of metaphor and analogy. The reason is that providing the literal details about what lives are and what characteristics they have is, he thinks, a job for biologists.²⁷ He does nevertheless offer some general characteristics. Lives, he says, are self-maintaining events like flames and waves except that unlike flames and waves they are *well-individuated* and *jealous*.

Flames are not as well-individuated as lives, van Inwagen argues: "If I light seven candles from one taper, has a spatially connected flame become a scattered flame, or have seven new flames come into existence? Presumably, there are no answers to these questions."²⁸ Waves are better individuated than flames, but waves for their part are not jealous:

Consider two waves . . . which are moving in opposite directions and which pass through each other . . . I think we must say . . . that both the waves exist at the moment of superposition and that each is at that moment constituted by the activities of the same water molecules. We may describe . . . the possibility of two waves' being simultaneously constituted by the activities of the same objects . . . by saying that a wave is not a *jealous* event. Lives, however, are jealous. It cannot be that the activities of the *xs* constitute at one and the same time two lives . . . When two waves impinge upon the same water molecules, the activities that each demands of these molecules . . . sum neatly according to the rules of vector addition . . . A life, on the other hand, does not deposit and withdraw sequentially an invariant sum of energy . . . A life takes the energy it finds and turns it to its own purposes.²⁹

Lives are thus a special kind of self-maintaining event on van Inwagen's view, and importantly, they play precisely the kinds of theoretical roles that hylomorphic structures are supposed to play. *Lives matter* on van Inwagen's view; they are ontological principles: whether the *xs* constitute a life makes a difference to whether a composite individual exists. Likewise, *lives make a difference*; they are explanatory principles: living beings can do things that cannot be exhaustively described and explained using the conceptual resources used to describe and explain the materials that compose them.³⁰ Finally, *lives count*; they operate as principles of unity³¹ and persistence:³² what binds the simples that compose me into a single being is that their activity constitutes a life, and what enables me to persist through changes in those simples is the persistence of that life. Because van Inwagen's lives play these roles, it is easy to use his view of composition as a basis for understanding the hylomorphic view.

Configuring materials and being composed of materials are co-foundational concepts on the hylomorphic view, just as having a life and being composed of simples are co-foundational concepts on van Inwagen's. Likewise, just as van Inwagen restricts composition to living things, hylomorphists restrict it to structured things in general. According to hylomorphists, composition occurs when and only when an individual configures materials.

Structured individuals are *emergent* individuals on the hylomorphic view: there are empirically describable conditions that are sufficient to bring into existence a new structured individual where previously no such individual existed. Suppose, for instance, that $b_1, b_2, \dots, b_n$ are physical particles or

materials of some sort. On the hylomorphic view, there are changes the *bs* can undergo which will result in there being a new individual, *a*, which is composed of the *bs*. In the natural course of human events, for instance, changes of this sort regularly happen in utero: physical materials that didn't compose a human organism at time t_1 come by a series of changes to compose a human organism at time t_2 . A new human individual comes to exist where previously no such individual did.

Once a structured individual comes into existence it is continuously engaged in configuring materials, and the materials it configures are precisely those that compose it. The individual *a* comes into existence exactly with the start of its configuring activity—exactly when that configuring activity begins. When it comes to characterizing that activity, hylomorphists can adopt most of what van Inwagen says about lives, at least when it comes to the configuring activities of living things, the paradigmatic structured individuals. My life is identical to my configuring various fundamental physical materials at various times—an event that has the characteristics van Inwagen attributes to lives and that has many other characteristics it is the business of the biological sciences to describe.

An individual living thing does not configure the same materials for very long; the materials composing it are in constant flux. If *a*'s existence commences with its configuring the *bs*, it will not take long for it to exchange some of the *bs* for other things. Yet despite this, *a* maintains itself one and the same through these changes on account of its ongoing configuring activity. That activity is what unifies various materials into a single individual, both synchronically and diachronically, just as lives do on van Inwagen's account.

Van Inwagen is well known for embracing the Denial, the claim that many objects in a commonsense ontology do not exist, including artifacts and natural bodies such as mountains and planets. According to van Inwagen, there is no table occupying the region of space before me—no single, unified individual. There are instead many physical particles spatially arranged table-wise. Since the hylomorphic account of composition is similar in its outlines to van Inwagen's, this raises an important question: how do we know which quantities of physical materials compose unified wholes on the hylomorphic account, and which are mere spatial arrangements of materials? How do we know, for instance, that the physical materials located in this region of space actually compose a human being, that they are not instead diverse materials that are merely spatially arranged human-wise and that do not compose a unified whole at all? What prevents us from concluding that, in fact, there are no human beings just as there are no tables and mountains?

In response, hylomorphists take a cue from van Inwagen: structured individuals have non-redundant causal powers that mere spatial arrangements of physical materials do not have.³³ Suppose, for instance, that it initially seems to us as if *a* is a structured whole composed of the *bs*. This initial impression could be accurate or not. Determining which is a matter

of determining whether *a* has powers not had by the *bs*, and determining whether *a* has any such powers is a matter of determining whether the theories or conceptual frameworks that we use to describe and explain *a*'s behavior are reducible to the ones that we use to describe and explain the behavior of the *bs*.

