THE OXFORD HANDBOOK OF

4E COGNITION

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PART I

INTRODUCTION

CHAPTER 1

4E COGNITION

Historical Roots, Key Concepts, and Central Issues

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Historical Roots of the Debate

The debate about the role of the body in cognition has been ongoing since close to the beginnings of philosophy. In Plato's dialogue *The Phaedo*, for example, Socrates considers the idea, which he attributes to Anaxagoras, that one could explain his decision to remain in prison by a purely material or physical explanation in terms of bodily mechanisms. Socrates himself rejects this idea—surely, he thinks, there is something more to reason than just bodily processes. Aristotle, however, was motivated by the idea that Anaxagoras was not entirely wrong. While Aristotle did not accept the radical view of Anaxagoras, he considered that the body (with special reference to the hands) may play some role in what makes for human rationality. Such debates considering the role of the body for the mind can be traced through medieval texts authored by Neoplatonists, Aquinas, and others, and are given their modern formulations in thinkers such as Spinoza, La Mettrie, Condillac, and many others. Pragmatists, phenomenologists, and philosophers of mind wrestle with the same issues throughout the twentieth century. The more proximate background for the current debates about embodied cognition, however, is to be found in the disagreements between behaviorists and cognitivists. Continuing tensions within cognitivism, and the cognitive sciences more generally, brought on by contrasting functionalist and neurobiological accounts that tended to ignore the role of body and environment and focus on internalist explanations of brain function, set the stage for the emergence of contemporary views on embodied cognition.

In the 1990s, Varela, Thompson, and Rosch's (1991) *The Embodied Mind*, drawing on phenomenological and neurobiological resources, proposed an enactivist account of cognition that emphasized the role of the dynamical coupling of brain–body–environment. Around the same time, a paper by Flor und Hutchins (1991) introduced distributed cognition as a "new branch of cognitive science" for which the unit of analysis includes external structures, collectives, and artifacts organized as a system to perform a task. Hutchins's (1995) *Cognition in the Wild* was a direct influence on Clark and Chalmers's (1998) now-classic philosophical essay, "The Extended Mind." Throughout this time period, additional work inspired by Gibson's ecological approach to psychology contributed to a growing realization that cognition was not limited to processes in the head, but was embodied, embedded, extended, and enactive.

Although the concept of 4E cognition[1] brings these different approaches together under one heading and conceives of them as coherently opposed to the internalist, brain-centered views of cognitivism, there are continuing disagreements about a variety of issues within and among these embodied approaches. Is cognition embodied, embedded, extended, or enactive? The issues that continue to be debated concern the very nature of embodiment, the precise way that brain, body, and environment are coupled or integrated in cognition, and how much we can generalize from the observation of embodiment in one type of cognitive performance to others. Furthermore, there are questions about the role of representations and what it means to say that cognition is "constituted" by bodily and environmental processes.

Key Concepts

How to Individuate Cognitive Processes

Before introducing the key concepts in the debate, we first need to consider whether there are certain constraints that need to be taken into account in order to answer the question of what cognition is and how we should individuate cognitive processes.

If we take cognition as a *natural kind* (even if we do not know the underlying mechanisms) this would limit the nature of our investigation to a search for the relevant mechanism constituting it. But there is no consensus on this question: while Buckner (2015) argues that cognitive processes are indeed natural kinds, evidence about neural plasticity presents a strong challenge to this claim (Hübener and Bonhoeffer 2014). An alternative strategy for answering the question is to focus on *typical examples* (Newen 2015). This seems to be a promising strategy, but it is not without problems. One complication is that a selection of the typical examples is already biased by certain assumptions concerning the nature of cognition. Thus, where traditional cognitive science focused primarily on playing chess and mastering the "Tower of Hanoi," i.e., tasks that are strongly rule-governed, proponents of 4E cognition appeal to experiments that involve spatial navigation, face-based recognition of emotion, and basic forms of social interaction. It is therefore paramount to get a clear view on the assumptions about cognition that are made by proponents of both positions.

4E Cognition and Traditional Cognitive Science

The foundation of traditional cognitive science used to be the representational and computational model of cognition (RCC). According to this model, cognition is a kind of information processing that consists in the syntactically driven manipulation of representational mental structures. In particular, cognitive processes were said to be (1) abstract, a-modal processes that mediate between modality-specific sensory inputs (perception) and motor outputs (action), and (2) computations over mental representations that are either symbolic (e.g., concepts in a "language of thought"; Fodor 1975) or sub-symbolic (e.g., activations in neural networks; Rumelhart et al. 1986). The RCC also involves a specific view of where cognition was supposed to take place—some kind of "contingent intracranialism" (Adams and Aizawa 2008). On this view, cognitive processes are, as far as their ontology is concerned, realized by brain processes only (at least in the case of humans and other animals), and as far as their explanation is concerned, understandable and explainable by focusing on brain processes only.

During the past couple of decades, these key elements of the RCC—the pivotal role of computation and representation in all cognitive processing and the pivotal role of a central processing unit in the brain as the sole relevant factor of cognitive processing—have come under pressure (Gallagher 2005; Walter 2014). Proponents of 4E cognition have argued against the assumption that cognition is an isolated and abstract, quasi-Cartesian affair in a central processing unit in a brain. This idea is typically associated with functionalism, which claims that cognitive phenomena are fully determined by their functional role and therefore form an autonomous level of analysis. According to proponents of 4E cognition, however, the cognitive phenomena that are studied by modern cognitive science, such as spatial navigation, action, perception, and understanding other's emotions, are in some sense all dependent on the morphological, biological, and physiological details of an agent's body, an appropriately structured natural, technological, or social environment, and the agent's active and embodied interaction with this environment. Even most of the phenomena studied by traditional cognitive science—such as language processing (e.g., Glenberg and Kaschak 2002), memory (Casasanto and Dijkstra 2010), visual-motor recalibration (Bhalla and Proffitt 1999) and perception-based distance estimation (Witt and Proffitt 2008)—are not abstract, modality-unspecific processes in a central processing area either, but essentially rely on the system's body and its dynamical and reciprocal real-time interaction with its environment.

Thus, by maintaining that cognition involves extracranial bodily processes, 4E approaches depart markedly from the RCC view that the brain is the sole basis of cognitive processes. But what precisely does it mean to say that cognition involves extracranial processes? First of all, the involvement of extracranial processes can be understood in a strong and a weak way. According to the strong reading, cognitive processes are partially *constituted* by extracranial processes, i.e., they are essentially based on them. By contrast, according to the weak reading, they are non-constitutionally related, i.e., only *causally dependent* upon extracranial processes.

Furthermore, cognitive processes can count as extracranial in two ways. Extracranial processes can be *bodily* (involving a brain–body unit) or they can be *extrabodily* (involving a brain–body–environment unit).

Following this line of reasoning, we can distinguish between four different claims about embodied cognition:

a. A cognitive process is *strongly embodied by bodily processes* if it is partially constituted by (essentially based on) processes in the body that are not in the brain;
b. A cognitive process is *strongly embodied by extrabodily processes* if it is partially constituted by extrabodily processes;
c. A cognitive process is *weakly embodied by bodily processes* if it is not partially constituted by but only partially dependent upon extracranial processes (bodily processes outside of the brain);
d. A cognitive process is *weakly embodied by extrabodily processes* if it is not partially constituted by but only partially dependent upon extrabodily processes.

The last version of the claim (d) is identical with the property of *being embedded*, i.e., being causally dependent on extrabodily processes in the environment of the bodily system. Furthermore, *being extended* is a property of a cognitive process if it is at least partially constituted by extrabodily processes (b), i.e., if it *extends* into essentially involved extrabodily components or tools (Stephan et al. 2014; Walter 2014).

Many proponents of 4E cognition not only maintain that cognition involves extracranial processes, but also that cognition is *enacted* in the sense that it involves an active engagement in and with an agent's environment (Varela, Thompson, and Rosch 1991). We can distinguish between two versions of this claim:

e. A cognitive process is *strongly enacted* if it is partially constituted by the ability or disposition to act;
f. A cognitive process is *weakly enacted* if it is only partially dependent upon the ability or disposition to act.

It should be emphasized that proponents of 4E cognition differ greatly in terms of their commitments to these claims, and consequently in their interpretation of what it means for cognition to be embodied, embedded, extended, and enactive. One famous example of an enacted theory of cognition is Noë's (2004) theory of perception, according to which perception is not something passive that happens to us or in us but something we do: according to him, having a 3D-perceptual experience of an object includes having a specific disposition to act which he spells it out in terms of implicit knowledge of sensorimotor contingencies. It is part of the discussion whether this justifies a strong or only a weak enactment claim (Engel et al. 2013).

Constitution Versus Causal Dependency

As we saw earlier, the distinction between constitution and causal dependency plays an important role in the debate on embodied cognition. But what exactly grounds this distinction? Consider the example of cognitive processes involved in solving a simple math problem. It likely involves visual perception (if the problem is presented on paper), memory, language or symbol processing, etc. This means it would depend on a variety of elements and processes that include neuronal processes in the visual cortex, in motor areas, in language areas, the hippocampus, frontal areas, etc. In addition, as I read the problem I move my eyes, and likely my head. I posture my body so that my eyes are a certain distance from the text. I may gesture with my hands as I work out the solution. All of these factors can be involved even if I am solving the problem "in my head," without pencil and paper or other instruments. If I am involved in a competition to solve the problem, that stressful fact may have an effect on my cognitive performance. Can proponents of embodied cognition claim that not only the neuronal processes, but also eye movements, head movements, posture, use of pencil and paper, and perhaps even the competitive situation are all parts of the cognitive system that constitutes cognition in this case? When they make such claims, critics have accused them of the so-called coupling/constitution fallacy (Adams and Aizawa 2008; Rupert 2009), according to which the strong coupling between neural and extraneural processes, including bodily movement and use of pencil and paper, for example, does not suffice to make the non-neural processes constituents, rather than just causal or enabling conditions of the cognitive process. Quite generally, the question is whether, and if so, how, we are able to decide (either empirically, pragmatically, or a priori) whether a particular cognitive process is constituted by or merely dependent upon extracranial or extrabodily processes.

One strategy in this debate is to question whether the concept of constitution necessarily involves just non-causal, part-whole relations (e.g., Craver 2007), or in some cases requires diachronic and dynamical relations that depend on reciprocal causality (e.g., Kirchhoff 2014, 2015; Leuridan 2012). Another strategy is to take relevant features as constitutive of a cognitive process (e.g., an emotion or an episode of self-consciousness) if it is a characteristic feature of the phenomenon and part of a minimal pattern of integrated features sufficient to realize this phenomenon (e.g., Newen et al. 2015; Gallagher 2013). It may be that most of the features of mental phenomena are neither necessary nor sufficient but only characteristic. For example, a facial expression of fear is partially constitutive of fear although there are realizations of fear that do not involve the typical facial expression, e.g., in the case of a trained poker face (Newen et al. 2015). Issues about the relation of constitutive, causal, or background conditions are unresolved, and are still subject to ongoing debate in the embodied cognition literature.

Mental Representations

Another important question in the debate on embodied cognition concerns what role, if any, *mental representations* play in cognitive processing. The theoretical landscape is such that 4E approaches can and in fact do have supporters from both the computational/representational and the anti-computational/anti-representational camp. Dynamicists like Chemero (2009), for instance, defend a decidedly anti-computational/anti-representational version of embodied cognition (see also Barrett 2011), while Wilson's (1994) "wide computationalism" and Clark's (2008) "extended functionalism," according to which the mind is the joint product of intracranial processing, bodily input, and environmental scaffolding, are unequivocally computational/representational. In a similar vein, while some proponents of embodied cognition, for instance, in the area of vision research, explicitly try to supersede traditional computational/representational approaches (Gibson 1979; Noë 2004; Hutto and Myin 2013), others merely try to enrich them by integrating environmental resources (Ballard et al. 1997; Clark 2013). Thus, embodied approaches range from the computation/representation friendly variety (Alsmith and de Vignemont 2012; Prinz 2009) to accounts that are explicitly anti-computational and/or anti-representational (see Thelen et al. 2001; Brooks 1991; Pfeifer and Bongard 2006). This shows that the 4E approach as such does not presuppose a specific view on representation and computation.

An Overview of This Book

Since the volume is organized in nine additional parts, we will provide a short overview of the main questions that are treated in these parts.

Part 2: What is Cognition?

The second part of essays explores the concept of cognition specifically from the perspectives offered by 4E approaches to the mind. From a standard viewpoint, the debates around embodied approaches seem to turn the "what" question into the "where" question, so that the answer to the question about the nature of cognition is first of all about location: precisely where is cognition located? In this regard the line that demarcates between inside and outside plays an important role. From the perspective of the 4Es, however, the question of location is less critical; indeed, the distinction between inside and outside is downplayed, and the boundary line turns out to be a movable and permeable border. Thus, on the extended mind paradigm, if you happen to be using a piece of the environment to assist memory or to solve a problem, then in that case the mind extends into the environment; on the enactivist view, if there is a dynamical coupling to others or to tools in joint action, then there is no line that cuts the organism off from these other social and environmental factors. Cognition is affordance-based, where affordances are always relational (between the cognizing subject or some form of life and the possibilities offered by some entity or complex of entities), and where entity may be some physical part of the environment, another person who can provide information or opportunity, a social or cultural structure, or even something more abstract, such as a concept that, with some manipulation, offers a solution to a problem. Such approaches transform the question about cognition into questions about the nature of affordances, about whether cognition is extended or extensive, about what precisely we mean by coupling, about whether a dynamical systems approach can do without representations, and so forth.

Part 3: Modeling and Experimentation

How should we go about answering such questions? This question is taken up in Part 2, as well as in other parts of this volume. There is general agreement that a priori definitions or models of cognition are not helpful, and that we need to conduct experiments and consult the empirical literature. 4E approaches are part of cognitive science and as such offer models that need to be tested using a variety of methods drawn from different disciplines. This part draws on research in experimental psychology and neuroscience, developmental psychology, dynamical systems theory, predictive processing, and so on. Testable models are required, not only for the most basic forms of human cognition found in infancy, or in perceptual crossing experiments, but in the more complex instances of social interactions and cultural expression. One question here is whether one model (e.g., predictive processing or dynamical systems theory) can explain the broad varieties of cognitive events by itself, or whether we need an integration of different models for different forms of cognition. This pushes further to the question of whether such integration is possible and whether there is some consistency between predictive processing, dynamical systems theory, and the various interpretations of these models found in cognitivism, extended mind, enactivist, and ecological approaches. Equally critical are questions about whether experimental science remains business as usual, or whether the more holistic demands of 4E approaches—to account for not just brain processes, and not just bodily and affective processes, and not just environmental and social and cultural processes, but all of these as they function together to shape cognition—put pressure on what we can operationalize and test.

Part 4: Cognition, Action, and Perception

Traditional analyses of perception tend to focus on sensory processing as it happens in cortical areas that correspond to different sense modalities, and questions concerning cognitive penetration. 4E approaches, in contrast, place significant emphasis on embodied action and the idea that perception is action-oriented. Furthermore, it often challenges the orthodox view, found in Helmholtz and recent models of predictive coding, that perception is inferential. Gibson worked out a theory of direct (noninferential) perception that was controversial from the start, but that nonetheless continues to be developed in recent work in ecological psychology. Putting direct perception together with the focus on action complicates the picture, which is complicated further if we think that object perception is not equivalent to social perception, and that direct social perception is involved in joint actions. These are issues explored in this part, but they are basic ones that tie directly into questions about intentionality, spatial perception, social cognition, evolution, culture, brain plasticity, and the nature of cognition in nonhuman animals and robots—all of which are explored in later parts. Importantly, it remains controversial whether the principles worked out for perception and action, sometimes referred to as "basic" cognition, scale up to apply to higher-order operations and cognition in general.

Part 5: Brain–Body–Environment Coupling and Basic Sensory Experiences

This part explores concepts of intentionality found in 4E approaches. The notion that perception is action-oriented leads to a consideration of a very basic motor intentionality—a concept that derives from phenomenology (e.g., Merleau-Ponty 2012), but that can also be found in pragmatists such as John Dewey. As Robert Brandom notes, citing Dewey, the "most fundamental kind of intentionality (in the sense of directedness toward objects) is the practical involvement with objects exhibited by a sentient creature dealing skillfully with its world" (2008, p. 178). This captures a form of intentionality that is built into skillful bodily movement in tandem with environmental demands. Indeed, one might argue that it is just this kind of intentionality that should be considered "non-derived" intentionality, which is seemingly the favorite candidate for the "mark of the mental." Alternatively, one might think that given the complexity of cognition, there is no one mark of the mental, but that one requires, perhaps, a pattern of factors to explain the varieties of cognitive practices. One issue at stake here is the very notion of embodiment as it defines embodied cognition. Whether embodiment is something that is reducible to neural representations, or requires some forms of complex coupling between brain, body, and environment, is one of the central issues that defines debates about cognition.

Part 6: Social Cognition

In many explanations of cognition, the concept of social cognition is regarded as a specialized topic. Although it is, in some regards, a specialized form of cognition that involves understanding other conspecifics, for some 4E approaches it also forms a more generalized constraint on cognition overall since most of what we consider human cognition originates in social interactions. Social cognition is itself a sophisticated form of cognition that spans a large spectrum of circumstances, from very basic embodied interactions that involve perception of and response to movement, posture, facial expression, gestures, and situated actions, to complex actions and joint actions within a large variety of everyday and specialized social and institutional frameworks. In this regard, social cognition may involve capacities for basic, empathic, embodied resonance processes, as well as more knowledge-based practices that involve conscious inference and familiarity with the person or group with whom one is engaged. If the various theories of embodied cognition have sometimes challenged the more standard theory-of-mind approaches to this topic, the overall suggestion of the papers in this part is that a pluralistic approach that includes a variety of capabilities and practices may be more appropriate in order to deal with the multiple forms of social cognition that need to be explained.