Reduction is a primarily relation between theories or conceptual frameworks.³⁴ It occurs when one theory or conceptual framework can take over the descriptive and explanatory roles of another. Suppose that TB is a conceptual framework whose predicates '*F*₁', '*F*₂', ..., '*F*_{*n*}' apply to the *bs*, and that TA is a conceptual framework whose predicates '*G*₁', '*G*₂', ..., '*G*_{*m*}' apply to *a* but not to the *bs*. Even though the predicates of TA do not apply to the *bs* it might still turn out that *a*'s having this or that *G*-property is something that can be given an exhaustive account in terms of the *bs*. It might turn out that what makes it true that *a* is *G*_{*i*} is that various *bs* stand in the relation *F*_{*j*}. In that case, *a*'s being *G*_{*i*} is what van Inwagen calls a "disguised cooperative activity" performed by some of the *bs*.³⁵ By analogy, we are not tempted to say that when Alice and Benny perform a tango they bring into existence a third entity of which they are proper parts. The reason is that any agency we might attribute to such an entity can be understood in terms of the cooperative activity of Alice and Benny alone: the power of each to modulate his or her own behavior in coordination with the behavior of the other.

Suppose now that all the properties we attribute to *a* are like *G*_{*i*}. In that case, there is nothing happening in the region we take to be occupied by *a* that cannot be exhaustively described and explained by appeal to the *bs* alone. The conceptual framework TA is reducible to TB. If there is nothing to *a*'s being *G*_{*i*} other than some *bs* standing in *F*_{*j*}, then we can in principle dispense with or replace descriptions and explanations that attribute *G*_{*i*} to *a* with descriptions and explanations that attribute *F*_{*j*} to the *bs*. If the replacement of TA-descriptions and explanations by those of TB is possible across the board, then TB can take over in principle all the descriptive and explanatory roles that TA performs. Reduction is what we would expect, therefore, if *a* is not a unified individual in its own right.

Consider now the converse case. Suppose that *a* is a unified individual composed of the *bs*, and that the predicate '*G*_{*i*}' expresses a power of *a* not had by the *bs*. There is, then, more to *a*'s having *G*_{*i*} than simply some *bs* standing in an *F*-relation. As a result, we cannot dispense with or replace descriptions and explanations that attribute *G*_{*i*} to *a* with descriptions and explanations that appeal to the *bs* alone. TA resists reduction to TB; the latter is not able to take over, even in principle, all the descriptive and explanatory roles that TA performs.

Because *a*'s ontological status is reflected in the conceptual situation in the ways I've described, the discovery that TA is reducible to TB gives us good reason to think that *a* is not a unified whole, and conversely, the discovery that TA is irreducible to TB gives us good reason to think that *a* is a unified whole with powers that the *bs* lack. According to hylomorphists,

the conceptual frameworks we use to describe and explain the behavior of artifacts and natural bodies are reducible to the frameworks we use to describe and explain the behavior of physical materials alone, and this gives us good reason to think that strictly speaking there are no artifacts and natural bodies, but only physical materials spatially arranged in various ways. According to hylomorphists, however, the conceptual frameworks we use to describe and explain the behavior of living things like us resist this kind of reducibility, and this resistance gives us good reason to think that living things like us are unified wholes with powers distinct from those of the materials composing them.³⁶

The hylomorphic view clearly implies a kind of property pluralism since structured individuals have properties of at least two sorts: properties due to their structures (or their integration into individuals with structures), and properties due to the materials composing them independent of the way those materials are structured. This is illustrated by the squashing example considered earlier. Gabriel's powers to think, feel, and perceive are clearly structure-dependent properties: destroying his structure destroys those properties. By contrast, the squashed contents of the bag have the same mass that Gabriel has despite losing Gabriel's human structure. Mass is thus a structure-independent property.

Similarly, subatomic particles, atoms, and molecules have properties such as mass irrespective of their surroundings, but when they are integrated into structured wholes, they become genes, growth factors, and metabolic and behavioral regulators. Each thus admits of two types of descriptions: a description in terms of the contribution it makes to the structured system, and also a description in terms of the properties it would possess independent of any such contribution. Descriptions of the former sort express structure-dependent properties, while descriptions of the latter sort express properties had independently of being integrated into a structured whole. A strand of DNA might always have various atomic or fundamental physical properties regardless of its environment, but it acquires new properties when it is integrated into a cell and begins making contributions to the cell's activities.

Some philosophers and biologists call the new properties of structured systems *emergent properties*. Emergent properties have three characteristics:

1. They are first-order properties, not higher-order ones; that is, they are not logical constructions with definitions that quantify over other properties; they are rather powers in their own right.
2. They are not epiphenomenal, but make distinctive causal or explanatory contributions to the behavior of the individuals having them.
3. They are possessed by an individual on account of its organization or structure.

Notice: it is not a characteristic of emergent properties (at least not on the hylomorphic view) that they are generated or produced by lower-level

systems. As a result, hylomorphists do not need an account of how lower-level systems generate emergent properties. Emergent properties are due to something's structure, and structure is a basic principle on the hylomorphic view; it is not generated by something else.

4. Functional Analysis

Metaphysicians like van Inwagen are not the only ones attracted to a view of composition like the foregoing. Philosophers of biology and neuroscience have been attracted to a view like this as well because it is suggested by actual work in biology and neuroscience—both the methods of those sciences and the kinds of explanations they employ. Of central importance is a method of scientific investigation philosophers sometimes call *functional analysis*. Biologists, cognitive scientists, engineers, and others frequently employ this method to understand how complex systems operate. They analyze the activities of those systems into simpler subactivities performed by simpler subsystems.³⁷

Consider a complex human activity such as running. Functional analysis reveals that running involves among other things a circulatory subsystem that is responsible for supplying oxygenated blood to the muscles. Analysis of that subsystem reveals that it has a component responsible for pumping the blood—a heart. Analysis of the heart's pumping activity shows that it is composed of muscle tissues that undergo frequent contraction and relaxation, and these activities can be analyzed into the subactivities of various cells. Analyses of these subactivities reveal the operation of various organelles that compose the cell and that are composed in turn of complex molecules. We can continue to iterate this analytic process until we reach a level at which no further functional analysis is possible. If, for instance, electrons contribute to the activities of things by virtue of having negative charges, and they have those charges not on account of the activities of some yet lower-level subsystems, but as an unanalyzable matter of fact, then no further functional analysis is possible. We reach a foundational level of functional parts.

Functional analysis provides a way of supplying empirical content to the idea that parts contribute to the activities of their respective wholes—that they are caught up into the lives of those wholes. If we want to know how a part contributes to the activity of a whole, hylomorphism leaves it to the relevant empirical disciplines to tell us. When we look at these disciplines, we find that they describe those contributions in terms of the operation of functional parts—the kinds of parts revealed through functional analysis. Even though it is possible to divide a human along, say, purely spatial lines into thirds, or fifths, or tiny metric cubes, empirical practitioners are typically more interested in dividing them functionally.³⁸ Given ontological naturalism, this provides a basis for understanding the kinds of parts that structured individuals have. Those parts are subsystems that contribute in

empirically specifiable ways to the activities of the wholes to which they belong.

Two clarifications are in order about functional analysis. First, a remark about the name: 'functional analysis' is a name that has been used by philosophers, but biologists often call the method 'reduction.'³⁹ This notion of reduction is different from the notion typically discussed in connection with the philosophy of science and the philosophy of mind.⁴⁰ The latter notion concerns the ability of one conceptual framework to take over the descriptive and explanatory roles of another. To claim that, say, psychology is reducible to neuroscience implies that it is possible in principle for neuroscience to take over all the descriptive and explanatory roles psychology currently plays. By contrast, when biologists speak of reduction they are typically not speaking of the relation between conceptual frameworks I've just described, but of a *method* for studying complex systems—what I've been calling 'functional analysis.' A commitment to employing this method does not imply a commitment to reduction in the philosophical sense. It might be impossible for neuroscience to take over the descriptive and explanatory roles of psychological discourse even though it is possible and even necessary to use functional analysis to understand how humans can engage in psychological activities. In fact, this is precisely what hylomorphists claim. Explanations of living behavior are not reducible to descriptions of the lower-level mechanisms revealed by functional analysis because of the distinctive explanatory contributions a living thing's structure makes.

A second note about functional analysis: the notion of function that gives functional analysis its name is different from the notion of function discussed in connection with functionalism in philosophy of mind. According to classic functionalist theories of mind, mental states are postulates of abstract descriptions framed in terms analogous to those used in computer science—descriptions that ignore a system's physical details and focus simply on a specific range of inputs to it, outputs from it, and internal states that correlate the two.⁴¹ When it comes to functional analysis, by contrast, the notion of a function is not abstract in this way, and it has a teleological dimension: subsystems contribute to the activities of the wholes to which they belong, and that contribution is their reason or purpose for belonging to the system: the purpose of the spark plug is to ignite the fuel; the purpose of the heart is to pump the blood, and so on.⁴²

Teleological functionalism is a type of functionalist theory that appeals to a teleological notion of function along these lines. William Lycan's homunctionalism is an example.⁴³ Like functionalist theories of all sorts, however, teleological functionalism claims that higher-level discourse is abstract discourse: higher-level properties are higher-order properties—logical constructions that quantify over lower-order properties. Saying that something has a belief, for instance, amounts merely to saying that it has *some* internal state that correlates inputs with outputs in appropriate ways. Hylomorphists reject this understanding of higher-level properties;

they claim that higher-level properties are first-order properties in their own right. So although teleological functionalists and hylomorphists both claim that a system's components contribute teleologically to its overall operation, they disagree about how the notion of contribution is to be understood. Teleological functionalists say that descriptions of higher-level phenomena are simply abstract descriptions of lower-level occurrences. Hylomorphists deny this: higher-level descriptions correspond to distinctive natural structures, ones that factor into descriptions and explanations of living behavior in ways that cannot be eliminated, reduced to, or paraphrased in favor of lower-level descriptions and explanations.

5. Activity-Making Structures

So far I've focused on composite individuals and their structures—*individual-making structures*, the kinds of things Medieval hylomorphists called 'substantial forms.' But individuals are not the only composite entities on the hylomorphic view, nor are individual-making structures the only structures. There are composite events as well. The activities in which structured individuals engage have structures too: *activity-making structures*.

The activities of structured individuals involve coordinated manifestations of the powers of their parts. When we walk, talk, sing, dance, run, jump, and engage in the various other activities we do, we impose an order on the ways our parts manifest their powers. My parts needn't manifest their powers in an ordered way. It is possible for my neurons to fire or my muscles to contract in ways that do not compose an activity of, say, throwing a baseball or playing an instrument. Fatigue, injury, insufficient training, and many other factors can result in uncoordinated manifestations of the powers of my parts. But when I succeed in throwing or playing, I succeed in imposing a structure on the way my parts (and in many cases surrounding things) manifest their powers: I structure their manifestations throwing- or playing-wise. In some cases, the structuring is conscious and intentional, as in throwing a baseball or producing the precise limb movements in a dance. But in many cases, the structuring is neither conscious nor intentional, as in digesting food or increasing blood flow to the legs in response to something fearful. In whatever way it occurs, whether consciously and intentionally or not, the result of this structuring is not a new individual but rather an activity, another manifestation of the power structured individuals have of imposing order on things.

Activity-making structures unify diverse events in something analogous to the way individual-making structures unify physical materials in composite individuals. The very same muscle fibers that contract in my shoulder when I throw a baseball might also contract when I experience an uncontrolled muscle spasm. What unifies or coordinates the contractions of the muscle fibers along with changes in surrounding things, such as the baseball, is what I do when I try to make an out, or try to knock down cans at

the county fair, or try to accomplish whatever I try to do when I throw a baseball. In undertaking these activities I impose a unified order on the way my parts and surrounding things manifest their powers.