Part 7: Situated Affectivity

The concept of emotion, or more generally, affect, has come to play a larger role in mainstream analyses of cognition over the past 20 years. Cognition is not the narrow, hard, cold process of ratiocinative intellect that seems to fit so well with the computational model. Affect requires a more embodied and situated conception of cognition, and we need to recognize that it permeates cognitive processes, rather than occasionally penetrating them. One can trace the role of embodied affect from early infancy, through empathic processes, into sophisticated social situations that characterize adulthood. In this respect, it is not just emotion or the conscious feeling of emotion that is important; rather, non-conscious and wide-ranging affective processes that manifest in terms of hunger, fatigue, pain and pleasure, satiation and satisfaction can bias perception and thinking. My everyday intentionality, for example, is always conditioned by particular interests, and such interests are always modulated by a variety of affects, including emotions and moods. My anger makes me see things in specific ways; my joy leads me to ignore some of the negative factors in my environment; my fear moves me to act one way rather than another; my dark funk makes this rather than that matter. What I remember, what I perceive, how I respond to another person—all of these cognitive performances are pushed and pulled by affective factors, and these need to be accounted for in any account of cognition, whether it's framed in terms of predictive processing, dynamical systems theory, social and environmental situations or empathic resonance.

Part 8: Language and Learning

On some accounts, language is deeply rooted in bodily movements, not only for its material performance, but also for its semantic sense, and even to the extent that language transcends the body toward high cultural accomplishments (as Merleau-Ponty 2012 suggests), it remains tied to it. At the same time that "speech accomplishes thought" (again to borrow a phrase from Merleau-Ponty), it remains a form of action, and most frequently a form of communicative action. Communication is not all linguistic, strictly speaking, since there are significant aspects of nonverbal communication involved from the very beginning; but linguistic communication is required for establishing most of human social practices and the normativity that comes with those practices. In that sense, language is a bridge from very basic embodied practices to the most sophisticated practices and rituals of instituted and normative life that come along with standards of correctness, the senses of rightness and wrongness, and the practice of giving reasons in our everyday social engagements. The bridge goes both ways since what results from linguistic practice loops back to shape our bodily actions and affective life.

Part 9: Evolution and Culture

4E cognition, in contrast to anthropocentric views, which take cognition to be defined in representationalist terms, provides a perspective on cognitive evolution where principles of biological organization (or, for some, life-to-mind continuity) help us to understand cognition. This more biological approach points to the importance of the adaptive, flexible behavior of agents who operate in an ambiguous, precarious, and generally unstable worldly environment that they help to rearrange to reduce precariousness and increase stability. One problem, it seems, is that if we start our evolutionary story on this basis of continuity across the nonrepresentational aspects of life, this seems to lead to a significant gap between prelinguistic and linguistic cognition, if we take the latter to involve representation. Can we have evolutionary continuity that leads to a psychological discontinuity? The discontinuity, however, may not be about the advent of language and/or representation, but rather may be opened up by differences in embodiment introduced by evolutionary forces themselves, and corresponding differences in sociocultural practices, the use of artifacts, and the construction of affordance-based niches. These are predicated on a mix of material and social resources. Here, then, it is not just the biology of genes or organism that evolves, nor just the accompanying plastic changes of the brain that account for the rise of human cognition; it's the physical environment and what we can do with it in terms of moving *things* about to create a species-relative livable niche —where *things* are at first natural things, and then artifacts, and then later become things like words. We have a coevolution that involves corresponding changes in brain, body, tools, artifacts, language and cultural practices, and so on, and on, and on.

Part 10: Applications

In the last part, the essays examine the practical implications of the various theoretical insights to be found in the 4E literature. What can theories of embodied, embedded, extended, and enactive cognition tell us about psychopathology, animal cognition, robotic design, social and political institutions, or about the less practical but not less important aspects of aesthetic judgment, literature, and the arts? In all of these cases the central principles of the 4E approaches are relevant. When cognition or everyday communicative practices fail, as in psychopathology, we need to look not only at neuronal anomalies, but also at basic variances in embodied social interactions and the social structures that may themselves promote pathologies. When we attempt to understand nonhuman animals, we need to suspend our anthropocentric notions of cognition as primarily linguistic and representational and look more closely at the kinds of coupling and coping mechanisms that exist between body and environment. It may be that rethinking robotics from the bottom up (Brooks 1991) may have been one of the prime motivators for the development of 4E cognition, but it is also the case that robotic design can continue to learn from insights taken from the various aspects of biological self-organization, sensorimotor contingencies, evolutionary niche construction, affordance-based coping, social interaction, etc. that 4E theory has been advancing.

Can similar resources in the ecosystem of 4E theory help us explain juridical reasoning and how priming effects and biases generated in situated bodily processes can enter into such higher social-cognitive processing? Are such effects and biases strong enough or pervasive enough to challenge the legitimacy of a judicial system? Would a similar analysis tell us something important about a first responder's perception and response in a life-or-death situation? And can those same resources explain the generation of aesthetic experience by the imaginative drive of the humanities and arts? What is the nature of literature (or the theatrical play, or a film) if it enacts meaning or a world only when the reader (or audience) engages with it? What is the nature of that engagement if it is embodied, embedded, extended, enactive, and affective? These are questions that are clearly at the cutting edge of 4E research, not because they are recent applications of 4E principles, but because answers to these questions have the potential to loop back into theory and to challenge already formulated principles.

We are obviously in need of an improved theory of cognition. Why should we go for it now? The answer is a philosophical one that we can formulate by borrowing some famous words from the US President John F. Kennedy about reaching the moon: it is incumbent to resolve these issues, "not because they are easy, but because they are hard, because that goal will serve to organize and measure the best of our energies and skills, [and] because that challenge is one that we are willing to accept."

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[1] Mark Rowlands (2010, p. 3) attributes the 4E label to Shaun Gallagher who organized a conference on 4E cognition in 2007 at the University of Central Florida. The first use of that term, however, as far as we know, emerged in discussions at a workshop on the embodied mind at Cardiff University, in July 2006, which included the following participants: Shaun Gallagher, Richard Gray, Kathleen Lennon, Richard Menary, Søren Overgaard, Matthew Ratcliffe, Mark Rowlands, and Alessandra Tanesini. Richard Menary edited a special issue of the journal *Phenomenology and the Cognitive Sciences* on 4E cognition based on selected papers from the 2007 conference (Menary 2010).

PART II

WHAT IS COGNITION?

CHAPTER 2

EXTENDED COGNITION

JULIAN KIVERSTEIN

Introduction

4E cognitive science is a broad church housing a number of theoretical perspectives that to varying degrees conflict with each other (Shapiro 2010). In this chapter I will argue that the debates within 4E cognitive science surrounding extended cognition boil down to competing ontological conceptions of cognitive processes. The embedded theory (henceforth EMT) and the family of extended theories of cognition (henceforth EXT) disagree about what it is for a state or process to *count* as cognitive. EMT holds that cognitive processes are deeply dependent on bodily interactions with the environment in ways that more traditionally minded cognitive scientists might find surprising. The strong dependence of some cognitive processes on bodily engagements with the world notwithstanding, EMT claims that cognitive processes are nevertheless wholly realized by systems and mechanisms located inside of the brain. Thus advocates of EMT continue to interpret the concept of cognition along more or less traditional lines (Adams and Aizawa 2008; Rupert 2009). That is to say, they think of cognitive processes as being constituted by computational, rule-based operations carried out on internal representational structures that carry information about the world.

EXT by contrast argues that bodily actions and the environmental resources that agents act upon can, under certain conditions, count as constituent parts of a cognitive process. Consider, for example, how thoroughly integrated mobile phones have become in those moments in our lives when we are left with our own thoughts. Chalmers describes how he uses his iPhone to daydream, "idly calling up words and images when my concentration slips" (Chalmers 2008, ix). Smartphones and other mobile technologies are so thoroughly interwoven in our everyday lives that according to EXT they might be now thought of as parts of our minds.

The debate between EMT and EXT is often taken to turn on the cognitive status or otherwise of bodily actions in which agents exploit the material and technological resources of their environments for cognitive purposes (see Rowlands 2010, ch. 3; Wheeler 2014). Does thinking always take place entirely inside the head of individuals? Does it sometimes constitutively depend upon an agent's coupled interactions with structures and resources found in the environment? I shall argue that to resolve this issue we need a mark of the cognitive (Adams and Aizawa 2008; Wheeler 2010; Rowlands 2009). We need a theory of what makes a state or process a state or process of a particular cognitive kind.

The mark of the cognitive consists of properties a system must possess if it is to count as cognitive. Not everyone is agreed that there is any such well-defined set of properties. Clark (2008) has argued, for instance, that the processes and mechanisms that fall under the category of the cognitive are too disunified for there to be any distinguishing properties they share in common. Yet there remains a question to be settled about whether instances of cognitive processes, which seem to work in very different ways, count as instances of the same kind of process. We might try to answer this question by comparison with prototypes of a given cognitive process such as learning, memory, categorization, decision-making, and so on. We might appeal to folk intuition as Clark and Chalmers (1998) propose. Either way, we are assuming a position on what makes a process count as a process of a particular cognitive kind. We might be drawing our standard from folk psychology or relying on some other standard to identify prototypical examples of cognition. In either case, we are relying at least tacitly on a mark of the cognitive.

The mark of the cognitive is also at the heart of a debate *within* EXT about the nature of extended cognition. One side in this debate makes the case for EXT on the basis of considerations drawn from functionalism in the philosophy of mind. I will label this position "extended functionalism" (abbreviated as FEX). FEX is in agreement with the cognitive science orthodoxy that cognitive processes are essentially computational in nature (Clark 2008; Wheeler 2011a). FEX departs from the cognitive science orthodoxy in arguing that some of the relevant computations take place in the world, through bodily actions on information-bearing structures located in the environment.[1]

The self-declared "radical" theorists of extended cognition (henceforth REX) propose an alternative explanatory framework to that of classical cognitive science drawn from dynamical systems theory and ecological psychology (Chemero 2009; Silberstein and Chemero 2012; Hutto and Myin 2013). REX claims that we find extended cognitive processes whenever the variables that describe one system are also the parameters that determine change in the other system, and vice versa. In such a system, it is only as a matter of explanatory convenience that we treat the agent and its environment as separately functioning systems. In reality the dynamics of the two systems are so tightly correlated and integrated that they are best thought of as forming a single extended brain–body–world system (Silberstein and Chemero 2012).

REX claims that basic forms of cognitive processes are essentially extended. Basic cognition is the type of cognition found in non-language-using creatures (Hutto and Myin 2013). It is nonrepresentational and unfolds over time through the skilled bodily engagements of agents with the affordances of the environment. The terminology of "extended" cognition is thus potentially misleading insofar as it seems to imply that cognitive processes have their home inside of the heads of individuals, and occasionally reach out into the world. The extendedness of cognitive processes is to be understood not only in a spatial sense as a claim about the location of the boundaries of the mind. It also refers to the relational character of basic cognitive processes. Basic cognition is relational in the sense of being constituted by an agent's skilled activity in relation to its environment (Hutto et al. 2014).

My argument will proceed in two stages. In the first stage (first and second sections), I outline the debate between EXT and EMT. In the first section I show how there is substantial agreement in both camps about how cognitive science is to proceed. Both sides agree that the best explanation of human problem-solving will often make reference to bodily actions carried out on externally located information-bearing structures. The debate is not about how to do cognitive science. It is instead, to repeat, a debate about the mark of the cognitive: the properties that make a state or process count as being of a particular cognitive kind. In the second section, I then turn to functionalist formulations of EXT that make appeal to what has come to be called the parity principle. The third section shows how after many twists and turns the debate has reached a deadlock, notwithstanding arguments to the contrary recently developed on either side of the EXT-EMT divide. I then turn my attention to REX and argue that EXT would fare better were it to drop its commitment to a representationalist mark of the cognitive.

The EMT and EXT Debate

Since Descartes's skeptical arguments in the *Meditations* it has seemed natural to many philosophers to think of mind and cognition as essentially inner phenomena. The mind partakes in causal transactions with the world by means of epistemically, more or less reliable sensory channels. The mind can likewise produce effects in the world by sending commands to the muscle systems in the body to move in particular ways. However, mental and cognitive processes such as perceiving, remembering, thinking, and reasoning take place within the minds of individuals. EMT departs from this Cartesian tradition in stressing the ways in which mental processes causally depend on the environment in which the agent is embedded in deep and surprising ways.[2] When, for instance, we use a calculator to divide a bill in a restaurant, the calculator is an essential part of how we successfully compute a solution to an otherwise computationally challenging arithmetical problem. The calculator "scaffolds" mathematical thinking that is fully constituted and realized by causal mechanisms found within a person's brain.[3]

EXT is even more thoroughgoing in its rejection of the Cartesian legacy. EXT claims that cognitive processes can, under certain conditions, extend or spread across the boundary separating the agent's body from the rest of the world. Consider, by way of illustration, the expert bartender who lines up different glasses in a particular spatial order as he prepares a drinks order (Beach 1988).[4] This simple trick makes the bartender's task of remembering which drink to serve next far easier than it would otherwise be. Instead of needing to store all of this information and keep it in mind, some of the work of remembering is offloaded onto the environment in the line of glasses. The environment now functions as an external store of information, and performs the role of a stand-in for the drinks order. To work out which drink to serve next, the bartender need only look and reach for the next glass in the line. The information-bearing load on his working memory is thereby significantly lightened. Part of this work is delegated to the representational structure temporarily assembled in the world, which can then be used to control and guide action so as to bring the task at hand to successful completion.

The bartender's initial action of arranging the line of glasses is what David Kirsh has called an "epistemic action." It is an action that gives structure to the information processed by internal cognitive systems in ways that fit with the goals of the system. The result of this active structuring of information is that now the agent can couple with the external structure (the line of glasses), and through this coupling gather the information needed about the next drink to be served. When the bartender generates a plan to serve the next drink, he does so on the basis of his coupling with this external structure. It is on the basis of such a coupling that the information is generated necessary for successfully planning and accomplishing his task.[5]

It might be naturally objected that this is just another example of the scaffolding of internal cognitive processes by the environment. EXT and EMT can both agree that the line of glasses functions as an external store of information that is tightly integrated with inner perceptual, working memory, and attentional processes in such a way as to guide and control action. EXT claims that the external structure works together with inner cognitive processes to form a softly assembled cognitive system that brings about the bartender's behavior.[6] Describing the system as "softly assembled" marks a contrast with systems made up of component parts, each of which has a pre-specified and fixed function (Anderson et al. 2012). Softly assembled cognitive systems are characterized by an "interaction-dominant dynamics," which makes it difficult, if not impossible, to assign specific functions to specific component parts. For instance, each time the bartender looks to the row of the glasses, this delivers the systems responsible for planning the next action with just the information they need. The systems that are planning the bartender's actions are simultaneously influencing and being influenced by the perception-action systems that are sustaining the coupling with the environment. These systems stand in a relation of mutual and continuous causal influence on each other.

As already noted in my introduction, the dispute between EMT and EXT is typically taken to concern the cognitive status of external information-bearing structures and the bodily actions that are performed on those structures. EXT claims that environmentally located structures and resources, and the operations that are carried out on them form *constitutive* parts of a cognitive process. EMT agrees that coupling to the environment can contribute in an ongoing and interactive way in the production of a cognitive phenomenon of interest. However, proponents of this theory argue that the contribution of such couplings to cognitive processes is best understood as causal, not as constitutive.

This disagreement notwithstanding, there is, however, much that EMT and EXT are agreed upon. Both theories agree that the *explanation* of how internal cognitive processes give rise to some behavior of interest will often need to advert to bodily actions on external, environmentally located structures. Embedded and extended theorists therefore agree that internal cognitive processes will often not be sufficient for *explaining* cognitive behaviors. Given the extent of this agreement about how to go about explaining many of our problem-solving behaviors, one might be forgiven for wondering what is really at stake in this debate.

Sprevak (2010) has argued, for instance, that the dispute is unlikely to make a difference to how cognitive scientists go about their everyday business. The two theories can both equally well accommodate the available experimental evidence.[7] Cognitive scientists could frame their theories either in embedded terms or in extended terms. It would make little or no difference when it comes to the explanatory value of the resulting theories. Thus EMT and EXT do not seem to be genuinely competing theories when judged from an empirical perspective by the experimental data each theory can explain. Moreover, it is far from clear that any explanatory advantage is really gained from labeling the construction and manipulation of environmental structures as parts of a "cognitive" process. If this is what the debate is about, it has all the hallmarks of being a merely semantic disagreement.

I agree with Sprevak, however, that the debate between EXT and EMT isn't about the best conceptual framework for interpreting findings in cognitive science. It is a debate in metaphysics about "what makes a state or process count as mental or non-mental" (Sprevak 2010, p. 361).[8] For instance, the two theories fundamentally disagree about the body and world and their role in cognitive processes. EXT casts the body in the role of a tool for mediating between neural processes and the intelligent use of the environment. The body of the agent is what Clark describes as "a bridging instrument" that enables "the emergence of new kinds of distributed information-processing organization" (Clark 2008, p. 207). EMT argues by contrast that it is the body and world as represented in the brain that plays a necessary part in problem-solving behavior.

In the next section I explain how EXT has been defended by appeal to the so-called parity principle by defenders of extended functionalism (FEX for short). FEX claims that bodily action on external information-bearing structures is one of the many ways in which the computational processes that underpin cognitive processes can be implemented. The human brain has a rich variety of modes of encoding and processing information, some of which involve constructing and acting on information-bearing structures located in the environment.[9] We shouldn't treat instances of problem-solving differently when the agent makes active use of resources located in the environment. We will see, however, that the appeal to parity and the equality of treatment for the inner and outer have been found to be less than persuasive by advocates of EMT. In the third section, I will argue this has led to stalemate in the debate, suggesting that EXT might be in need of new, more radical ideas.

The Parity-Based Defense of EXT

The parity principle was first formulated by Clark and Chalmers in a paper that initiated the debate about the extended mind as we know it today (Clark and Chalmers 1998). Here is how they formulated the parity principle:

> If as we confront some task, a part of the world functions as a process which, were it to go on in the head, we would have no hesitation in accepting as part of the cognitive process, then that part of the world is (for that time) part of the cognitive process. (p. 8)

Consider how the parity principle might apply to the bartender example discussed in the previous section. Instead of physically arranging the glasses in the world, suppose instead that the bartender visually imagines the same line of glasses. He then keeps in mind this visual image, accessing it when he needs to, until the order is completed. Now, most of us would, I guess, be willing to say that such a visual image would count as a part of the cognitive process that causes the bartender's behavior. However, if we say this of the visual image of the line of glasses, then surely we ought to say the same of the actually existing line of glasses in the world. The visual image is nothing but an inner reconstruction of the same physical structure in the world. All I have done in constructing this example is transpose a process that in the original example takes place partly in the world into one that instead takes place wholly inside the head. The parity principle says that if we count a process as cognitive when it takes place inside the head, we should also count it as cognitive when it extends into the world. A cognitive process ought to be counted as cognitive regardless of where (inside the head or out in the world) it takes place.

Taken as a self-standing principle, the parity principle doesn't settle anything. It works as an argument for EXT only when taken in conjunction with some pre-existing conception of when a process counts as a cognitive process (Adams and Aizawa 2001; Rupert 2009; Wheeler 2011b; Walter and Kästner 2012). After all, it is the *cognitive* status of a process that partly takes place in the world that we are using the parity principle to try to settle. In order to apply the parity principle, we must therefore have some pre-existing standards for making judgments about which processes are cognitive and which are not. We must have some pre-existing philosophical theory of what makes a state or process count as a state or process of a particular cognitive kind.[10]

Clark and Chalmers answer this question in part on the basis of considerations drawn from commonsense psychology, and in part by reference to cognitive science. Consider once again Clark and Chalmers's infamous case of Otto who because of his Alzheimer's relies on a notebook to remember the location of the Museum of Modern Art (MOMA) in New York (Clark and Chalmers 1998). The notebook can do the work of storing information just as well as the brain can. It doesn't matter that information is encoded, stored, and recalled very differently in the Otto notebook system as compared with Inga, who recalls the location of MOMA using her biological memory. The entries in Otto's notebook causally interact with his perception, beliefs, desires, and behavior in many of the same sorts of ways as the memory states of Inga. The Otto notebook system and the declarative memory systems in Inga's brain can thus be seen as different physical realizations of functionally equivalent dispositional belief states. They are instances of the same type or kind of mental state because they play the same coarse-grained, action-guiding role.

Proponents of EMT have, however, queried this last move by pointing to significant fine-grained functional differences in how memory works in Inga and Otto. Otto, for instance, would likely show no difference when it comes to remembering items at the beginning or end of a list of items as compared with those that occur in the middle of a list (Adams and Aizawa 2008).[11] Functional differences like these, and there are many others, give us grounds for doubting that extended and inner cognitive processes really do count as functionally equivalent.

This objection is not based on the claim that fine-grained similarity of internal and extended cognitive processes is necessary for the application of the parity principle.[12] The objection is rather based on a claim about what makes a state or process count as an instance of a particular cognitive kind. EMT takes cognitive processes to have a nature that is determined by causally explanatory properties, identified by our best theories in cognitive science. It is for this reason that they pay close attention to the details of the causal roles played by cognitive processes in humans.

Clark and Chalmers applied the parity principle according to standards that were in part based on common sense. They take ordinary folk to identify the causal properties that determine the nature of a given cognitive state in the types of explanations they give when making sense of one another as rational agents. Proponents of FEX more generally promote an attitude of maximal inclusiveness in the range of non-standard realizers we count as possible realizers of the mental. They encourage us to be as liberal as possible in the creatures we count as being minded like us (Clark 2008; Sprevak 2009; Wheeler 2010). AIs, robots, and other creatures of science fiction all count as having states that mediate between inputs and outputs in ways that are similar enough to the states appealed to in folk psychological explanations. All of these systems have states that guide action in roughly the same type of way as the states picked out in folk psychological explanations.

The debate between EMT and EXT (in its functionalist formulations) is at least in part a debate about which theories we appeal to in fixing the reference of our cognitive concepts. These theories tell us whether there is sufficient similarity between two instances of a cognitive process for both to count as tokens of the same type of process. Some have allowed for folk psychological explanation to do the work of fixing the reference of our cognitive concepts. Others have argued that folk psychology is irrelevant and have instead made appeal to scientific theories and explanations to identify causally explanatory properties. It is to these questions that I turn in the next section.

The Varieties of (Extended) Functionalism

Clark and Chalmers suggested we look to folk psychology to decide whether an inner (e.g., Inga) and extended (e.g., Otto) cognitive process count as tokens of the same type of cognitive process. Folk psychology, as has often been noted, doesn't guarantee an answer to this question that favors EXT. As Chalmers (2008) has noted, folk psychology gives us some reason to treat perception and action as marking the boundaries of the mind. The only way Otto has of retrieving information from his notebook is by means of perception and action. It might then be argued based on folk psychology, that Otto does not have any beliefs before he checks to see what is written in his notebook. The notebook functions as at best an environmental cue for the formation of internal mental representations. Sure, Otto depends on his notebook for the guidance of his behavior, but conceding this is consistent with his behavior being in part the outcome of beliefs located entirely inside of his head about the contents of his notebook. These are beliefs that Otto can form only by reading what is written in his notebook.[13] Folk psychology therefore gives us some reason to treat the notebook as lying outside of the boundaries of the cognitive system.[14]

One might wonder in any case how much trust one should put in intuitions drawn from folk psychology. Folk psychology may invite us to count the states of Otto and Inga as states of the same kind by virtue of their action-guiding role (though there is room for debate on this point). Playing a similar role in guiding action is, however, not a scientifically illuminating causal property. We want to know more precisely what the action-guiding causal role is in virtue of which Otto and Inga count as sharing a state or process of the same kind. There is little reason to think folk psychology will prove a useful guide when it comes to identifying causally explanatory properties. Indeed the judgments that folk psychology yields may well encourage us to mistakenly lump together states and processes that empirical science distinguishes, and conversely to make distinctions where none are found in nature.

It is this type of reasoning that has led parties on both sides of the debate to look instead to cognitive science to identify the causally explanatory properties that make a state or process the type of state or process it is. What verdict would we reach if we individuated functional roles instead on the basis of our best empirical scientific theories? Do such theories allow for kinds of cognitive processes that sometimes extend into the world beyond the boundaries of the organism? Once again, there is no clear consensus.

Wheeler has argued in a series of papers for an affirmative answer to this question. He agrees that our empirical theories may well point to many functional differences between extended and internal memory processes. However, he asks us to imagine that cognitive psychologists found people whose internal memory processes exhibited the same functional differences as the Otto notebook system (Wheeler 2010). Wheeler thinks the psychologists would still classify the people in question as having declarative memory processes so long as they exhibited, for instance, "context-sensitive storage and retrieval of information" (Wheeler 2011b). He thus doubts that the existence of functional differences speak against treating extended and inner memory processes as processes of the same *generic* kind.

Why should we count extended and inner memory processes as instances of a generic kind of declarative memory? There is some debate within EXT about whether we must do so because generic cognitive processes share common underlying mechanisms. As we saw in the introduction, Clark argues that extended cognitive processes may prove to be fundamentally disunified, a motley of different mechanisms. The methodological moral of EXT for cognitive science would therefore be to let a thousand flowers blossom. Although Sutton (2010) presents himself as making the case for extended cognition on the basis of computational cognitive science, he can also be read as falling within this first camp. Sutton has argued for a second wave in EXT that stresses the functional differences between inner and outer problem-solving resources. Second-wave EXT argues that external structures like Otto's notebook complement the cognitive capacities of the biological brain, joining forces with them to deliver new hybrid cognitive systems that are part biological and part cultural.[15] A key claim of second-wave EXT is that the scientific study of intracranial, or inner cognitive processes is just one part of cognitive science. The scientific study of extended cognitive systems is, Sutton argues, also a central research question in cognitive science, often undertaken in collaboration with the social sciences.

The complementarity of heterogeneous inner and outer elements that is emphasized by the second wave seems to have the consequence that extended and intracranial cognitive systems are unlikely to be built on the basis of the same mechanistic principles. On the contrary, the point of stressing complementarity is that "in extended cognitive systems, external states and processes need not mimic or replicate the formats, dynamics, or functions of inner states and processes. Rather, different components of the overall (enduring or temporary) system can play quite different roles and have different properties" (Sutton 2010, p. 194).

The alternative empirical functionalist view defended by Wheeler requires that the underlying mechanisms that support generic memory must at least share in common some family resemblance (Wheeler 2011b).[16] Wheeler allows for a variety of mechanisms, some of which are dynamical, nonrepresentational, and noncomputational, others of which are computational and representational (Wheeler 2005; Wheeler 2011b). However, he argues that these mechanisms are nevertheless partially unified: either as computational and representational processes on the one hand, or as dynamical and nonrepresentational on the other.

Trouble lies in waiting for FEX in playing this empirical functionalist card. First, cognitive science licenses a number of different theory-loaded accounts of the cognitive, not all of which support EXT. Wheeler proposes the physical symbol systems hypothesis of Newell and Simon (1976) as an uncontroversial account of the nature of cognitive processes that he thinks every party in the EXT-EMT debate ought to be able to accept.[17] We can think of Otto together with his notebook as forming "a sufficiently complex and suitably organized physical symbol system" (Wheeler 2011a, p. 236).[18] Both the Otto notebook system and Inga can thus be interpreted as physical symbol systems. While there are no doubt significant differences in the mechanisms that realize declarative memory in Otto and Inga, there is nevertheless a family resemblance. Both can be described as physical symbol systems.

Conceding this much doesn't settle the issue of whether to describe the notebook as making a cognitive as opposed to a merely causal contribution to Otto's memory processes. Take Robert Rupert as an example of a proponent of EMT;[19] he could no doubt agree with Wheeler's proposal to use Newell and Simon as a scientifically informed account of the cognitive. However, he is well known for his skepticism about the concept of generic memory as a scientifically well-formed category (Rupert 2004, 2009, 2013). Rupert argues that science would only treat Otto and Inga as instantiating a generic kind of declarative memory if memory in Otto and Inga was brought about by the same cluster of integrated and persisting mechanisms. The Otto notebook system arguably does form a cluster of integrated and persisting mechanisms. Thus at first glance it seems to pass one of Rupert's tests. However, before we celebrate the victory of EXT, we should note that the clusters of mechanisms that are the basis for remembering in Otto are very different to those of Inga. Rupert argues that we would only be warranted in attributing to Otto states of the same kind as Inga on the following condition. Our model of how Otto's behavior is produced would have to overlap significantly with our model of the mechanisms that bring about Inga's behavior. Rupert argues that there is no reason to think this will be the case.

This conclusion doesn't settle the empirical functionalist case in Rupert's favor. For it should be noted that any mechanistic system can be described at many levels of organization (Craver 2007). Wheeler could argue that extensive lower-level implementational differences may disguise from view significant higher-level functional similarities. However, such a reply doesn't take us far. Suppose a proponent of EMT were to concede, as I think they should, that declarative memory processes allow for information to be stored either internally (as in Inga) or externally (as in Otto).[20] Consistent with this concession, they could nevertheless insist against EXT that the contribution of the external elements is only causal, and not cognitive. Memory processes so conceived can take the form of *hybrid* processes made up of causally interacting elements, some of which are cognitive and some of which are noncognitive.[21] Such a version of EMT wouldn't yield a genuinely competing explanation to EXT (Sprevak 2010). It would agree with EXT that memory processes can take a variety of forms, some of which are wholly internal and others of which are environment-involving. Disagreement would persist over whether to count the environmental components as constituent parts of the memory process.

The upshot of all this is that empirical functionalism leaves us pretty much where we started. In order to bring science to bear on this debate, we must settle the philosophically prior issue of what makes a state or process count as a cognitive state or process of a particular kind. The empirical functionalist answers this question by looking to the causal properties of a state or process as identified by our best scientific theories. However, we have just seen that cognitive science might be taken to yield an answer to this question that doesn't decide between EXT and EMT. The causal properties in putative cases of extended cognition can be interpreted as hybrid: part cognitive, and part noncognitive. We thus have two possible descriptions. One favors EMT (the description of the system as a hybrid of cognitive and noncognitive elements); the other favors EXT. Science on its own doesn't seem to allow us to decide which is the better description. To settle the matter we need a mark of the cognitive: a philosophical theory of what it is that makes a state or process a cognitive state or process.

Should we conclude then that we have no alternative but to rely on folk psychology? This would seem to follow on the assumption that our philosophical intuitions about the nature of the mind have their basis in folk psychology. We've seen, however, that folk psychology will prove to be of only limited help in making the case for EXT. It can help us to form a pre-theoretical sense of what states and processes stand in need of explanation. However, if we assume it is a state or process' causally explanatory properties that make it the state or process that it is, folk psychology cannot help us with our original question. It is through scientific investigation that we will learn about causally explanatory properties, not by recourse to folk psychological intuition.

This all leaves us in a rather unsatisfying place. Scientific findings need to be given a philosophical interpretation if they are to settle the issue of which causally explanatory properties are constitutive of a given cognitive state or process. We need a theory that tells us which causal properties count as cognitive, and which do not. However, if a theory is to do this work for us it must be based on scientific findings that identify causally explanatory properties. Philosophical theorizing needs scientific grounding, but scientific theorizing needs philosophical interpretation. Neither empirical functionalism nor commonsense functionalism succeeds in providing us with the philosophical account of the cognitive we need to settle the debate between EXT and EMT. It is time to try something different.

Taking the Radical Option

Chemero (2009) writes that radical embodied cognitive science (henceforth RECS) is "a variety of extended cognitive science" (p. 31). He characterizes this branch of cognitive science as having its roots in the American pragmatist tradition of William James, John Dewey, George Mead, and Charles Peirce.[22] A theme that looms large in the work of these philosophers (and also in RECS) is the mutuality of animal and environment. Here is Dewey explaining the central idea:

> To see the organism in nature, the nervous system in the organism, the brain in the nervous system, the cortex in the brain is the answer to the problems which haunt philosophy. And when seen thus they will be seen to be in, not as marbles are in a box but as events are in history, in a moving, growing, never finished process. (Dewey 1958, p. 295)

To say that animal and environment stand in a relation of mutual dependence is to claim that animal and environment are interdependent in the sense of together forming a "moving, growing, never finished process." The connection of RECS to this older tradition in naturalistic thinking comes from the thesis that if we model the agent and environment as coupled dynamical systems, then it is only as a matter of convenience that we treat them as separate systems. Instead of describing how external environmental factors cause changes in the agent's behavior, we instead model how the whole agent-environment system as a single process changes over time.

The argument for this claim is based in part on the mathematics of dynamical systems theory. Dynamical systems theory models change over time in complex systems using the mathematics of differential equations. Examples of complex systems are the solar system, weather systems, the diffusion of ink in water, interaction of populations of predator and prey, and so on.[23] The key concept we will need for the arguments that follow is that of the "coupling" of the agent and environment. Two systems S_1 and S_2 are said to be coupled when the equations describing one system S_1 contain variables whose value is a function of the variables in the equations describing S_2, and vice versa. Thus take the example of dynamical systems description of rate of change in a population of predators and prey. The equations describing a population of predators will include variables for prey, and the equations describing change in the population of prey will include variables for predators.[24] For example, if the number of predators steadily increases, the number of prey will steadily decrease, thereby putting pressure on the predators. As the predators begin to die off, the prey can begin to recover, and this dynamic will continue until the two populations reach some sort of equilibrium, and the size of each population remains relatively stable.

Now if we apply the concept of coupling to agent–environment interactions, we get the following result. We have two equations: one describing the changes that take place in the agent, and the second describing the changes that take place in the environment. The variables in the respective equations describe how components of the agent and the environment change in relation to each other. For the agent, some of the components are located in the brain, others in the rest of its body relating, for instance, to its bodily movements or affective states. On the environment side, the components will in cases of extended cognition be the information-bearing structures that the agent makes use of in the performance of a cognitive task. The agent and environment are dynamically coupled in cases of extended cognition because the equation describing change in the environment contains variables whose values are determined by the changes taking place in the agent. Similarly, the equations describing change in the agent contain variables whose values are determined by change in the environment.

Two systems that are coupled resist decomposition into separately functioning systems. We cannot model the behavior of the system as the additive product or sum of the interactions of separate structures and components, some on the side of the agent, and others on the side of the environment. Such is the degree of continuous, integrated, and coordinated mutual influence between the two systems that we can't solve the equations describing the behavior of each system separately.[25] There are really two claims here that combine to yield the result that the agent–environment system is best described as a single system. First, the components that make up the agent system exhibit fluctuating rates of change that depend on components belonging to the environment system, and vice versa. Second, if we look at the behavior of the agent–environment as a whole, this behavior isn't the product of the behavior of each of the components. We must also look at the interaction of the components and the nonlinear effects that arise from those interactions due to the continuous causal influence of the components on each other.

Clark has also made extensive use of these types of considerations in arguing for extended cognition. He characterizes the interactions between internal and external resources as "highly complex nested and nonlinear." He continues:

> As a result, there may, in some cases, be no viable means of understanding the behavior and potential of the extended cognitive ensembles by piecemeal decomposition and additive reassembly. To understand the integrated operation of the extended thinking system created, for example, by combining pen, paper, graphics programs, and a trained mathematical brain, it may be quite insufficient to attempt to understand and then combine (!) the properties of pens, papers, graphics programs and brains. (Clark 2008, p. 116)

Clark retains a commitment to representational and computationalist explanation. This renders his appeal to dynamic coupling vulnerable to Rupert's objections (Rupert 2009, ch. 7). Rupert argues that in a range of cases in which dynamical systems theory is used to model cognitive behaviors, we do not find coupling. We don't find variables for environmental elements showing up in the equations describing the agent's behavior. Instead we find the environment causing variation "among a small number of dimensions (e.g., input units) of the organismic system" (2009, p. 136). It is the value of these internal organismic systems that then determine how the agent behaves, not the states of the external environment.