On the hylomorphic view, structured activities include thinking, feeling, and perceiving. When, for instance, I experience an emotion, I am engaging in an activity in which various parts of my nervous system and various objects in the environment manifest their powers in a coordinated way that unifies them into a single event. It is possible to describe the unifying role of activity-making structures in terms of a notion of activity composition analogous to the notion of composition for individuals. Just as physical materials compose an individual exactly if they have the right kind of individual-making structure, various events compose an activity exactly if they have the right kind of activity-making structure. An individual *a* engages in the activity of *F*-ing exactly if *a*'s parts and surrounding things manifest their powers *F*-wise. I throw a baseball exactly if my parts and surrounding materials manifest their powers throwing-a-baseball-wise. Similarly, I experience anger or enjoyment exactly if my parts and surrounding things manifest their powers anger- or enjoyment-wise.

Given reasonable assumptions, activity composition implies that the behaviors of structured individuals never violate the laws governing their fundamental physical components. According to hylomorphism, the activities of structured wholes are composed of the structured manifestations of the powers of their lower-level components and surrounding things. If those components or things were to lose their powers, or were to become incapable of manifesting them, they would become incapable of composing the activities of structured wholes. Those activities depend on lower-level items retaining and manifesting the powers they have. By analogy, it is only because bricks and timbers retain their shapes under compression that they can be recruited as components of buildings. Similarly, it is only because lower-level materials retain their distinctive powers that structured individuals can recruit them as components for their own activities. This is one thing that sets the hylomorphic view apart from those classic emergentist theories such as Roger Sperry's, which claim that higher-level powers trump or nullify the powers of lower-level things.⁴⁴

Activity composition also makes it clear in what sense a structured individual has the power to engage in various activities *because of* its parts. Those parts form a subset of the individuals with powers whose coordinated manifestations compose its activities. We can express this idea by saying that a structured individual's parts *embody* its powers. My visual system embodies my power to see; your circulatory system embodies your power to bring oxygenated blood to various parts of yourself; Gabriel's limbic system embodies his power to experience emotions, and so on.

According to the hylomorphic theory I've been describing, all the powers of structured individuals are essentially embodied in their parts; the activities in which they engage are essentially composed of the coordinated

manifestations of the powers of their parts and surrounding things. It is impossible, not just nomologically but metaphysically, for me to engage in the activity of throwing a baseball unless my parts manifest their powers in the right coordinated way. Likewise, it is impossible, not just nomologically but metaphysically, for Gabriel to experience anger or enjoyment unless his parts manifest their powers in the right coordinated way.⁴⁵

On the hylomorphic view, then, thought, feeling, and perception are essentially embodied in the physiological mechanisms that compose us, yet it is not possible to reduce explanations of them to explanations of physiological mechanisms.⁴⁶ The reason is that there is more to these activities on the hylomorphic view than the operations of physiological mechanisms: there is also the way those operations are coordinated or structured, and structure in general is something different from things that get structured. It is possible for parts of our nervous systems to be activated in the ways they are when we are experiencing an emotion, for instance, even though we are not experiencing the emotion in fact. Patients with pseudobulbar affect suddenly and unpredictably cry or laugh in ways that are indistinguishable from the ways they would if they were experiencing sadness or mirth, and yet they do not feel sad or amused (Parvisi et al. 2006). Parts of their nervous systems are activated in the ways they would be during a real emotional episode, and yet their activation fails to be coordinated in the way necessary to compose an emotion. The hylomorphic view is thus robustly antireductive despite its commitment to essential physical embodiment.

I've already explained how hylomorphism differs from Lycan's homuncualism and other nonreductive physicalist views that endorse functionalism. It will perhaps be helpful to say more about how it differs from physicalist theories in general. Physicalism is the claim that everything can be exhaustively described and explained by the most empirically adequate theories in current or future physics. Philosophers sometimes use the term 'physicalism' to refer to much weaker claims, such as the claim that everything has physical properties, that everything is composed of physical parts, or that everything is necessitated by or supervenes upon physical events or facts. Elsewhere I've argued that these definitions are inadequate because each fails to imply the core physicalist thesis that everything is physical.⁴⁷ Each is compatible with the existence of nonphysical properties, and because of that each is compatible with dual-attribute theories such as emergentism or epiphenomenalism.⁴⁸ This is true especially of many varieties of nonreductive physicalism. As John Bickle observes, "Much current 'nonreductive physicalism' is not physicalism at all. It is instead . . . a dualism not of substances but of their properties."⁴⁹

Once physicalism is properly defined in the way I've suggested it should be evident why hylomorphism is incompatible with it. According to hylomorphists, there are structures which can't be described using the conceptual resources of physics alone—structures of the sort described by special sciences such as biology and psychology. The claim that there are such

structures is, we've seen, largely an empirical one on the hylomorphic view I've outlined. That view, like physicalism, operates as a "high-level empirical hypothesis," to use Hartry Field's expression.⁵⁰ It is thus open to empirical falsification. Perhaps biological or psychological structures can ultimately be identified with complex relations that are exhaustively describable by physics. In that case, the kind of hylomorphic theory I've outlined will be false. At present, however, the question is not whether hylomorphism is true, but whether it is compatible with physicalism. It should be evident why it isn't: if hylomorphism is true, then there are individual- and activity-making structures which cannot be identified with any structures that might be described and explained exhaustively by physics. If there are such structures, then physics cannot exhaustively describe and explain everything, and if that is the case, then physicalism must be false. Hylomorphism is thus incompatible with physicalism.