Rupert's objection depends for its success on his conception of cognitive processes as persisting and integrated sets of mechanisms that causally contribute in the production of a wide range of cognitive phenomena (Rupert 2009, ch. 3). Armed with such a conception of cognitive systems, he can argue that agent–environment interaction leads to changes in the agent's internal representational states. The agent is sensitive to such changes in its internal representational states, and on the basis of this sensitivity it adapts its behavioral outputs so as to accomplish its tasks. The agent's interaction with the environment is causally relevant only through the changes it brings about in the agent's internal representational states.

REX argues by contrast that the agent doesn't interact with the environment through the intermediary of internal representations. It is not only dynamical systems theory and the concept of coupling that does the argumentative work but also crucially ideas drawn from ecological psychology, or so I shall propose. Ecological psychologists show how the layout of the ecological niche of a given species of animal is rich with higher-order, structural invariants that specify affordances, and which the mobile animal is able to immediately and directly detect. Warren summarizes the idea well:

> The perceptual system simply becomes attuned to information that, within its niche, reliably specifies the environmental situation and enables the organism to act effectively. (Warren 2005, p. 358)

Perceptual systems function first and foremost to guide action. The perceiving animal is immediately and directly sensitive to higher-order invariants or patterns in sensory stimulation that specify affordances, the possibilities for action provided to an animal by its surrounding environment. Interaction with the environment produces patterns of energetic stimulation, which form the basis for directly and immediately detecting higher-order invariants that specify affordances. As an agent approaches the edge of a precipice there is an immediate shearing off of the texture of the ground of the supporting surface (Gibson 1969) and the perceiver immediately detects that here is a place that offers the potential to fall. This is a meaning that is carried in the light that reflects from this place. This type of informational regularity can be thought of as an ecological constraint under which the perceptual systems of animals evolved. Thus the tusk of the narwhal is "tuned to the salinity differentials that specify the freezing of the water's surface overhead," information that is critical to its survival (Warren 2005, p. 341).

With the ecological context in place, the argument from coupling looks a little different. It can be argued that the environment doesn't causally influence behavior only by means of internal representations. Interaction with the environment isn't only about the delivery of afferent stimuli that can be used by the brain to construct internal representations. It can be argued instead that the agent dynamically couples with information-bearing structures located in the environment. Agent and environment exert continuous and mutual causal influence on each other making it the case that agent and environment cannot be modeled as separate systems. They are instead best modeled as a single extended cognitive system.

Rupert, however, has another argument up his sleeve. He claims that even if we grant that the external environment can causally influence behavior, this still doesn't suffice for coupling. For the direction of causal influence is only one-way: from environment to agent and not the other way around (Rupert 2009, p. 136). The environment may make a difference to behavior sometimes, but the agent makes no difference to the environment. For example, when in a game of Tetris the subject rotates the zoid in order to see into which space it might fit, "the fundamental dynamics of the object are not changed: its evolution in state space from any given point remains the same as it was before the rotation" (Rupert 2009, p. 136).

What exactly does Rupert mean when he claim that the dynamics of the zoid remain the same before and after rotation? The player's rotation of a zoid is a now-classic example of an epistemic action. Players perform this action in order to recognize the shape of a zoid, and to verify whether a given orientation will help to fill a line or not. Rotation therefore influences the spatial path of the falling zoid and the place it comes to rest. The path the zoid traverses and its orientation when it finds its resting place all clearly influence play and the arrangement of the pieces on the board. Thus we have what looks like a case of coupling: the equations describing the game will include variables for the player's action of rotation. The equations describing the player's actions will include variables for the rotation of the zoid. Recognition of the shape is facilitated by the act of rotation.

Perhaps, however, Rupert has something more demanding in mind when he talks of coupling. He describes the coupling relation as holding when "an order parameter of one subsystem acts as control parameter of the other, and vice versa; as a result, one subsystem's evolution can change the very character of the evolution of the other" (Rupert 2009, p. 133). A control parameter is a value whose continuous quantitative change leads to qualitative change in the behavior of the system. An example is the temperature of a fluid: a difference in this parameter can change dramatically how the fluid changes over time from an initial state. An order parameter is a composite or macroscopic state of a system such as the convection patterns or Bénard rolls that can be seen in a viscous fluid, such as oil when it reaches a certain temperature. In the Tetris example, it is the player's action of rotating the zoid that is the candidate for the control parameter. It is tricky to say what would count as the order parameter of the game. Let us suppose that it is the overall configuration of the pieces on the board at a particular moment in the game. We can see why Rupert would think the order parameter so conceived isn't affected by rotation. The pieces do not suddenly change their position when one rotates.

Notice, however, that this is to describe the game at a single point in time. Kirsh's classic research on Tetris shows that rotation when done early enough in the game does have a sizable influence on the player's success. Without rotation the layers of the board would fill up much sooner. With rotation the player succeeds in filling more lines and thus playing longer. Suppose we are given the task of predicting how a given game is going to play out. We would need to take into account whether the player used the strategy of rotation, and when they chose to do so. Compare this with the earlier example of populations of predators and prey. The growth in the population of prey, for instance, is dependent on the effects of predation. Similarly, how fast the layers of the board fill up in part depends on the performance of the action of rotation.

Both of Rupert's arguments fail. An obvious further objection, however, appeals to the concept of hybrid cognitive systems used so effectively against EXT earlier in the chapter. Why doesn't an extended cognitive system count as a hybrid cognitive system composed of cognitive elements inside of the head of the agent, and noncognitive elements in the environment? (Adams and Aizawa 2008, ch. 7).

This objection assumes precisely the kind of decomposition that has been called into question earlier. The elements inside the head could realize cognitive processes only by representing what is outside the head. The debate between EXT and EMT (with its commitment to hybrid cognitive systems) thus turns on whether one takes representation to be the mark of the cognitive. I've argued this is a mark of the cognitive that EXT must reject.

Conclusion

The central claim of this chapter has been that to resolve the debate about extended cognition we will need to come up with a mark of the cognitive. We will need to say what makes a state or process count as a state or process of a particular cognitive kind. All sides in the EXT-EMT debate have supposed that we must answer this question by appeal to the causally explanatory properties of a state or process. However, of the causally explanatory properties, some may be only causally relevant and not constitutively relevant.[26] Externally located structures might be argued to fall in the category of causally relevant but not constitutively relevant properties. In order to come down on one side or the other in this debate, we will need to have some basis for deciding whether a causally explanatory property is constitutively relevant. This requires us to have a theory of which causal processes count as cognitive.

RECS may hold the key to breaking the stalemate that has been reached in the debate between EMT and EXT. Interaction with the environment cannot be argued to be of only causal relevance so long as agent and environment are exerting continuous mutual causal influence on each other. This mutual causal influence stands in the way of modeling agent and environment as separate, independently functioning systems.

Doesn't the success of this argument depend on the empirical functionalist claim that it is causal explanatory properties that make a state or process an instance of a particular cognitive kind? Empirical functionalism has traditionally been aligned with the computational and representational theories of mind, a connection that REX seeks to break. Empirical functionalists take the states that mediate between inputs and outputs to be representational states with an internal structure to which computational processes are sensitive. This commitment to computational and representational explanation is arguably essential to empirical functionalism. One of the main selling points of the computer theory of mind was supposed to be that it can make it intelligible how a causal and mechanistic process can also be sensitive to semantic properties of thinking (Crane 1995; Fodor 2000). The computer theory of mind was supposed to help us to understand how causal properties can constitute a cognitive process. REX, however, rejects the computer theory of mind, and stripped of this theoretical commitment, empirical functionalism has little to recommend it.

REX draws its mark of the cognitive from a variety of sources that spans the phenomenological and American naturalist tradition. REX takes extended cognitive systems to be perception-action systems on the basis of which the person or animal is adapted to its environment and so able to deal adequately with its affordances. REX is thus committed to a pragmatist interpretation of what cognition is, inspired by the mutual fit and complementarity of the animal and its environment. The argument I gave earlier for EXT stressed the importance of nonlinear causality and the dynamical properties of interaction-dominant systems. However, what makes all of this relevant to cognition in the end is the way in which dynamical properties of this kind relate to the mutuality of animal and its environment. It is this mutuality that grounds the mark of the cognitive needed to make a successful case for extended cognition.

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[1] Whether or not a cognitive process counts as an extended cognitive process is to be settled on a case-by-case basis. We see this policy at work in the debate about the realizers of phenomenal conscious experience. Prominent defenders of extended cognition deny that the material vehicles of phenomenal experience ever extend into the world (see, e.g., Clark 2012; Wheeler 2015). These authors argue that the computational processing that forms the basis for phenomenal experience is firmly encased within the heads of individuals.

[9] The exact balance of internal and external resources recruited to solve a problem is negotiated on a case-by-case basis, in ways that are constrained by the task at hand. Whether the cognitive agent makes use of structures located in the environment in problem-solving will depend on the costs and benefits of doing so, as evaluated, for instance, in terms of energy expenditure, risks, and uncertainties (Clark 2008, ch. 7; Rowlands 2010). There are interesting connections here to Clark's recent work on predictive processing (Clark 2015).

[2] See, e.g., Rupert 2009.

[3] Sutton et al. (2010) argue for a distinction between embedded and scaffolded theories of cognition. The former position, which they attribute to Adams and Aizawa, holds that cognition is fundamentally intracranial but may causally depend upon interactions with external resources located in the environment. Theories of scaffolded cognition by contrast argue that cognitive processes can unfold through couplings between heterogeneous internal and external resources. Distributed cognitive processes made up of heterogeneous elements, some inner and some outer, should figure among the processes that are investigated in cognitive science. Sutton and colleagues distinguish scaffolded cognition from extended cognition, arguing that the former comes in degrees and often falls short of satisfying the degree of integration required for some external resource to count as a constitutive part of a cognitive process. (See also Sterelny 2010.) In what follows I will for the most part treat embedded and scaffolded cognition as coextensive, but it should be noted that some cases of scaffolded cognition may also qualify as cases of extended cognition. Thus, the category of scaffolding cognition may cross-cut the distinction between extended and embedded cognition.

[4] See Kirsh (1995) for a classic treatment of more cases of problem-solving of this flavor in which actions are performed that structure the spatial environment in ways that simplify the reasoning the subject engages in to solve a problem. For more recent update, see Kirsh (2009).

[5] There is an important question in the literature about the nature of the extra conditions coupling with an external resource has to meet in order for some external resource to count as a part of a cognitive process. Everyone is agreed that causal coupling on its own is not sufficient. (See Adams and Aizawa 2008, 2010, on what they call the coupling-constitution fallacy.) Some degree of functional integration of the external resource is necessary. (See Menary 2007 for an account of cognitive integration.) What are the additional conditions that need to be satisfied in order for the external resource to be integrated in the right way? Clark and Chalmers (1998) make some tentative suggestions, specifying what have come to be called "conditions of glue and trust" (see also Wilson and Clark 2009). The glue conditions relate to the availability and accessibility of the information that an external resource provides. The trust conditions concern

the reliability of this information and the degree to which the individual accepts it without question or critical scrutiny. Sterelny (2010) describes a spectrum of possible cases of cognitive integration of an external resource, identifying three key dimensions—trust, entrenchment, and individualization. For further discussion of these dimensions, see Sutton et al. (2010). Colombetti and Krueger (2015) make use of Sterelny's dimensional analysis of integration to argue for extended and scaffolded affectivity.

[6] Not everyone in the EMT camp would reject this claim. Adams and Aizawa (2008, ch. 7) make a distinction between extended cognitive systems and extended cognition. They allow that softly assembled systems like the ones I've just been describing count as examples of extended cognitive systems. They deny, however, that the extension of a cognitive system suffices for extended cognition on the basis that not every part of a cognitive process itself counts as cognitive. Rupert (2009), by contrast, does deny that softly assembled systems count as cognitive systems. They fail to meet Rupert's integration condition, according to which systems count as cognitive only when made up of persisting mechanisms, the integrated functioning of which is explanatory of intelligent behavior. My thanks to an anonymous reviewer for reminding me of the lack of consensus in the EMT camp about this issue.

[7] Also see Rupert (2009, ch. 5) for an argument to this effect. Clark echoes Sprevak's worry when he writes that the debate "though scientifically important, and able to be scientifically informed, looks increasingly unlikely to admit of straightforward scientific resolution" (Clark 2011, p. 454).

[8] This is a question whose answer I have said will come from providing a mark of the cognitive. I depart from Sprevak in framing the debate as being about cognition rather than the mental.

[10] We will eventually see how this question in turn depends on one's preferred mark of the cognitive. Adams and Aizawa (2001) also make this point (p. 46). Thus I am in effect repeating their claim here that the deployment of the parity principle to motivate EXT will depend on a prior commitment to a mark of the cognitive.

[11] For this line of argument, also see Rupert (2004).

[12] Criticisms of EMT along these lines can be found in Clark (2008, ch. 7), Sprevak (2009), and Wheeler (2010).

[13] Clark (2008) calls this move "the Otto 2-step" and offers a brief rebuttal (p. 80).

[14] Chalmers responds to this objection by arguing that folk psychological explanation is context-sensitive. Sometimes our explanatory interests concern an individual's large-scale behavior, in which case it makes sense to look at the larger system of agent together with environmental resource. On other occasions our explanatory interests might be more local, relating to Otto and the interactions with his notebook, in which case it makes sense to treat perception and action as marking the boundaries of the cognitive system.

[15] How does the second wave in EXT differ from EMT? Sutton et al. (2010) make a distinction between embedded and scaffolded cognition (discussed in fn. 5). Scaffolded cognition can allow for a spectrum of cases, some of which fit the description of extended cognitive processes in which cognitive processing is partially externally constituted.

[16] It is not entirely clear to me whether the second-wave EXT would disagree with Wheeler on this point. Indeed I suspect there may be no agreement on this point within the second-wave camp. Sutton and colleagues, for instance, stress that the interdisciplinary science of biotechnological minds is one that still works within the classical framework of cognitive science, the only difference being that the object of study is "cognitive and computational

architectures whose bounds far exceed those of skin and skull." (Sutton 2010, p. 191, quoting Clark 2001, p. 138). Menary (2010) by contrast presents the second wave as being aligned with enactive cognitive science, viewing cognition as "constituted by our bodily activities in the world in conjunction with neural processes and vehicles" (p. 227).

[17] It should be noted, however, that the effect of this stipulation might be to exclude REX from the debate. For suppose we go along with Wheeler and agree that the physical symbol systems hypothesis does tell us what it is for a state or process to count as cognitive. Either it will follow that REX is wrong to claim that dynamical and ecological cognitive processes are nonrepresentational and non-computational, or it will follow that the processes REX investigates are not cognitive at all.

[18] This quote is actually taken from Wheeler's discussion of a neural network model that is able to do pattern completion and recognition for external symbol systems, such as systems of mathematical notation or written symbols. I take it the conclusion Wheeler wants to draw for this particular example generalizes to the Otto notebook system.

[19] I choose Rupert here because he has written extensively against generic memory. Related arguments to those of Rupert can also be found in Adams and Aizawa (2008, ch. 4)

[20] Again see Sutton et al. (2010) for detailed arguments that this is actually the case based on empirical research concerned with transactional memory.

[21] Recall Adams and Aizawa's (2008, ch. 7) distinction between extended cognition and extended cognitive systems (see fn. 6): elements can be a part of an extended cognitive system while not themselves counting as cognitive.

[22] Here is not the place to enter into the historical details, but for excellent accounts, see Heft (2001) and Gallagher (2014).

[23] For useful entry points see Kelso (1995), Ward (2001), and Chemero (2009).

[24] The Lotka–Volterra equations describe variation in population size in predators and prey using two equations. The first describes how the prey population changes over time as a function of growth minus the effect of predation. The second describes change in predator population as a function of size of prey population minus natural loss of predators.

[25] Van Orden et al. (2003); Silberstein and Chemero (2012); Anderson et al. (2012). The type of nonlinear ongoing causal influence between coupled systems or components we have described previously is sometimes described as "interaction dominance" (Anderson et al. 2012). Van Orden et al. (2003) show how 1/f scaling, also known as "pink noise," is a "signature" of interaction dominance. Pink noise has also been found in agent–environment interaction. For instance, Dotov et al. (2010) found 1/f scaling when subjects were playing a video game, controlling an object on a monitor using a mouse. When the mouse connection was temporarily disturbed, however, 1/f scaling decreased, indicating that "during normal operation, the computer mouse is part of the smoothly functioning interaction-dominant system engaged in the task" (Silberstein and Chemero 2012, p. 45).

[26] I borrow this distinction between causal relevance and constitutive relevance from Craver (2007).

CHAPTER 3

ECOLOGICAL-ENACTIVE COGNITION AS ENGAGING WITH A FIELD OF RELEVANT AFFORDANCES

The Skilled Intentionality Framework (SIF)

ERIK RIETVELD, DAMIAAN DENYS, AND MAARTEN VAN WESTEN

Introduction

The topic of this Oxford handbook is "4E cognition": cognition as embodied, embedded, enactive, and extended. However, one important "E" is missing: an E for *ecological*. In this chapter we will sketch an ecological-enactive approach to cognition that presents a framework for bringing together the embodied/enactive program (Chemero 2009; Thompson 2007) with the ecological program originally developed by James Gibson, in which affordances are central (e.g., Gibson 1979). We call this framework the skilled intentionality framework.

The skilled intentionality framework (SIF) is a philosophical approach to understanding the situated and affective embodied mind. It is a new conceptual framework for the field of 4E cognitive science that focuses on skilled action and builds upon an enriched notion of affordances, which we have recently argued for in *Ecological Psychology* (Rietveld and Kiverstein 2014). We define skilled intentionality as the selective engagement with multiple affordances simultaneously in a concrete situation (Rietveld, de Haan, and Denys 2013; Bruineberg and Rietveld 2014; Kiverstein and Rietveld 2015; Van Dijk and Rietveld 2017). The skilled intentionality framework clarifies how complementary insights on affordance responsiveness from philosophy/phenomenology, ecological psychology, emotion psychology, and neurodynamics hang together in an intertwined way. The long-term ambition of the SIF research program is to understand the entire spectrum of skilled human action,[1] including social interaction, creativity, imagination, planning, and language use in terms of skilled intentionality.