Hylomorphism is nevertheless compatible with many weaker claims that have sometimes been labeled 'physicalism.' We've seen, for instance, that hylomorphism implies that structured individuals and their activities are exhaustively decomposable into the activities and subactivities of their parts and surrounding materials, and that these parts and materials are in turn exhaustively decomposable into fundamental physical materials. But this kind of exhaustive physical decomposition does not imply physicalism in the strong sense that everything can be exhaustively described and explained by physics. It is possible for individuals that are exhaustively decomposable into fundamental physical materials to have first-order nonphysical properties and for their behavior to be governed by emergent laws in addition to those governing their fundamental physical constituents. Claims like these are hallmarks of dual-attribute theories such as emergentism and epiphenomenalism.

Exhaustive physical decomposition would imply that all properties are physical if it were combined with a thesis like the following:

Property exhaustion thesis: Necessarily, for any x , if x is exhaustively decomposable into $y_1, y_2, \dots, y_n$, and the activities of x are exhaustively decomposable into the manifestations of the powers of the y s, then x has no properties other than those of the y s.

We have seen, however, that hylomorphists reject any such thesis. They claim that some of a composite individual's properties depend on its structure. Even if x is exhaustively decomposable into the y s, x will still have some properties that the y s lack, namely the properties due to its structure. The same is true *mutatis mutandis* of x 's activities on the hylomorphic view. If my throwing a baseball is exhaustively decomposable into the manifestations of the powers of my parts, there is still the way those manifestations are structured or coordinated. That coordination is not a property of the parts and materials taken on their own; it is rather a property of the

individual as a whole—a structure that I impose on them. Hylomorphism thus implies that anything like the property exhaustion thesis is false.

6. Hylomorphism and the Mental-Physical Dichotomy

The hylomorphic view I've outlined takes thoughts, feelings, perceptions, and other prototypical mental or psychological phenomena to be coordinated manifestations of the powers of our parts and surrounding things. When, for instance, Gabriel sees something—a ripe tomato, say—he and the tomato both manifest powers they possess. He manifests the power to see the tomato, and it manifests the power to be seen by him. Gabriel and the tomato are reciprocal disposition partners. The powers of both are mutually manifested in each other's presence when the surrounding conditions are right, just as water and salt mutually manifest their powers to dissolve and be dissolved when conditions are right.

Moreover, Gabriel has the power to see by virtue of having the parts he has. The coordinated manifestations of the powers of some of his parts (intuitively those composing his visual system) contribute to his seeing, and those parts form a subset of the individuals whose powers, when manifested in the right way, compose his seeing. The same is true *mutatis mutandis* of the tomato. Intuitively, the parts of the tomato by virtue of which it has the power to be seen are those composing its surface, the ones which reflect light to Gabriel's eyes. In addition, there are other environmental factors involved in Gabriel's seeing the tomato such as the direction and intensity of the light, the condition of the air through which he sees it, and so on. Gabriel's seeing the tomato is thus a complex structured activity composed of the coordinated manifestation of the powers of his parts and those of surrounding things.

Let us now return to our original desiderata. We wanted a metaphysical framework that did three things: first, it would enable us to make sense of an empirically-informed notion of organization or structure like Dewey's; second, it would enable us to understand thoughts, feelings, and perceptions as species of structured phenomena, and third, it would not require us to adopt a mental-physical dichotomy. It should be evident how the hylomorphic theory I've outlined satisfies the first two desiderata. Hylomorphic structure carves out composite individuals (paradigmatically living things) from the otherwise undifferentiated sea of matter and energy that is or will be described by our best physics, and it confers on those individuals powers that distinguish what they can do from what unstructured materials can do. The activities of those individuals—including the thinking, feeling, and perceiving in which humans engage—are essentially embodied in the powers of their parts. Details about what parts those are, what powers they have, and how the manifestations of those powers must be structured to compose our activities, are all to be supplied through empirical methods like functional analysis.

What of the third desideratum? Based on what's been said, we can begin to appreciate how hylomorphism satisfies it too, for within the hylomorphic framework, whether we decide to call some of the powers and activities of structured individuals 'mental' or 'nonmental,' or 'physical' or 'nonphysical' is orthogonal to the project of understanding what they are, and why and how they operate as they do. Consider some ways of drawing a mental-physical distinction:

- Something is mental if and only if it displays intentionality.
- Something is mental if and only if it is subjective or has a subjective point of view.
- Something is mental if and only if it can be described or explained using a psychological vocabulary.
- Something is mental if and only if we have privileged access to it.
- Something is physical if and only if it can be exhaustively described by physics.
- Something is physical if and only if it is composed of materials that can be exhaustively described by physics.
- Something is physical if and only if it belongs to the causal order of the world.
- Something is physical if and only if we do not have privileged access to it.

There is nothing to stop hylomorphists from adopting one of these definitions or another, but nothing about their framework of powers and manifestations forces them to do so. The hylomorphic framework does not imply a commitment to categorizing powers or manifestations or individuals or their parts, as mental or nonmental, physical or nonphysical. According to hylomorphists, we can get on with the empirical investigation of powers, parts, and manifestations without ever employing these categories. Whether we decide to draw these distinctions or not is purely a function of our descriptive and explanatory interests. There is nothing built into the nature of things on the hylomorphic view that forces us to draw the distinction one way or another, or that forces us to draw any such distinction at all.