By "affordances" we mean the possibilities for action provided to us by the environment (Gibson 1979; Chemero 2003, 2009; Michaels 2003; Reed 1996; Costall 1995;

Heft 2001; Rietveld and Kiverstein 2014). Structuring and scaffolding our skilled activities, affordances are crucial for understanding the embodied mind. Grasping a glass, riding a bike, or improving an architectural design, for instance, can all be seen as a skilled individual's immediate responsiveness to affordances. An individual can respond to affordances thanks to abilities. In the relational approach to affordances developed in this chapter, the possession of the relevant ability is seen as necessary for being able to act on an affordance. Someone who does not have the ability to read English cannot be responsive to the possibility this sentence offers of being read. Humans typically acquire their abilities thanks to a history of interactions in sociocultural practices (Rietveld 2008a). For example, architects acquire their skills thanks to their being selected for education in specialized architecture academies, their traineeships in architecture firms, and repeated interactions with builders, other architects, and clients for the projects they realize.

Both humans and animals respond to affordances in a context-sensitive way. To an earthworm, for instance, a leaf affords plugging its burrow and thus regulating the humidity of its immediate surroundings. Such a context-sensitive engagement with this affordance is important for the condition of its skin (Darwin 1881). In a similar way, the environment offers all sorts of possibilities for humans, including possibilities for social interaction. For example, given a certain context, the sad face of a friend can invite a consoling gesture, a person waiting in a queue at a coffee machine can invite a conversation, and an extended hand can invite a handshake. Crucially, skilled responsiveness to affordances is not only encountered in everyday skilled activities, but also in activities that are traditionally characterized as "higher" cognition. Skills are crucial for knowledgeable action. For example, through her interaction with a patient, a skilled psychiatrist could intuitively, without explicit reflection, diagnose the patient with depression, based on pale complexion, red eyes, rigid and slow movements, disturbed language, pace of thinking, way of dressing, smell, and specific use of words. The prototypical example that we will use in this article to theorize the role of affordances in "higher cognition" is the design process of architects, which involves *both unreflective and reflective* episodes (Rietveld 2008a; Rietveld and Kiverstein 2014; Rietveld and Brouwers 2016; Van Dijk and Rietveld 2017).

Unlike, for example, Dreyfus's work on skilled action (Dreyfus 2002a, 2002b, 2006) or Hutto and Myin's (2012) early work on basic minds in enaction, the richer

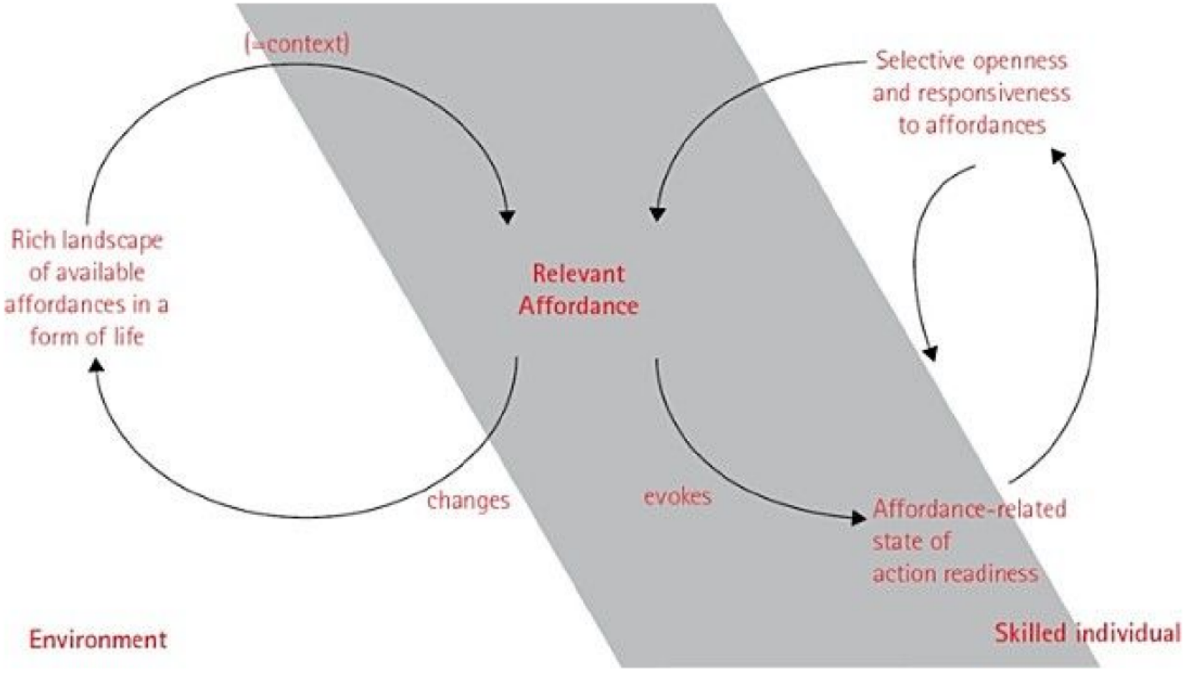

FIGURE 3.1. The skilled intentionality framework is a philosophical framework for understanding skilled action in context that integrates perspectives of various disciplines: ecological psychology (landscape of affordances), phenomenology (selective openness to and relevance of affordances), emotion psychology (states of action readiness, along the lines of Frijda 2007), and embodied neurodynamics (self-organizing affordance-related states of action readiness).

Adapted from J. Bruineberg and E. Rietveld, Self-organization, free energy minimization, and optimal grip on a field of affordances, *Frontiers in Human Neuroscience*, 8, e599, Figure 1, doi:10.3389/fnhum.2014.00599 © 2014 Bruineberg and Rietveld. This work is licensed under the Creative Commons Attribution License (CC BY). It is attributed to the authors Bruineberg and Rietveld.

notion of affordances we have developed includes possibilities for long-term planning, possibilities for reflection, possibilities for creative imagination, possibilities for social interaction, and possibilities for language use (Rietveld and Kiverstein 2014; Rietveld and Brouwers 2016; Van Dijk and Rietveld 2017). The skilled intentionality framework (SIF) dissolves the dichotomy between "lower cognition" and "higher cognition" by interpreting affordances for the latter types of skilled activities as *just more affordances* available in our human ecological niche (left part of Figure 3.1) and responsiveness to them as just a manifestation of skilled intentionality in context. Moreover, a key aspect of so-called "higher" cognition regards the way in which persons are oriented toward the possible. The concept of skilled intentionality as multiple simultaneous states of *action readiness* for engagement with affordances entails orientation toward and preparation for possibilities for future action, which is a situated form of anticipation.

Skilled action is paradigmatic for embodied/enactive cognition (Rietveld 2008a, 2008c) and is investigated by different scientific traditions. The notions of affordances and affordance responsiveness are becoming central in various disciplines studying skilled action, including philosophy/phenomenology (Abramova and Slors 2015; Noë 2012; Kiverstein and Miller 2015; Van Dijk and Withagen 2016; Ramstead, Veissière, and Kirmayer 2016), sports/ecological psychology (Hristovski, Davids, and Araújo 2009; Chow et al. 2011; Withagen, Araújo, and De Poel 2017), affective science (Frijda, Ridderinkhof, and Rietveld 2014), and neuroscience (Friston et al. 2012; Schilbach et al. 2013; Dotov 2014; Dotov et al. 2010; Kirchhoff 2015; Jelic 2016; Pezzulo and Cisek 2016). For example, *affordance-related states of action readiness* are central to understanding both emotions (Frijda et al. 2014; cf. Frijda 2005) and the neurodynamics of skilled action (Bruineberg and Rietveld 2014). We will see later that these varying perspectives on skilled action can be understood as describing the same phenomenon of skilled intentionality from different yet complementary points of view. Ultimately, we will need all of them for a solid understanding of skilled action in context (for more on this integrative methodology based on complementarity of different scientific fields, see Klaassen, Rietveld, and Topal 2010; Rietveld 2008a, 2008c; Van Dijk and Rietveld 2017).

In short, the skilled intentionality framework (SIF) aspires to do justice to the complex phenomenon of embodied cognition as skilled engagement with multiple affordances by integrating perspectives at different levels of analysis: ecological psychology, phenomenology, emotion psychology, and neurosciences. The aim of this chapter is to summarize the distinctive Amsterdam SIF approach to skilled action in context, which can be characterized as *ecological-enactive* cognition.

In a series of papers, we have shown that the tendency toward a grip on multiple affordances simultaneously is something that is found at each of these levels of analysis and thus provides a way of conceptually bridging them (Bruineberg and Rietveld 2014; Rietveld and Kiverstein 2014; Rietveld and Brouwers 2016; Bruineberg, Kiverstein, and Rietveld 2016). It will be seen later how our concept of affordance-related states of action readiness in particular is able to facilitate crossings between these levels of skilled action in context.

SIF acknowledges that different fields of study like ecological psychology, phenomenology, affective science, and neurodynamics approach the same phenomenon over different time scales. For instance, what from a phenomenological perspective is described in philosophy as the experienced invitation of an affordance (i.e., a solicitation, Dreyfus and Kelly 2007; Rietveld 2008a), can be measured (and analyzed) as a state of "action readiness" in emotion psychology and (affective) neuroscience (Frijda 1986, 2007; Rietveld 2008b; Bruineberg and Rietveld 2014; Van Dijk and Rietveld 2017). In the next three sections, we will show how the notion of skilled intentionality returns in particular ways at various levels of analysis and time scales of the integrated individual-environment system (Figure 3.1). The first section describes skilled intentionality at the ecological level (left part of Figure 3.1), i.e., the ecological niche that forms the context in which individuals are situated. We will discuss how our rich definition of affordances relates to different kinds of skilled activities, including social interaction, language use, and reflection. This situates the skilled individual in the context of a rich *landscape of affordances* that is shared with the other individuals inhabiting the same ecological niche.

The second section describes skilled intentionality at the phenomenological level of analysis (depicted in the middle of Figure 3.1). We discuss how a particular individual can be *selectively open* to this landscape, responding only to the *relevant* affordances in the particular situation. An individual can be solicited or drawn to act on relevant affordances and doing so will change their surroundings. This relevance of affordances relates to a disequilibrium within a self-organizing individual–environment system (the whole of Figure 3.1). We will explain later—using Merleau-Ponty's phenomenology of life—that such a disequilibrium is inherent to all living beings (Merleau-Ponty 1968/2003.). This disequilibrium develops dynamically as a result of material changes in the context/situation (left dynamic, Figure 3.1) and changes of states of the active individual (right dynamic, Figure 3.1). Crucially, skilled intentionality means reducing disequilibrium by moving toward an optimal grip on multiple relevant affordances simultaneously, that is, on a *field of relevant affordances*.[2] The third section describes how at the embodied neurodynamic level, which is depicted in the right of Figure 3.1, skilled intentionality is understood as expressing a process of self-organization of multiple affordance-related states of action readiness. Due to the fact that we analyze the same self-organizing system from these different perspectives in the different sections, some amount of reiteration is inevitable.

SIF's Rich and Resourceful Landscape of Affordances and "Higher" Cognition

The SIF builds not just upon own work in different fields of embodied/enactive cognitive science (philosophy, emotion psychology, psychiatry, and radical embodied cognitive neuroscience), but also on decades of research on affordances in the tradition of ecological psychology (Gibson 1979; Heft 2001; Reed 1996; Chemero 2003; Withagen et al. 2012; Withagen et al. 2017). Starting from this latter tradition, we have argued that the first question to ask about an affordance is what the ecological niche is in which it is embedded or "nested" (Rietveld and Kiverstein 2014). This allows us to stay close to Gibson's idea of the primacy of the ecological niche for understanding the kind of animal one is interested in. In recent philosophical work we (Rietveld and Kiverstein 2014) have refined Chemero's (2003) definition of affordances, using Wittgenstein (1953), to show that affordances always have to be understood in the context of an ecological niche that implies the form of life of a certain kind of animal. Therefore, we define an affordance as a relation between (a) an aspect of the (sociomaterial) environment and (b) an ability *available in a "form of life"* (Wittgenstein 1953).

A form of life is a kind of animal with a certain way of life and ecological niche. A form of life refers to a certain kind of practice: coordinated patterns of behavior of multiple individuals. The main reason we prefer the use of the Wittgensteinian notion of a form of life is because, at least in certain contexts, it is important to acknowledge the fact that within the human form of life there are many different sociocultural practices (e.g., communities of English language speakers, builders, academics, and architects, etc.). The notion "form of life" can refer both to a sociocultural practice and to a species (e.g., lions, earthworms, humans). The form of life of a certain kind of animal or a sociocultural practice is manifested in relatively stable patterns of behavior, generated by the coordinated activities of many individuals over time.[3] As such, a form of life is independent of any particular individual. A novice typically acquires his or her skill within an already existing form of life. Just like Wittgensteinian norms (Wittgenstein 1953; Rietveld 2008a), affordances continue to exist when an individual dies, because they are not related to a particular individual but to an entire practice, to a form of life (Rietveld and Kiverstein 2014; Van Dijk and Rietveld 2017). Affordances are just as deeply social as, for example, the norms of spelling are, because they are by definition related to (abilities available in) a practice in SIF.

The variety (cf. Roepstorff, Niewöhner, and Beck 2010; Roepstorff 2008) that is manifested in both relata of the definition of affordances, i.e., in both the sociomaterial environment and in available abilities in a form of life, allows us to see the human ecological niche as a rich and resourceful *landscape of affordances* (Rietveld and Kiverstein 2014). The variety in the environmental structure, which is one relatum of our definition, was outlined by Gibson (1979) already: different surfaces afford locomotion and support; substances afford nutrition and manufacture; objects afford many kinds of manipulation; animals afford each other all sorts of interactions (sexual, playful, fighting, cooperating, communicating, predatory, nurturing, etc.; see Gibson 1979).

Following an important development in the social sciences, we have suggested that in the human case the material environment is best understood as a *sociomaterial* environment (Mol 2002; Orlikowski 2007; Suchman 2007) because of "the intertwinement of the material and the social in practice" (Rietveld and Brouwers 2016; Rietveld and Kiverstein 2014; Van Dijk and Rietveld 2017). With the second relatum (of abilities available in a form of life) in our definition of affordances we go beyond Chemero's (2003, 2009) original and influential relational definition and are able to clarify how an affordance-based account of skilled action can do justice to the "whole spectrum of social significance" in the human form of life (Gibson 1979, pp. 127–8). The human form of life encapsulates many different sociocultural practices, which in turn entail and include many different abilities (and tools) (Wittgenstein 1953; Varela 1999). This move, which we have argued for elsewhere (Rietveld and Kiverstein 2014; Kiverstein and Rietveld 2015; Rietveld and Brouwers 2016; Van Dijk and Rietveld 2017), broadens the notion of affordances and, crucially, opens it up to include affordances for activities that people would traditionally classify as forms of "higher" cognition. For example, the ability to make correct epistemic judgments is part of the human form of life. So a particular sociomaterial aspect of the environment, say the letters typed here, can afford—in the context of our form of life—not just reading, copying, or photographing them, but also making a correct explicit color judgment.

The Fundamentally Social Character of the SIF's Landscape of Affordances

According to our Wittgensteinian definition of affordances, affordances are relative to the abilities available in a form of life (Rietveld and Kiverstein 2014). Because abilities thrive in particular social situations embedded in a sociocultural practice, it follows from our definition that the human landscape of affordances is thoroughly social.[4] Novices also acquire their abilities in these situations in practice (Rietveld 2008a). Examples of forms of life within the overarching human form of life are builders, English language users, concert pianists, and academics. A human individual typically belongs to multiple partially overlapping forms of life. The notion of a form of life is central in the Wittgensteinian account of *situated normativity* that we have developed to do justice to the normative aspect of embodied/enactive cognition (Rietveld 2008a). Sociocultural practices (i.e., forms of life) provide a frame for understanding the normative aspect of embodied/enactive cognition in a way that individual action or dyadic moments of social interactions fail to do (Rietveld 2008a). In other words, the forms of life provide the right level of analysis for understanding Wittgensteinian normativity and, as we saw above, affordances.

Situated normativity is crucial for understanding skilled "higher" cognition (e.g., of an architect correcting the design of a door) both in its linguistic and nonlinguistic forms (Klaassen, Rietveld, and Topal 2010; Kiverstein and Rietveld 2015; Rietveld and Kiverstein 2014).[5] This normative aspect of such skillful action is about distinguishing between correct and incorrect or better and worse in the context of a particular situation in a form of life. By placing Wittgenstein's notion of a form of life at the heart of SIF's definition of affordances, we give skilled intentionality the normativity that is necessary for dealing with the whole spectrum of human social significance. Given the abilities available in our sociocultural practice, it is, for example, possible to state correctly that, independently of a particular individual's actual perception of it, but not independently of the form of life (i.e., our practice), the color of the letters on my computer screen is black. Or, to give an example that involves another sociocultural practice, it is possible to judge correctly that the word "black" in this context affords being translated into Dutch by using the word "zwart."

Recent work in embodied and enactive cognition has been right to emphasize the importance of social interactions and that social cognition fundamentally encompasses the bodily and affective aspects of these social interactions (e.g., Schilbach et al. 2013). Although social interactions are extremely important for understanding both our everyday life and possible disorders of it, it is key to take into account that they take place within a broader context. Crucially, it is not just the *moment* of interaction that is social, but, rather, our *whole landscape* of available affordances reflects the abilities that originate in our sociocultural practices (Rietveld, de Haan, and Denys 2013). This foundational character of the social follows from our definition of affordances as relations between aspects of the (sociomaterial) environment and abilities available in *a form of life, in a practice*.