If we want to understand Gabriel's running, we might look to locate his running within the broader rational structure of his intentional activities: he is running because he wants to stay fit, and he wants to stay fit because he wants to continue playing baseball, and he wants to continue playing baseball because, etc. Or, we might look to understand how he can engage in a complex activity like running by analyzing that activity into simpler subactivities whose coordinated occurrences compose his running. Whichever way we take our inquiry—whether we look to describe the reasons for Gabriel's running or the physiological subsystems that enable him to run—the important thing is that we do not at any point need to introduce a distinction between mental factors and nonmental ones or between physical

factors and nonphysical ones. Once we accept the hylomorphic framework I've described, nothing forces us to accept a mental-physical dichotomy.

Nothing forces us to reject a mental-physical dichotomy either. The choice to accept or reject such a dichotomy is contingent upon whatever theoretical or practical ends we are looking to achieve. Within a hylomorphic framework the mental-physical dichotomy is an artifact of our descriptive and explanatory interests.

Because there is nothing canonical about the mental-physical dichotomy on the hylomorphic view, the latter provides an alternative way of understanding the nature of psychological science. Within a hylomorphic framework, sciences can be defined by the kinds of structures their methods enable us to investigate. Psychological science can be defined, then, simply by appeal to the actual methods that working psychologists employ. Those include methods that yield descriptions of higher-level structures in animal behavior such as the structures that make thinking, feeling, and perceiving what they are, as well as methods like functional analysis that yield descriptions of various lower-level subsystems whose coordinated operations compose higher-level behavior. Because this way of defining psychological science makes no appeal to a mental-physical dichotomy, it gingerly sidesteps the mind-body problems which the dichotomy generates. It thus has the potential to provide a stable conceptual foundation for understanding how psychological science meshes with biology and neuroscience. An example involves the science of perception.

7. Hylomorphism and the Science of Perception

On the hylomorphic view I've been developing, the manifestation of perceptual powers—of, say, Gabriel's power to see and the tomato's power to be seen—is a temporally extended process. To understand this idea, it is helpful to contrast it with the approach to perception that has tended to dominate the empirical literature. For decades, that approach has been inspired by the functionalist thinking described in Section 4. David Marr's theory of vision is an example.⁵¹

According to Marr, a perceiver receives sensory stimulation from the environment. That stimulation is nevertheless insufficient to tell the perceiver exactly what objects in the environment have produced it since the same retinal image could be produced by an infinite number of distinct shapes at various distances (Figure 11.1). The perceiver must therefore supplement the meager sensory input with internally stored assumptions about its likely environmental causes. Perception is thus a process of constructing an internal model of the external world based on a combination of sensory stimuli and internally stored assumptions about the environment. That process, moreover, does not depend in any essential way on the perceiver's movements through the environment, nor does it depend on the perceiver having a specific bodily organization since the same manipulations

Figure 11.1 The Retinal Stimulation Pattern Underdetermines Its Environmental Cause

of internal information might be carried out in physical systems of very different kinds.

On the hylomorphic view I've been developing, by contrast, we come to know the perceptible properties of things through a temporally extended process of sensorimotor interaction of the sort described by J. J. Gibson and, more recently, Alva Noë.⁵² Objects in the environment reflect light to a perceiver in different ways. The differences in reflected light provide information about the objects reflecting it—information picked up by perceivers at various points of observation. Those points of observation can be understood as points at which pyramids of reflected light converge. The sum of converging pyramids of light at a point is what Gibson calls the *ambient optic array* (Figure 11.2). That array changes as a function of a perceiver's movements—what Gibson calls the *optic flow*.

Some appearances nevertheless remain invariant across the optic flow, and these invariants provide information about objects in the environment. Invariant proportions among the angles and lines on surfaces, for instance, provide information about the relative sizes of objects, while horizon cuts and occluding edges provide information about the relative positions of objects.⁵³ Because information about objects in the environment is conveyed by the reflected light itself, there is no need for sensory information to be supplemented with internal representations; all that's required is that the perceiver be equipped with a way of picking up invariants in the optic flow.

Pyramids of reflected light converge at different points. As perceivers move through the environment, they pick up information about the surrounding layout from features that remain invariant across changes in the optic flow.

As Gabriel moves relative to the tomato, for instance, he gains an implicit understanding of how its various facets come into and go out of view as a function of his movements: he knows implicitly that moving this way or

Figure 11.2 The Ambient Optic Array (Gibson, 1979, p. 72)

that will bring into view these or those facets which he expects to look these or those ways under the present conditions. In this way, Gabriel comes to know the tomato's perceptible properties—its uniform redness, for instance. That redness is revealed through a series of appearances none of which is uniformly red. The young child who depicts a tomato by applying a single shade of red paint across the canvas fails to capture how it really looks. The skilled painter, by contrast, uses a variety of colors to depict the tomato: a bit a red here, a bit of gray there, white toward the top, and so on. The result is a more accurate depiction of how the tomato really looks from a particular vantage point. If Gabriel's vision were limited to the way the tomato looks from that point, he might never know its uniform color; there would be no explanation for what psychologists call *color constancy*, the ability of perceivers to discern that an object has a uniform color despite changes in its nonuniform appearance. But Gabriel's vision is not limited in this way. By moving in relation to the tomato he grasps its uniform redness through the shifting appearances.

Perception is not a passive process, therefore, of receiving sensory stimuli and constructing internal representations of external objects, but an active, temporally extended process of coming to know the perceptible properties of objects through a series of appearances that vary as a function of the perceiver's movements through the environment. Movement is thus essential to perception. So too is a perceiver's specific bodily organization since the way

appearances vary as a function of movement depends on that organization. The changes in visual experience that vary as a function of turning one's head side to side, for instance, depend on having a head that can turn in that way and having eyes situated in particular locations on that head. On the hylomorphic account I've described, then, perception is both enactive and embodied.