On "Higher" Cognition: The Landscape of Affordances Includes Affordances for "Higher" Cognition

As has been noted rightly by Alva Noë (2012) in his criticism of Hubert Dreyfus's work, we should avoid "over-intellectualizing the intellect." In recent ethnographic work, we (Rietveld and Brouwers 2016) have shown how in architectural design, which is a typical form of "higher" cognition, architects tend toward a grip on affordances in their situation. The following fragment from that paper shows how this tendency dissolves the distinction between "lower" and "higher" cognition by making engagement with multiple affordances central to the way architects do, for example, problem-solving and long-term planning:

> Continuously adjusting their creations [in the design process] the architects seek insight into how they can advance the architectural art installation. They particularly do so through switching between different ways of visualizing the design, thus keeping the design "moving," as they, repeatedly discontent with a new result, over and over again evaluate the different ways in which the design could be made. . . . After spending several days optimizing the sculpture's rear wheel, AM and RR still experience discontent with its design and continue their search. They study the sketched design-possibilities for some moments before RR decides that he has to see the design in 3D: "I cannot see it well in this way, I want to see it in 3D." . . . They immediately switch from the design as visualized on paper to the design as visualized in 3D in the CAD computer program. . . . The process resembles a kind of situation-specific improvisation in which they "join forces" (Ingold 2013) with the available affordances. They experiment by actively manipulating aspects of the design, thus finding out what the design affords (cf. Charbonneau, 2013, p. 592) and which of these possibilities they *experience* as improvements of the overall design. In this manner they explore various adjustments. In the episode we highlight here RR is also unhappy with the 3D visualization as drawn in the CAD program. He concludes that it doesn't look good and that, in order to get insight into how this detail should be designed, they again need to visualize it differently—this time as a cardboard model. In such practices of switching between various visualizing forms the design evolves and takes shape. The architects move toward an optimal grip on their design. (Rietveld and Brouwers 2016, pp. 12–13)

Affordances in that real-life case include, for example, possibilities for making a sketch, making a 3D visualization, making an architectural model in cardboard, possibilities for reflection,[6] and elsewhere in that paper even possibilities for communicating with a physically distant collaborator (Rietveld and Brouwers 2016). This kind of ethnographic work situated in real-life practices fits in well with our Gibsonian and Wittgensteinian approach. It is also important because, as explained in the introduction, it is often assumed that the increasingly influential paradigm of embodied/enactive cognitive science (Chemero 2009; Thompson 2007; Varela, Thompson, and Rosch 1991) has sensible things to say about so-called "lower" cognition, such as grasping a glass or riding a bike, but not about "higher" cognition, such as using creative imagination, comforting a sad friend, or seeking the right word in writing a sentence. (We have made a first attempt to show how our approach can deal with these latter two linguistic cases in Klaassen, Rietveld, and Topal 2010.) Similarly, it is assumed that embodied/enactive cognition can deal only with the immediately present environment but not with the absent or the abstract, such as a plan for a new building or the concerns of an absent (or better: spatially distant) collaborator (Rietveld and Brouwers 2016; Clark and Toribio 1994; Clark 1999; Noë 2012; Degenaar and Myin 2014; Di Paolo, De Jaegher, and Rohde 2010; Van Dijk and Withagen 2016). In our skilled intentionality framework these problematic divides between "higher" and "lower" cognition dissolve, because we are able to understand human "higher" cognition along the same lines as skilled "lower" cognition: both are seen as forms of *skilled engagement with multiple affordances offered by the sociomaterial environment in the context of the human ecological niche*.

Our improved definition of affordances made this move possible. It follows from our definition of affordances that a given aspect of the sociomaterial environment can offer a broad range of affordances, dependent on the abilities available in the form of life. These abilities include linguistic abilities, such as, for example, the ability to point out things about the world with words, to orient someone's attention to an aspect of the environment, and to use words for naming things (in the context of a form of life). The ability to state things is very important because you can do all sorts of things with it in all sorts of practices. However, the abilities in our form of life are obviously far more diverse than just linguistic abilities. The following example of a towel in a bathroom (cf. Wittgenstein 1969, pp. 510–11) makes this centrality of the whole spectrum of abilities clear, by showing how in the context of our form of life this aspect of the sociomaterial environment (i.e., the towel) offers multiple possibilities for action, such as:

(a) hanging it on a hook;
(b) getting perceptual access to aspects of the towel;
(c) grasping and taking hold of the towel;
(d) stating correctly, "that is a towel";
(e) drying my hands;
(f) judging correctly, "that the towel is gray";
(g) reflecting on sustainability of the material of which it is made, and many more.

So, in the context of our human form of life, just this one aspect of the sociomaterial environment offers many affordances. All affordances together contribute to the richness of *the landscape of affordances* of the human form of life in which individuals are situated (see the left part of Figure 3.1). However, with this towel example it is crucial to keep in mind that people typically act in the context of a sociomaterial practice. While engaged in a sociomaterial practice it is the landscape of affordances that forms the context of an agent's actions.

In our framework it is abilities acquired in such a form of life that allow individuals to engage with affordances adequately, and, crucially, this includes affordances for what others have called "higher" cognition. The possession of a skill allows an individual to coordinate actions with the sociomaterial practice in which the skill was acquired; to join forces with its affordances. Engaging with different affordances will require different abilities.

From the perspective of SIF, the possibility to perceive something is also afforded by an aspect of the sociomaterial environment. Gaining perceptual access to the world is a skilled activity (Noë 2012). Perceiving something[7] is just one of the many things we can do skillfully. Where Noë has argued that we use skills to get access to the world, our ethnographic observations suggest that skilled individuals tend toward an optimal grip on the landscape of affordances available in a form of life (Rietveld and Brouwers 2016). From a (complementary) phenomenological perspective, this is best characterized as tending toward a grip on a field of solicitations. Note that such an understanding radically undermines any separation between perception and action and makes responsiveness to (or coordination with) affordances a more basic notion than perception. The phenomenon that we characterize as "responsiveness to an affordance for perceptual access to an aspect of the environment" offers an affordance-based way of talking about perception. This is useful for certain purposes, because in many situations states of action readiness related to affordances for perceptual access compete at a bodily level with states of action readiness related to affordances for doing other things. In our framework, perception is really just one of the many things people do, as in the towel example earlier where the possibility of drying one's hands is on equal footing with the possibility of getting perceptual access to aspects of the towel.

Moreover, SIF shifts the focus away from sensorimotor skills (which dominate embodied/enactive cognitive science at the moment) to *all skills* available in the human form of life. Once we possess the necessary skills, we can take hold of affordances for "higher" cognition, such as reflecting, judging, or naming something, in a similar way as we take hold of affordances for very mundane activities, such as drying our hands:

> If I say "Of course I know that that's a towel" I am making an utterance. . . . For me it is an immediate utterance. . . . It is just like directly *taking hold* of something, as I take hold of my towel without having doubts. And yet this direct taking-hold corresponds to a sureness, not to a knowing. But don't I take hold of a thing's name like that, too? (Wittgenstein, 1969, pp. 510–511, our italics)

Unlike the work of Dreyfus (2002b) and Hutto and Myin (2012, see Kiverstein and Rietveld 2015), the reach of skilled intentionality is not limited to nonlinguistic activities. A skilled speaker of language can just as easily engage with the affordance for stating correctly, "That is a towel" as with the affordance for drying her hands offered by the towel. SIF broadens the scope of human abilities beyond (nonlinguistic) sensorimotor skills.

Skilled intentionality is skilled responsiveness to the *rich* landscape of affordances. This landscape in which we situate the embodied mind includes, for example, possibilities for social interaction in practice (affordances related to the abilities of architects, conductors of orchestras, and psychiatrists, for instance), and possibilities for language use, as well as affordances for making correct explicit epistemic judgments (Rietveld and Kiverstein 2014). An important part of the SIF research program for the coming years is observing, describing, analyzing, and understanding these different affordances for forms of "higher" cognition in the context of different real-life sociocultural practices.

A Situated Individual's Selective Openness and Responsiveness to Relevant Affordances

The immense variety of affordances available in the landscape of affordances of a form of life raises the question how, in a given situation, an individual can be selectively open to this landscape. How and why is an individual selectively responsive to only the *relevant* affordances out of all these available possibilities for action? And how do affordances solicit a particular course of action in a given situation? We distinguish *affordances* from *solicitations* (Rietveld and Kiverstein 2014; Rietveld 2008a). Solicitations (Dreyfus and Kelly 2007) are the affordances that show up as relevant to a situated individual, and generate bodily states of action readiness. As argued earlier, affordances should be understood as flowing from the form of life as a whole rather than being merely an individual matter. The right level of analysis for affordances is the form of life, and for solicitations it is an individual in a concrete situation.

Our focus in this section will be on how relevance arises for the situated individual. We will first show how for living beings relevance originates from the tendency toward a relative equilibrium in the individual–environment system. Being an inviting or relevant possibility for action, a solicitation is the pre-reflective experiential equivalent of a bodily action readiness moving toward this optimum. With this operationalization, SIF calls attention to the close relation between skilled action and consciousness or lived experience (the invitational character of affordances). Next to "solicitation," this section will introduce two other phenomenological notions, which help the reader see why we understand skilled intentionality as coordination with multiple affordances simultaneously. While the landscape of affordances comprises the affordances available to a form of life, the *field of relevant affordances* reflects the multiplicity of inviting possibilities for action for an individual in a concrete situation. So the field of *relevant* affordances is a field of solicitations. From a phenomenological perspective, the situated individual's integrated responsiveness to multiple solicitations simultaneously can be characterized as a *tendency toward optimal grip* on a field of relevant affordances.

We will start by explaining the phenomenon of being drawn by one relevant affordance and then go on to discuss engagement with multiple relevant affordances.

Relevance and the Tendency Toward an Optimal Grip

Within the skilled intentionality framework we are careful not to presuppose goals, tasks, or aims of some mysterious origin as the source of relevance, but instead see the emergence of the soliciting character of affordances as the result of a process of self-organization. Merleau-Ponty's (1968/2003) philosophy of life helps us see that the environment always already solicits something to the active individual. Merleau-Ponty observes that, as complex biological systems, living organisms are always simultaneously "in a state of relative equilibrium and in a state of disequilibrium" (p. 149). Crucially, this inherent disequilibrium "inspires or motivates self-organized compensatory activity" (Merleau-Ponty 1968/2003, p. 149; Rietveld 2008c, ch. 7). This happens for example, when the organism repairs its tissue damage or restores its glucose level by eating (Rietveld 2008c; Kiverstein and Rietveld 2015). This inherent disequilibrium of the living animal (to the right in Figure 3.1) is the source of a lack that can never be compensated for and will always give rise to selective openness to the landscape of affordances and responsiveness to relevant affordances (middle of Figure 3.1) (Rietveld 2008a; Bruineberg and Rietveld 2014). Due to this lack, the material environment is always encountered as a world of value or significance, of affordances having affective allure. To use the words of enactive philosopher of emotions Giovanna Colombetti (2014), living beings have a "fundamental lack of indifference." Due to this source of primordial affectivity, all living beings are affective beings and there will always be a field of significant affordances soliciting the human being.

So, due to this inherent disequilibrium, this inevitable lack, humans and other living beings are concern-ful systems of possible actions and actually never manage to realize an optimal grip on their situation. They can only *tend toward* an optimal grip in the dynamic coupling of world and active body. (The need for the tendency toward an optimal grip will become clear later.) Our grip on the situation can only be a local optimum because our existence as a whole has "a problem," an absence, which is "not a lack of this or that" (Merleau-Ponty 1968/2003, pp. 155–6).

Solicitations are fundamentally related to the individual's need to re-establish this relative equilibrium.[8] We might say that a skilled individual can be "moved to improve" its situation by being responsive to solicitations (Rietveld 2008a). The inviting or soliciting character of affordances can be characterized phenomenologically by the idea that individuals are being "drawn" (Dreyfus and Kelly 2007) to affordances that they care about and are able to act on.[9] Such a description emphasizes the invitational or soliciting character of the environment. Merleau-Ponty describes this in the following example of the tendency toward an optimal grip:

> For each object, as for each picture in an art gallery, there is an optimal distance from which it *requires* to be seen. (Merleau-Ponty 1945/2002, p. 352, our italics)

Standing too close to a painting might make us, for example, lose grip of the overall composition, insofar as it impedes the "appearance" of the object. On the other hand, standing too far away may make the colors blend in such a way that we cannot grasp the texture of the brushstrokes.[10] Note the deliberate use of the word "grip," which brings a sense of actively maintaining oneself in relation to one's situation. In other words, there seems to be an optimum or equilibrium in the individual–environment relation that structures the individual's experience of (not) having grip. Accordingly, an individual's lived experience and the dynamically developing state of (dis)equilibrium of the living being can be seen as two sides of the same coin.

This notion of optimum can easily be misunderstood. We (Bruineberg and Rietveld 2014) have explained the tendency toward an optimal grip using empirical work from ecological dynamical systems theory, which will be described in the third section. One of these studies on boxing (Hristovski, Davids, and Araújo 2009) showed that in boxing there actually is an optimal distance from the heavy bag that is used in training. This optimum is a kind of relative equilibrium in the individual–environment relationship that allows the boxer to be ready to respond to multiple affordances simultaneously and rapidly switch from making one kind of punch (say a jab) to making another (a hook or an uppercut).[11] Our technical term for such an optimal position in which rapid switching is possible is the "metastable zone."

Metastability is a property of coupled dynamical systems in which over time the tendency to integrate and segregate coexist (Kelso 2012). Empirical work suggests that expert athletes make use of these metastable regimes to achieve functional performance outcomes (Seifert et al. 2014). Using these zones makes sense because there they are able best to join forces with the multiplicity of affordances (possible punches) that the situation affords. Crucially, we expect that the tendency toward an optimal grip can be formalized in terms of the tendency toward an "optimal metastable zone" (Bruineberg and Rietveld 2014) (see the third section). As will have become clear earlier, this optimal metastable zone can only be a relative equilibrium.

Earlier we also mentioned the link between affectivity and the inherent disequilibrium of living beings. The tendency toward optimal grip characterizes the internal relation between affectivity and adequate performance in a way that is well described in Dreyfus's work on skilled action:

> According to Merleau-Ponty, . . . absorbed, skillful coping . . . is experienced as a steady flow of skillful activity in response to one's sense of the situation. Part of that experience is a sense that when one's situation deviates from some *optimal* body-environment relationship, one's activity takes one closer to that optimum and thereby relieves the "tension" of the deviation. One does not need to know, nor can one normally express, what that optimum is. (Dreyfus 2002b, p. 378)

Disequilibrium, suboptimality, or a lack of adequate grip can be experienced as an affective tension that needs to be reduced (cf. Rietveld 2008a, 2008c). In an informative example, Wittgenstein (1978) describes this integrated engaged responsiveness and lived affective experience. A door is appreciated as too low in its current context by an expert architect. The dissatisfied architect immediately and skillfully joins forces with one of the affordances offered by this aspect of the material environment: with the solicitation to increase the height of the door. In working on improving the door, the architect expresses a basic form of normativity, in the sense that he distinguishes better from worse or correct from incorrect in the context of the particular situation. As mentioned earlier, we have called this normative aspect of being moved to improve in skilled action "situated normativity" (Rietveld 2008a). The architect's discontent—directed at the door in its context—and, related to that disequilibrium, the solicitation of the relevant affordance, shows how lived affective experience and context-sensitive performance are two sides of the same coin in skilled intentionality. Even without explicitly verbalizing a judgment or articulating any feelings, the architect's (facial/bodily) expression can show how he appreciates the situation. And, inversely, his action aimed at changing the design of the door is an expression of his discontent. Therefore affectivity is a central aspect of selective responsiveness to relevant affordances.[12] The notion of action readiness from emotion psychology can shed further light on this, as we will see in the next section.

Bodily Action Readiness Links Emotion and Ecological Psychology with Phenomenology

A core concept from the field of emotion psychology (Frijda 1986, 2007) is central in SIF: action readiness. The phenomenological observation that relevant affordances evoke or solicit bodily action readiness enables us to show how the perspectives of ecological psychology (Gibson 1979; Chemero 2009; Reed 1996; Heft 2001) and emotion psychology (Frijda 1986, 2007) converge: relevant affordances are bodily potentiating. The notion of action readiness was introduced by emotion psychologist Nico Frijda and identified as typical for a spectrum of emotions (Frijda 1986, 2007). States of action readiness characterize affective states in ways that reflect the strivings of organisms to modify their relation to the environment.

Action readiness is a bodily phenomenon in-between overt action and ability, a form of action preparation. States of action readiness can be observed, measured, and analyzed. Emotions, and states of action readiness, in particular, reflect a tendency of the individual to modify the relation between herself and the environment in a way that is in line with what matters to her. Relevant affordances move us, affect, and solicit us as they get us ready to act. Often they move us to improve our situation, as we have seen earlier. Affective tension and action readiness are two sides of the same coin. Affective tension is not necessarily felt phenomenologically.

For action control it is important that multiple states of action readiness can *self-organize* into a macrolevel pattern of preparation for action (Bruineberg and Rietveld 2014; Lewis and Todd 2005). It is this characteristic of states of action readiness that allows SIF to avoid presupposing goals of mysterious origin and make self-organization central instead. Frijda and colleagues write in this regard that "multiple states of action readiness may interact in generating action, by reinforcing or attenuating each other, thereby yielding . . . control" (Frijda, Ridderinkhof, and Rietveld 2014). Below we will show that due to this process of self-organization, multiple states of action readiness fuse in a way that is similar to mixed emotions like nostalgia (which, for example, might reflect both sadness and happiness).[13]

The tendency toward an optimal grip we pre-reflectively experience when a relevant affordance (i.e., a solicitation) shows up is related to the readiness of the affordance- related ability (Rietveld 2008a; Bruineberg and Rietveld 2014). Importantly, the notion of *relevant affordance-related states of action readiness* links the phenomenological level (pre-reflectively experienced solicitation) to the ecological level of analysis (relevant *affordance*-related action readiness). It makes explicit how the disequilibrium in the individual–environment relation makes a particular affordance stand out as soliciting and drives bodily action readiness (bottom right of Figure 3.1).