Some empirical work supports an account of perception along these lines. One prediction the account makes is that disrupting the interplay of sensation and movement will disrupt perception. This is precisely what experiments with inverted goggles appear to demonstrate. Inverted goggles are equipped with lenses that alter the trajectory of light to the eye: light reflected from an object on the left, for instance, is made to enter the eye from the right. If perceiving were simply a matter of passively receiving sensory stimuli, we would expect that subjects wearing inverted goggles would simply perceive objects on the left as if they were on the right. In fact, their perceptual abilities are disrupted in a much more radical way.⁵⁴ Subjects wearing inverted goggles initially fail to grasp what is in the environment and where it is. They undergo what Noë calls *experiential blindness*: although their retinas receive sensory stimulation, that stimulation doesn't enable them to gain knowledge of their environment.⁵⁵ An enactive account of perception explains why: perception depends not just on sensory stimulation, but on the regular interplay of sensory stimulation and movement. Inverted goggles disrupt that interplay: head movements that used to alter retinal stimulation in one way no longer do. As a result, subjects are unable to perceive things until they master the new patterns of sensorimotor correlation.

In addition, Ballard and his colleagues have shown that an embodied account of perception yields models of cognitive behavior that are more elegant than those based on functionalist assumptions.⁵⁶ Their experiments involve tracking test subjects' eye movements. Subjects are presented with an arrangement of colored blocks on a computer screen and asked to copy the arrangement in a workspace using a computer mouse by taking blocks from a supply area. Marr's functionalist account suggests that subjects construct an internal representation of the external environment and guide their hand movements by reference to that internal representation. Ballard's findings challenge this view. Subjects' eye movements suggest that they employ a deictic strategy in performing the task;⁵⁷ that is, they guide their actions not by reference to an internal representation of the external environment, but by reference to a fixation point in the environment itself. The environment-centered deictic model not only accounts for the experimental data, it also simplifies the amount of computational overhead needed to accomplish the perception-guided task. An account like Marr's, which posits an internal representation of the external environment, involves a great deal of algorithmic complexity which the environment-centered alternative sidesteps entirely.

The upshot of empirical work like the foregoing is reminiscent of the criticism Aristotle advanced against a philosopher he calls ‘Socrates the Younger,’ who appears to have claimed that human activities could be defined abstractly the way we define geometrical objects. The definitions of those objects make no essential reference to any realizing materials. Defining a circle as an infinite number of points equidistant from a single point does not specify that the points be in wood, plastic, metal, air, or any other material. Socrates the Younger appears to have claimed that definitions of human activities and capacities were like the definition of a circle: they made no essential reference to particular bodily parts. Aristotle disagreed:

. . . Socrates the Younger was wrong in always comparing an animal with the circle and bronze . . . [I]t supposes that a man can exist without his parts, as a circle can exist without the bronze. But in fact, the two cases are not similar, for an animal . . . cannot be defined without reference to parts in the right condition.

(*Metaphysics* 1037a22–31;
cf. *On the Soul* 403a3–b15 and *Physics* 194a1–27)

Empirical work of the foregoing sort seems to support Aristotle’s contention. It suggests that the human cognitive capacities are essentially embodied in a specific kind of body plan, that the best models of human cognitive performance presuppose that body plan.

A Neo-Aristotelian framework of powers and structured activities rejects the canonical status of the mental-physical dichotomy. It leaves it unmysterious how thought, feeling, and perception can exist in the natural world, and how psychology and biological subdisciplines such as neuroscience contribute to a synoptic vision of what kinds of things we are and what kinds of capacities we have.

Notes

1 Coon and Mitterer (2012: 14), Kalat (2013: 3), Griggs (2014: 1).

2 Plotnik and Kouyoumdjian (2013: 3).

3 Claims (1) and (2) seem to be well-supported empirically, and many examples seem to support claim (3): I have the mass I have because I am composed of physical particles with smaller masses that collectively add up my bigger mass. Likewise, I have the position and velocity I do because the particles composing me are located in such-and-such places and are moving with such-and-such velocities. Change their positions or velocities, and you succeed in changing mine. Given the range of properties that are like this, it’s not implausible to suppose that all the properties of composite wholes are determined by the properties of the particles composing them. It seems, moreover, that the behavior of those particles can be described and explained exhaustively by physics. We don’t need to use a psychological or even a biological vocabulary to describe and explain what they are and what they can do. This lends some support to claim (4). There are also, it seems, good reasons to endorse claim (5). One particle by itself does

not have the power to think, feel, or perceive. If it did, then thought, feeling, and perception would have emerged much earlier in the universe's history than we think they did, and they would also be more widespread—even rocks and tables would be thinkers, feelers, and perceivers. But if one particle by itself does not have the power to think, feel, or perceive, then it is difficult to see how any number of these particles could combine to form a whole that has these powers. Suppose that some number of particles, N , do not compose a whole with power to think, feel, or perceive. If one particle cannot make a difference to whether or not something has these powers, then clearly, $N+1$ particles cannot compose a whole that has them. Since N can be any number one likes, it seems to follow that no number of physical particles has the power to compose a whole that thinks, feels, or perceives. Each claim, (1)–(5), is therefore plausible.