From Engagement with a Single Relevant Affordance to a Field of Multiple Relevant Affordances

With the exception of the boxing example, up until now, our discussion in this section has focused mostly on the soliciting character of one single affordance. However, skilled intentionality as we encounter it in our real-life practices implies responsiveness to *multiple* affordances *simultaneously*. The situated individual responds in an integrated way to what we call a *field of relevant affordances* (Rietveld 2012). This phenomenological notion describes how the affordances that a situated individual simultaneously responds to are related. When an expert boxer is training on a heavy bag, for example (Hristovski, Davids, and Araújo 2009), the field of relevant affordances reflects the integrated readiness for multiple kinds of punches (left or right jab, hook, and uppercut, for example), as well as drinking water. In a field of affordances we understand the various relevant affordances to provide the *context* for one another. Accordingly, the SIF provides a very simple, yet elegant understanding of situational context as the multiple relevant affordances that are in play and of context sensitivity as selective openness to a multiplicity of relevant affordances simultaneously. So in the SIF, context turns out to be "just more affordances" (Rietveld 2012).

A situated individual's field of relevant affordances should be distinguished from the landscape of affordances available in a form of life. The landscape of affordances is not dependent on the abilities of a particular individual, but on the abilities available in the form of life as a whole; in the entire ecological niche or sociocultural practice. This locates the landscape of affordances at the proper level of analysis for dealing with normativity, as mentioned earlier. Take, for example, the norms of spelling in a language: what today counts as a correct way to write a word is not dependent on any particular individual but on the community or practice as a whole. The landscape of affordances should thus be seen as independent of particular individuals.[14]

The structure of the situated individual's field of affordances is sketched in a very rudimentary and schematic way in Figure 3.2(left). The first dimension of this figure, namely the width of the field, reflects the amount of affordances the individual is simultaneously responsive to. The height of the columns (the second dimension) indicates the relevance or strength of attraction of the different solicitations. We say that these solicitations "stand out" as relevant (against the background of other affordances in the situation); they have affective allure (Rietveld 2008a). The last dimension, namely the depth of the field, reflects the anticipatory character of affordance responsiveness. This is the action preparation aspect of engagement with affordances. It regards one's readiness for what one can do next. For instance, while reading this chapter you might already experience pre- reflectively a sense of excited anticipation for tonight's dinner with your best friend. Observe, by way of contrast, Figure 3.2(right), which depicts the field of relevant affordances of a person suffering from depression. To this person every solicitation is equally unattractive. The scope of possibilities for action is diminished and at this moment it seems like there will be no improvement in the future. For example, the possibility of meeting up with a friend now or in the future is experienced as lacking affective allure. In other words, depression results in the deactivation of the soliciting field of relevant affordances that normally drives individuals toward an optimal grip on their situation (Rietveld, de Haan, and Denys 2013; de Haan et al. 2013; de Haan et al. 2015). On this basis it can be said that depression entails a breakdown of a key aspect of everyday skillful action.

The depth-dimension of the field of relevant affordances is crucial, because our current actions are often performed while reckoning with future possibilities for action that exist "on the horizon." For example, a study in ice climbing showed that the climbers anticipated not only the next step, but the entire route ahead (Seifert et al. 2014). Since action readiness is a situation-dependent bodily phenomenon in-between overt action and ability, it is a useful notion for understanding such action preparation or anticipation

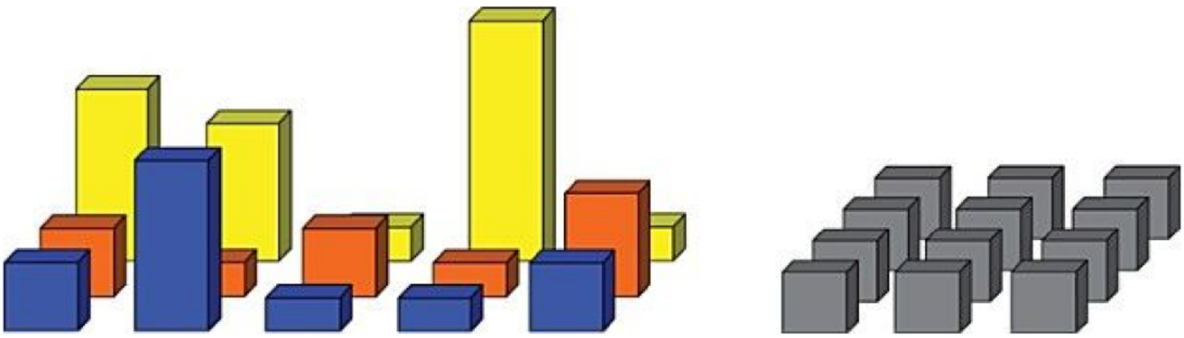

FIGURE 3.2. A sketch of the field of relevant affordances at a certain point in time for a normal person (left) and a depressed person (right). The height of the columns refers to the relevance or strength of attractiveness of the different solicitations. The width, depicted as the number of columns that are placed next to each other horizontally, reflects the scope of affordances the individual is engaging with. The depth of the field reflects the temporal dimension, namely, the anticipatory character of engagement with relevant affordances. In other words, one is not only ready for the affordances one is engaging with now, but also for possibilities for action one might engage with in the future (just as the skilled boxer who is performing a right jab now is already poised for performing a left hook and right uppercut next). It is a dynamic field: dynamics in the landscape of affordances (e.g., in the material environment) and dynamics of the instability on the side of the individual can both lead to a restructuring of the field.

Reproduced from S. de Haan, E. Rietveld, M. Stokhof, and D. Denys, The phenomenology of deep brain stimulation-induced changes in OCD: an enactive affordance-based model, *Frontiers in Human Neuroscience*, 7, e653, Figure 1 (a and b), doi:10.3389/fnhum.2013.00653 © 2013 de Haan, Rietveld, Stokhof and Denys. This work is licensed under the Creative Commons Attribution License (CC BY). It is attributed to the authors de Haan, Rietveld, Stokhof and Denys.

(Rietveld 2008a; Bruineberg and Rietveld 2014). Anticipation of the trajectory of affordances ahead is about developing a bodily readiness for what you can do next.

There is an interesting link with work on spatial experience in enactivism (Jelic 2016; Rietveld 2016; Rietveld et al. 2015; Bruineberg and Rietveld 2014). Like the heavy bag for a boxer with the relevant punching skills, places we are familiar with generate a multiplicity of states of action readiness simultaneously. In this way, arriving at a particular *place* or "behavior setting" (Barker 1968; Heft 2001), such as a party, swimming pool, climbing wall, or construction site, pre-structures our field of relevant affordances readiness. For example, at a swimming pool we are ready for encountering people in bathing suits, but not at a construction site. We speak of "place-affordances" because places are aspects of the sociomaterial environment that offer possibilities for action and can generate a multiplicity of states of action readiness. Accordingly, places can put constraints on the structure of our field of relevant affordances over a somewhat longer time scale (see the third section).

The field of relevant affordances is a highly dynamic structure. Relevant affordances move the individual, but are also "consumed" in the process of acting on them when the individual–environment relation is changed and other affordances come to stand out as relevant (Bruineberg and Rietveld 2014). An example of this would be a boxing situation in which the state of the material environment changes rapidly due to the fluctuating movements of the heavy bag. Every now and then the boxer switches unreflectively between affordances; from jab to hook to uppercut and back. Crucially, as in the ice-climbing example, these switches are not independent of each other: the individual is responsive to the entire field of relevant affordances (Rietveld 2012). At a dance party, for example, I might quickly finish the conversation when I hear the first notes of a popular song, but I would refrain from dancing if my friend were to say, for example, that "something terrible happened." In the field of relevant affordances, the possibility of asking what happened shapes the context of the possibility to dance (Klaassen, Rietveld, and Topal 2010). To put it more generally, what is at the foreground and what is at the background shifts continuously (Rietveld, de Haan, and Denys 2013). This means that the field of relevant affordances depicted in Figure 3.2 represents a snapshot of the continuously changing field of relevant affordances.

The field of relevant affordances is a *dynamical* phenomenon, as mentioned earlier. Changes in this field of solicitations can originate in the individual and her actions, but also in the sociomaterial environment. Change often results from the individual's current concerns (i.e., needs, interests, and preferences), which are related to its field of solicitations. These current concerns in turn depend on the individual's inherent disequilibrium in the situation. For example, drinking another beer makes the possibility of going to the toilet more urgent.

A change in the landscape might also change the field of relevant affordances by putting constraints on what is possible and appropriate. An example of this would be the way in which the optimal metastable zone (of distance) for conversation with a friend at a party changes when the noise level in the room increases. When the volume of the music is turned up, I need to speak louder, but at a certain music volume I cannot make myself heard and it is appropriate to stand closer to my friend. So in this case, a change in the environment changed the fields of relevant affordances of both myself and my friend. It changed what is appropriate and what counts as optimal grip.

This example illustrates again how we are skillfully attuned to the context, that is, to the available affordances.

In sum, at the level of the situated individual, skilled intentionality is characterized as an integrated response to the field of relevant affordances *as a whole*. Using ethnographic research methods, we investigated this phenomenon in a complex architectural design practice (Rietveld and Brouwers 2016). When tending toward an optimal grip on this integrated field of solicitations, the individual can improve the situation in line with what matters to him or her.

Tendency toward an Optimal Grip as Reduction of Disequilibrium in a Brain–Body–Environment System and the Friston Connection

In the previous section it was shown that the situated individual's field of relevant affordances is continuously restructured. Changes of the field of relevant affordances result from (a) the agent's actions that modify the environment, (b) from the agent-independent dynamics of the situated individual's physical environment, which is in flux (Ingold 2000, 2013), but follow also from (c) an ongoing dynamic within the individual's body and brain (e.g., Freeman 2000; Merleau-Ponty 1968/2003). In recent years, changes in body and brain gained a lot of attention in research on what is called "the anticipating brain" (see, e.g., Friston 2010, 2011; Allen and Friston, 2016; Allen and Gallagher 2016; Kiebel, Daunizeau, and Friston 2008; Cisek 2007; Cisek and Kalaska 2010; Pezzulo and Cisek 2016). These popular ideas in neurodynamics are contextualized in the SIF by connecting them to relevant findings from the fields of ecological psychology and phenomenology via the notion of states of action readiness (which we discussed in the previous sections) and by drawing on principles of the study of complex and dynamical systems (Bruineberg and Rietveld 2014; Kelso 2012; Friston 2011; Tschacher and Haken 2007).

Reduction of Disequilibrium as the Individual's Most Basic Concern

In the SIF the tendency toward an optimal grip on a field of relevant affordances is connected to the reduction of disequilibrium in the dynamical system "brain–body–landscape of affordances" (depicted schematically in Figure 3.3). The skilled individual is situated at a specific location in the landscape of affordances (say at a party or a swimming pool) and is selectively open and responsive to solicitations that reduce its state of *dis-equilibrium*. In a more technical paper (Bruineberg and Rietveld 2014), we characterized the reduction of disequilibrium within the brain–body–environment system as reduction of *dis-attunement* between the two dynamics depicted in Figure 3.3, namely, the internal dynamics (of multiple interacting and self-organizing affordance-related states of action readiness of the individual) and the external dynamics (of the dynamically changing landscape of affordances) (cf. Dotov 2014; Kirchhoff 2015;

Malafouris 2014).

Doing so, we incorporated the work of Karl Friston on the so-called "free energy principle" (FEP) (Friston 2010, 2011) into the SIF.[15] Friston takes an important philosophical stance when he calls his FEP enactive. The SIF takes this very seriously by developing and integrating an ecological-enactive interpretation of FEP. On our (Bruineberg and Rietveld 2014; Bruineberg, Kiverstein, and Rietveld 2016) interpretation, Friston's free energy principle applied to living organisms is about improving the individual's grip on

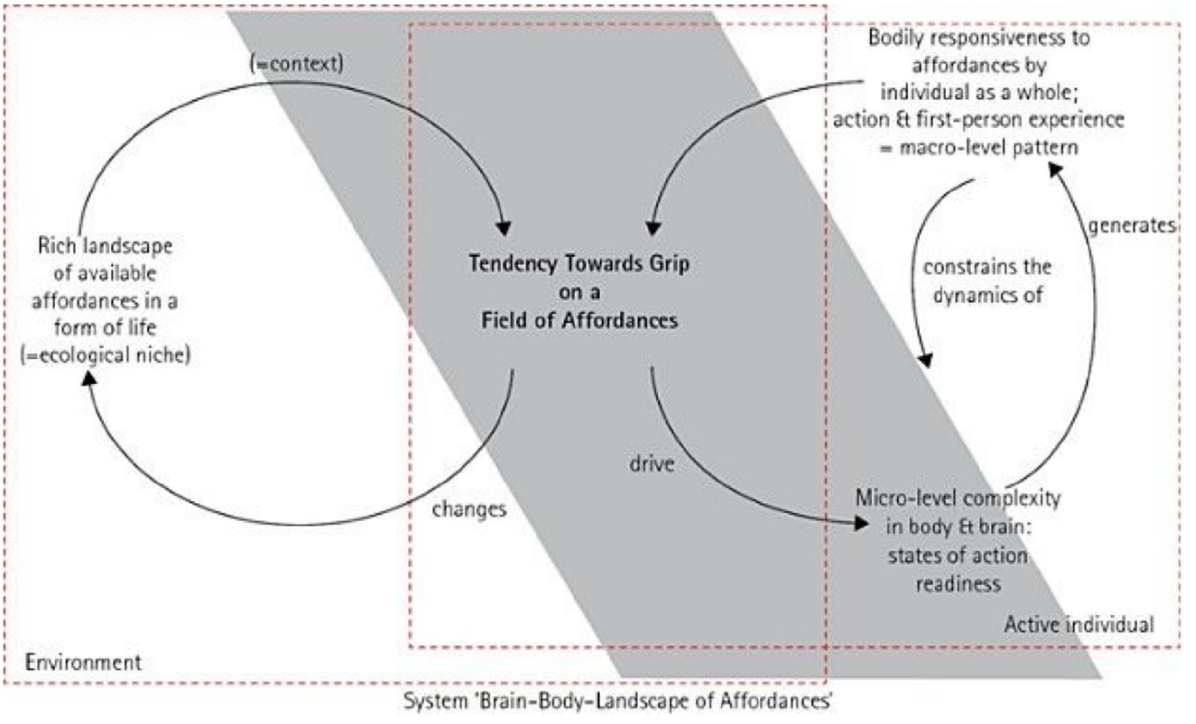

FIGURE 3.3. Sketch of the skilled intentionality framework.

Reproduced from J. Bruineberg and E. Rietveld, Self-organization, free energy minimization, and optimal grip on a field of affordances, *Frontiers in Human Neuroscience*, 8, e599, doi:10.3389/fnhum.2014.00599 © 2014 Bruineberg and Rietveld. This work is licensed under the Creative Commons Attribution License (CC BY). It is attributed to the authors Bruineberg and Rietveld.

the environment.[16] Crucially, Friston argues that you can predict the structure of the embodied brain from the structure of the environment (Friston 2011, 2013; Bruineberg, Kiverstein, and Rietveld, 2016).[17] It is precisely due to the fact that the structure of the individual's body reflects the structure of the ecological niche of the individual that she can stay attuned to it by being selectively open to affordances.

This fits in with the way in which the SIF explains how the field of solicitations and the individual coevolve during skilled action (and over a very long time scale during skill acquisition). According to the SIF, the multiple simultaneous states of action readiness that are generated are related to relevant affordances of the specific place and practice in which the individual is situated (see second section). Therefore, the SIF highlights the relevance of investigating the region of the landscape of affordances in which the individual is involved (e.g., by analyzing involvement in the sociomaterial practice over longer periods of time, see Rietveld and Brouwers 2016) and the structure of the resulting field of solicitations (including relevant place-affordances) to learn something about the activity of the brain and body, and vice versa (Bruineberg and Rietveld 2014).

In line with the discussion of the tendency toward an optimal grip in the second section earlier, reduction of disequilibrium within the system brain–body–landscape of affordances is seen in our SIF approach as a basic and continuous concern that drives the individual's selective openness to relevant affordances. This can, for instance, be observed in the improvement of energy levels by eating or by sleeping, but also in more complex improvements of a person's situation in the context of sociocultural practices, such as a discontented architect reducing a disequilibrium by improving the design of a door (in its context). Making the door higher reduces the architect's discontent and the disequilibrium of the situation. Continuously, the individual's readinesses of skills and her behavior are geared toward a re-establishment of relative equilibrium (Rietveld 2008a, 2008c; Bruineberg and Rietveld 2014). By generating responsiveness to solicitations, which are the (pre-reflective) experience of states of action readiness for resolving a suboptimality or disequilibrium in the individual–environment relation, this basic concern for reduction of disequilibrium moves the skilled individual to improve his or her situation.

Although disequilibrium is continuously reduced by an individual's skilled intentionality, complete stability will never follow as long as the organism is living (Merleau-Ponty 1968/2003). We have stated in the second section that this is why we talk about a *tendency* toward an optimal grip. Any movement toward optimal grip on the situation can only bring relative equilibrium, but will not lead to a fully stable state of the system individual–environment. Crucially, it is in virtue of this intrinsic instability or disequilibrium that affordances get their relevance, multiple states of action readiness are generated, and an organism can respond flexibly to the environment and maintain its structural organization.

Interacting States of Action Readiness

Skilled intentionality, understood as the tendency toward optimal grip on a field of relevant affordances, typically describes the change of an individual's situation as responsiveness to multiple solicitations simultaneously (see the second section). Earlier we mentioned that multiple affordance-related states of action readiness interact to generate a coordinated engagement with multiple affordances simultaneously, which makes it possible to understand integration of different states of action readiness (Frijda, Ridderinkhof, and Rietveld 2014) as well as the capacity to switch rapidly from doing one thing to doing another (Hristovski et al. 2009; Rietveld 2012, 2008b, 2008c). In a sense, the SIF generalizes some of the insights gained in the fields of emotion psychology and ecological dynamical systems theory. Research on self-organization and so-called coupled pattern generators, which produce rhythmic patterns in robot locomotion (see Beer and Chiel 1993), provides a paradigm for understanding this interaction or coordination of states of action readiness (Bruineberg and Rietveld 2014). When a pattern generator oscillates at a particular frequency, it can influence the frequency of other coupled pattern generators. Crucially, slower dynamics on longer time scales enslave or entrain the faster oscillations (cf. Dotov 2014). This mechanism of enslavement is also hypothesized to be the mechanism that leads neuronal populations to synchronize transiently (Freeman 2000; Varela et al. 2001; Friston 1997; Bruineberg and Rietveld 2014). This fits with what we know from complex systems theory that describes how macrolevel patterns typically constrain the movements of the microlevel parts, while at the same time being generated by these parts (Tschacher and Haken 2007). We observe that these principles of self-organization hold for states of action readiness as well (Bruineberg and Rietveld 2014; Kiebel, Daunizeau, and Friston 2008), which can be seen at different levels of organization in brain and body and are central in the SIF. In the right part of Figure 3.3 we depicted how coordination of multiple microlevel patterns of action readiness generates a macrolevel pattern of action readiness which constrains the dynamics of these microlevel patterns. In this way, self- organization of multiple affordance-related states of action readiness generates a macrolevel pattern of selective openness by the individual to the field of solicitations as a whole. Continuously, the individual's readiness of skills and her behavior are geared toward a re-establishment of equilibrium in the system brain–body–landscape of affordances.