- 4 Dewey (1958: 263).
- 5 Searle (1992: 26, 54–5).
- 6 Searle (2004: 79).
- 7 Dewey (1958: 253–8).
- 8 Schaffer (2009), Sider (2012).
- 9 Worrall (1989), Ladyman and Ross (2007).
- 10 Chalmers (2002: 258).
- 11 In fact, even some contemporary hylomorphists use the term 'structure' this way. Oderberg (2014: 177) is an example.
- 12 Miller (1978: 140–1).
- 13 Campbell (1996: 2–4).
- 14 Kitcher (1984: 369, 373).
- 15 John Dupré has endorsed a similar thesis: "I place myself firmly in the philosophical tradition that sees empirical, often scientific, inquiry as providing the most credible source of knowledge of how things are" (1993: 1). Replacing the phrase 'how things are' in Dupré's statement with 'what there is' yields what I am calling 'ontological naturalism.'
- 16 Fine (2008: 112).
- 17 Fine (1999), Johnston (2006), Oderberg (2007), Koslicki (2008), Rea (2011), Marmodoro (2013), Koons (2014), Evnine (2016), Jaworski (2014, 2016).
- 18 The hylomorphic theory I develop here assumes a substance-attribute ontology which takes substances or *individuals*, as I'll typically call them, and attributes or *properties*, to be fundamental entities. Individuals act on other individuals and are acted on by them on account of their properties. Properties are sparse, not abundant, in Lewis's (1983) sense (Jaworski 2014, 2016). The only properties that exist are ones that empower individuals to enter into causal relations. Properties are particulars, not universals. They are tropes—also called 'unit properties,' 'property instances,' 'individual accidents,' and 'modes,' among other things. I've defended this metaphysical framework in detail elsewhere (Jaworski 2016).
- 19 Martin (1996a, b, 1997, 2007), Heil (2003, 2005), Martin and Heil (1998, 1999), Jaworski (2014, 2016).
- 20 Martin and Pfeifer (1986), Place (1996a, b), Molnar (2003).
- 21 Martin (1996a) defends this idea with an example: there might be fundamental physical particles in the universe that have the power to interact in various ways with particles around here, and yet that are so far away that they reside outside the light cones of the particles around here. The two groups of particles never actually interact, yet it seems obvious that the distant particles still have the power to interact with the local ones.
- 22 Harré and Madden's (1975) examples of radioactive decay and ammonium triiodide seem initially to provide counterexamples to the general rule that powers are manifested or exercised in pairs, or triples, or n -tuples. But even here it

might be possible to understand the cases in a way that conforms to the general reciprocity model. At the very least, the environment surrounding the radioactive nuclei or the ammonium tri-iodide cannot include any agents that inhibit the exercise of their powers to decay or explode, respectively. Environments that are free of inhibitory factors might then be viewed as reciprocal disposition partners for the decaying nuclei and the explosive compound.

23 Van Inwagen (1990).

24 Ibid.: 94.

25 Young (1971).

26 Van Inwagen (1990: 94–5).

27 Ibid.: 84.

28 Ibid.: 88.

29 Ibid.: 88–9.

30 Ibid.: 122, 180.

31 Ibid.: 121.

32 Ibid.: 145, 148.

33 This response implies a certain meta-mereology which Kathrin Koslicki describes as follows: “I take the mereologist’s job to be to devise an appropriate conception of parthood and composition which accurately reflects the conditions of existence, spatio-temporal location and part/whole structure of those objects to which we take ourselves to be already committed as part of the presupposed scientifically informed, commonsense ontology. The question of which kinds [of objects] there are I take to be . . . answered [not] by the mereologist proper, but by the ontologist at large, in conjunction with . . . science and common sense, which . . . have something to contribute to the question, ‘What is there?’” (2008: 171).

34 Churchland (1986), Bickle (1998), Jaworski (2011, 2016).

35 Van Inwagen (1990: 122).

36 See also van Inwagen (1990: 118, 122).

37 Fodor (1968), Cummins (1975), Dennett (1978), Lycan (1987), Craver (2007), Bechtel (2007, 2008).

38 Bechtel (2007, 2008), Craver (2007: ch. 5) calls purely spatial parts ‘pieces’ and parts in the functional sense ‘components.’ John Heil (2003: 100) also suggests something like the distinction between merely spatial parts and parts of other sorts, which he calls ‘substantial parts.’

39 Campbell et al. (1999: 4).

40 Jaworski (2011: 277).

41 Putnam (1967).

42 Lycan (1987), Sober (1985).

43 Ibid.

44 Sperry (1984).

45 Many hylomorphists of the past have denied that all our powers are essentially embodied in the powers of our parts. Aristotle himself appears to deny it in *De Anima*, book 3, chapter 4, where he apparently argues that understanding or *nous*, the power to grasp the essences of things, has no organ and is in general unmixed (*amigēs*) with a body (429a10–27). A commitment to the essential embodiment of our capacities is nevertheless the default position for hylomorphists. In fact, Aristotle treats embodiment as the default position as well (403a16–19, 24–27; 403b17–18), and he claims that the emotions are essentially embodied (403a16–19, 24–27; 403b17–18; cf. 413a4–6). Elsewhere, I’ve argued in line with other commentators that the argument of *De Anima* is flawed in multiple ways (Jaworski 2016: 162–70).

46 The term ‘reduction’ is used in a variety of ways in philosophy and the sciences. The notion of reduction that interests us here is intertheoretic reduction

(Churchland 1986: 278–9). Intertheoretic reduction is a synchronic relation between theories or conceptual frameworks in which one of them, the reducing theory or framework, is able to take over the descriptive and explanatory roles played by the other, the reduced theory or framework.

- 47 Jaworski (2016: 221–49).
- 48 Jaworski (2011: 202–45).
- 49 Bickle (1998: 8).
- 50 Field (1972: 357).
- 51 Marr (1982).
- 52 Gibson (1979), Noë (2004).
- 53 Gibson (1979).
- 54 Taylor (1962), Kohler (1964).
- 55 Noë (2004).
- 56 Ballard et al. (1992), Ballard (1996).
- 57 Agre and Chapman (1987).

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