Dotov (2014) suggests what this might mean for understanding neural activity: brain activity at the microscopic level (e.g., neural activity evoked by the detection of a relevant affordance) contributes to behavior but these (microscopic) neural dynamics can perhaps best be understood as enslaved (Dotov 2014; Kelso 2012; Tschacher and Haken 2007) by the slower (macroscopic) dynamics of the larger dynamical system, that is, of what we call the system "individual-landscape of affordances." More research is needed to understand better how microscopic neural activity of certain brain areas is enslaved by the dynamics of the brain as a whole, which is in turn constrained by the dynamics of the macroscopic system "individual-landscape of affordances." This kind of research will benefit from keeping in mind that the brain is not only embedded in a body but also situated in a place (Heft 2001; Rietveld and Kiverstein 2014).

The relation between affordances and bodily (including neural) action preparation connects to our discussion on place-affordances and anticipation in the previous section. Behavior settings such as libraries, walls for ice climbing, and restaurants have a certain stability over a somewhat longer and slower time scale. We might say that place-affordances (e.g., the aspect of the sociomaterial environment that we call a library) generate patterns of action readiness over a longer time scale that can enslave or entrain faster affordance-related states of action readiness. As such, a place-affordance pre-structures which states of action readiness can be adopted, contributing to the situated individual's tendency toward an optimal grip on the situation embedded in the broader practice. In other words, this is a form of affordance responsiveness that unfolds over a somewhat longer time scale. States of action readiness related to place-affordances are high up in the hierarchical—or, better, nested—cascade of constraining states of action readiness. Similarly, anticipation of affordances on the horizon of the field of solicitations can influence our current affordance responsiveness (Van Dijk and Rietveld 2017). The action possibility to have dinner with one's best friend tonight can, for example, increase one's focus on the most relevant affordances so that one will finish working in time.

In the previous section, we explained that it is when we are well attuned to the dynamically changing landscape of affordances that we have the possibility to switch rapidly from doing one thing to doing another (Rietveld 2012). Being able to flexibly switch activities is described by the phenomenon of *hypergrip* on a field of relevant affordances (Bruineberg and Rietveld 2014). This notion of hypergrip is another expression for being in a (relatively) optimal metastable zone. We encountered a possible example of this earlier: for a skilled boxer, the zone of optimal metastable distance might solicit moving forward, because in this zone he or she is simultaneously ready for multiple relevant action opportunities and for flexibly switching between them in line with environmental fluctuations, like the sometimes very fast movements of a boxing bag (for another real-life example see Rietveld and Brouwers 2016). This phenomenon of tending toward an optimal metastable zone is potentially so important that it is worth taking a second look at the empirical study on optimal movement pattern variability in boxing (Hristovski, Davids, and Araújo 2009). At a critical distance of 0.6 (the distance to the punching bag scaled by arm length), boxers "could flexibly switch between any of the boxing action modes" (Chow et al. 2011; Hristovski, Davids, and Araújo 2009). At this distance the boxing bag "invited" (cf. Withagen et al. 2012, 2017) a wider variety of punches (left and right uppercuts, hooks, and jabs) than it did at other distances.

This boxing study and ethnographic observations of expertise in the practice of architecture indicate that we can describe optimal grip on a field of relevant affordances at a different level of analysis as optimal *metastable* attunement to the field of affordances (Bruineberg and Rietveld 2014; Rietveld and Brouwers 2016). Metastable attunement is a technical term for the ease with which a system can switch to another state (Kelso 2012; Bruineberg and Rietveld 2014) and the study of it in the brain–body–environment system as a whole provides a paradigm for understanding hypergrip. In the relative equilibrium of an optimal metastable zone, a self-organizing system as the "brain–body–landscape of affordances" can adopt a great number of states with only the slightest change (perturbation) in the environment (e.g., a random movement of the boxing bag) or the individual's internal state (the individual is also in motion; think, for example, of the many interacting patterns of bodily action readiness). Note that the affordances the individual has a readiness for are not endless, but limited to the relevant affordances given the agent's abilities and state of disequilibrium. A small disruption such as a random movement of the heavy bag can drive the system to settle on a new form of organization, which impacts the individual's phenomenology. The solicitation and related action readiness that gave rise to the movement are "consumed" in the process, making other solicitations stand out next (Bruineberg and Rietveld 2014). A new macrolevel pattern of selective openness to the landscape of affordances arises (right dynamic in Figure 3.3). As such, hypergrip on a field of relevant affordances is functional with respect to both the demands of the environment and the basic concern of the organism of tending toward an optimal grip on affordances in the situation.

Conclusion

The landscape of affordances in the human form of life is very rich and forms the context in which we should situate ecological-enactive cognition. In this chapter we have made skills for engaging with these affordances central to dissolve the distinction between "lower" and "higher" cognition. The long-term ambition of the Amsterdam SIF research program is to explore if the whole spectrum of things people do skillfully, including social interaction, language use, and other forms of "higher" cognition, can be understood in terms of skilled intentionality, which is the selective engagement with multiple affordances simultaneously. Both poles of our new Wittgensteinian interpretation of Gibson's (1979) notion of affordances (Rietveld and Kiverstein 2014; Chemero 2009), as relations between (a) aspects of the sociomaterial environment in flux and (b) abilities available in a "form of life" (Wittgenstein 1953), manifest an enormous variety. It is this definition that allows us to see the human ecological niche as a rich and resourceful landscape of affordances (Rietveld and Kiverstein 2014). The definition of affordances also makes it possible to deal with situated normativity because, just like Wittgensteinian normativity, affordances are always to be understood as related to a particular form of life. This practice-based normativity (Rietveld 2008a) is crucial for dealing with certain kinds of higher cognition, for example, the possibility of making correct epistemic judgments. In the human form of life the social dimension is implicated in a fundamental way as shaping and sustaining this landscape of affordances. The SIF approach shows that abilities are embedded in and acquired through participation in a sociocultural practice (Rietveld 2008a; Rietveld and Kiverstein 2014). The other relatum of an affordance, the environment, is also defined as sociomaterial from the start (Rietveld and Brouwers 2016; Van Dijk and Rietveld 2017). Moreover, the SIF approach distinguishes itself from more purely philosophical work in embodied/enactive cognition (e.g., Noë 2012) in that it is able to link complementary findings established in different scientific disciplines in one integrative conceptual framework. The SIF integrates the neurodynamic, the ecological/contextual, the affective, and the personal/phenomenological levels of analysis by showing how these perspectives on cognition describe different aspects of one self-organizing system that includes both the individual and its sociomaterial environment: the self-organizing system "brain–body–landscape of affordances." Re-establishment of equilibrium through reduction of dis-attunement between the internal dynamics (a hierarchy of interacting states of action readiness at multiple time scales, or, in other words, a nested cascade of constraining states of action readiness) and external dynamics (the dynamically changing landscape of affordances) is the individual's primary and ongoing concern. This primary and ongoing concern can phenomenologically be described as a tendency toward an optimal grip on the various relevant affordances encountered in a particular situation. In this process of skilled responsiveness to affordances, the sociomaterial environment is typically transformed as well. Moving toward an optimal grip on the field of solicitations implies reducing tension or discontent by engaging one's skills to join forces with multiple relevant affordances.

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[1] The words “action” and “skill” should be understood in a very broad sense in this chapter. For example, just like Alva Noë (2012) we even see perception as something we do, and can do more or less skillfully.

[2] Our synonym for the field of relevant affordances is the field of solicitations. Thanks to Shaun Gallagher for urging us to make this explicit.

[3] Here we have to be very concise so we refer readers interested in the work that the notion of a form of life does to another paper in which we explained this relation between the form of life and affordances as Gibson conceived of them (Rietveld and Kiverstein 2014; see also the discussion of Wittgensteinian “blind rule-following” in Rietveld 2008a).

[4] This has important consequences for the field of social-cognitive neuroscience (Schilbach et al. 2013) and thinking about the socially extended mind (Krueger 2013) that we do not have space to go into here.

[5] Separating the linguistic from the nonlinguistic might actually turn out to be artificial given the earlier-mentioned intertwinement of the social and the material in human practices, i.e., the sociomaterial nature of our environment.

[6] Reflecting is just one of the abilities available in our human form of life. See Section 4 of Rietveld (2013) for a short discussion of different kinds of possibilities for reflection.

[7] Also for Gibson things afford multiple activities including perceiving what they really are after one has acquired the right skills: “If the affordances of a thing are perceived correctly, we say that it looks like what it *is*. But we must, of course, *learn* to see what things really are—for example, that the innocent-looking leaf is really a nettle or that the helpful-sounding politician is really a demagogue. And this can be very difficult” (Gibson 1979, p. 142; see Rietveld and Kiverstein 2014).

[8] “The stability of the organism is a stability endlessly reconquered and compromised” (Merleau-Ponty 1968/2003, p. 150).

[9] For an affordance to stand out as relevant, the individual also has to possess the necessary ability or skill (see the first section). So not only what one cares about but also what one *can do* in the context of a practice is reflected by a solicitation (Rietveld 2008b; Merleau-Ponty 1945/2002). With the exception of some very basic innate abilities, these skills are acquired in sociocultural practice in our human case. What one is able to do also develops dynamically during the course of a day: when one is very tired one may not be able to pick up an available affordance.

[10] Note that both relevant affordances and grip vary with respect to the skills of the individual (an art historian will look in a different way than a child) as well as with the current concerns of the individual.

[11] Switching has been understood by Wheeler (2008) as intra-context sensitivity to relevance, which he explained dynamically. He distinguishes it from outer-context sensitivity to relevance. In earlier work we criticized this distinction by Wheeler and showed that in reality relevance sensitivity is actually related to the field of relevant affordances as a whole (Rietveld 2012).

[12] Note it is possible that it turns out, for example, that an important governmental regulation blocks the architect’s plan. In that case the architect will typically experience discontent again and see other action possibilities that would allow him to deal with the situation.

[13] “Simultaneous [states of action readiness] can be expected to interact. They in fact have to interact, since they have to share output channels: action provisions, attention resources, logistic support resources, and so forth. The interactions are required for coordinating the

multiple emotions' calls for action. Such coordinations lead to motive states, actions, and feelings that differ from those that would have become manifest when each emerged in isolation. Together, they result in mixed emotions or mixed feelings. . . . True mixed feelings are observed in nostalgia, consisting of pain moderated by the happiness that was, together with pleasure moderated by the regret that it had gone. . . . But what happens when multiple kinds of action readiness [interact depends] upon their relative strengths" (Frijda, Ridderinkhof, and Rietveld 2014, p. 5).

[14] Or, more precisely, relatively independent, because an individual is herself also part of the sociomaterial environment and her activities contribute over time to maintaining the patterned practice of the form of life (see Van Dijk and Rietveld 2017).

[15] Although Friston's language might sound too cognitivist to some to be united with enactive/embodied cognition, we have shown that it is possible to give a more charitable ecological and enactive/embodied interpretation of his work (Bruineberg and Rietveld 2014; Bruineberg, Kiverstein, and Rietveld 2016; Allen and Friston 2016). It is good to keep in mind that together with Walter Freeman (e.g., 2000), Karl Friston (e.g., 1997) is one of the world's main pioneers of neurodynamics and the metastable brain (see Rietveld 2008b for how this links up with Varela's and Kelso's ideas).

[16] From this perspective, free energy can be seen a measure of the individual's grip in terms of attunement of internal and external dynamics.

[17] By means of example, think of the way the skills, muscular body, and style of movement of a dancer reflect the practice she participates in. Similarly, the brain has become adapted to this niche over time.

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mentioned? I will suggest in what follows that, as is often the case, a mysterious, yet beautiful, formulation invites a deeper truth. In the context of embodied perspectives on cognitive phenomena, this truth has been the concern of enactivist researchers. For them it has become clear that to ask questions about how the mind works is at the same time to ask questions about what is it about certain entities that they can be minds at all, and how can such entities emerge in a natural world. These two questions, which might be divorced in other areas of inquiry, are for the enactive perspective one single question with different facets. Hence the insistence on the part of some enactive thinkers on the need to understand life and mind as part of a continuity.

Differently put, I am talking about the difficult question: what is a body? This question, not always put in these explicit terms, is the platform on which enactive theory[1] is raised. It is, in my opinion, what differentiates the enactive approach from all other so-called embodied approaches: the thematization of bodies as a prerequisite for understanding *anything* about minds.[2] This is not a line of theorizing that emerges from scratch with the enactive approach (Varela et al. 1991; Thompson 2007), even though it saw one of its clearest formulations in Francisco Varela's later work (e.g., Varela 1997, 2000). The idea has roots in the earlier theory of autopoiesis (Maturana and Varela 1980), an attempt to give a systematic, generative, logical answer to the question: what is a living system? It also traces back to other notable precursors, as I will mention later.

If we take the project-of-the-world image at face value, then, albeit voided of any teleological implications, we get a hint of the kind of inquiry we are trying to circumscribe; ultimately one that offers important conceptual categories for any theorizing about cognitive phenomena. To ask about the meaning of this image, to ask how a medium projects itself into a subjects and objects, is to ask about the material conditions out of which pre-individual processes result in the individuation of living organisms, and the concomitant emergence of *their* world. It is also to demonstrate the intimate relation between these two moments, subject and world, as they co-emerge dialectically out of the same tensions found in pregnant materiality (see, e.g., Grosz 2011). It is also to ask in what ways these conditions relate to forms of psychic and collective individuation. Finally, it is to ask whether these material conditions provide only a background of enabling factors, which can then be assumed invariant across different instances of cognition, and therefore "safely ignored" for specific research projects, or whether, on the contrary, these conditions permeate all cognitive and social phenomena and make their understanding inescapable for any scientific project concerning the mind, no matter how specific.

Life and Mind Continuity

The enactive insistence on the continuity between life and mind has often been met *image not available*

assumed to be stationary. Alternatively, even if during a period of construction the cognitive system does not verify the assumption of stationarity, this could be assumed to be a well-delimited period of transient transformations outside the remit of cognitive science, after which, the cognitive system can be safely be treated as stationary.

Why is stationarity at odds with an account of individuation? There is, first, an empirical answer, namely that such seems to be the nature of all known forms of cognitive systems: they grow, develop, adapt to unforeseen circumstances, and seem to have an open-ended (though not unconstrained) reserve of potentialities, which we have no reason to assume are all pre-given at birth, since potentialities are always relational with respect to an open-ended environment. As the enactive story unfolds, a stronger, conceptual answer emerges. It postulates that ongoing, open-ended, precarious processes are logically necessary for what makes a system cognitive. Like living systems, cognitive systems are identifiable as centers of activity and perspective. Cognition occurs when there is a cognizer that cognizes about something. This means that there is an entity that takes a stance, and from this stance relations between itself (the cognizer) and its world are inherently meaningful. But there cannot be any such relations unless the entity we call the cognizer is also an individuated entity. And as we will see, these relations cannot be meaningful unless individuation is an ongoing, open, precarious process; i.e., a non-stationary one. The possibility of unpredictable, frame-transforming changes is inherent to being a cognitive system, even in the particular circumstances where these changes are not actually occurring. Hence, to be a cognitive entity is to be a (generally) non-stationary organization in a (generally) non-stationary relation with the world. Since functionalism is limited to cases in which we can safely make the stationary approximation, it follows that it cannot account for fundamental aspects of cognition.

This is not merely an arcane conceptual issue. In many ways, its implications are always close to the surface in concrete research. When we study attention, volition, sense of agency, decision-making, value systems, learning, etc., all of these aspects are implicit. What makes a cognitive system one that can act purposefully, do so with spontaneity, have concerns about its ongoing well-being and activities as well as concern for others, decide correctly, recognize and solve problems, and so on? To try to answer how such acts are performed without understanding why they are carried out at all, why they are of any relevance for the cognitive agent in the first place, does not even amount to half the story. In the mind sciences, there can be no general account of "how it works" without also offering an explanation of "what is at stake and for whom," since these questions are inseparable. Otherwise, we are speaking of complex systems theory, not cognitive science.

Without a solid account of individuality, agency, and subjectivity, we have not even scratched the surface of a theory of the mind, and all the well-established results are provisional because we have no theory that specifies their range of validity, only intuitions and empirical data (which can only give instances of (non-)contradiction of an assumption, but not in themselves explicate the limits of its generalization).

Similar points can be made about the inexistence of a theory of agency in cognitive science, both traditional and "embodied." Again, nothing in functionalism, except external convention or convenience, enables us to theoretically distinguish between a system that is simply coupled to its environment, like the planets in the solar system are gravitationally coupled to the sun and each other, and a cognitive system that is an agent in a meaningful world. An agent does things as well as has things happen to it. Again, in practice, this lack is always complemented by some tacit commonsense assumptions when focusing on specific research concerns. We tend to assume that there is a clear difference between a person moving an arm of her own volition vs. having it moved by an experimenter. But do we have in principle ways to distinguish less obvious cases or to question whether accompanying the experimenter's movements and not opposing them is not also a volitional act?

In short, it seems that there are good reasons to bring to the surface some of the hidden assumptions of the prevalent functionalist framework in the sciences of mind—not only as a healthy exercise, but in order to offer a possible explanation of why certain questions have never been the center of cognitive science research, such as the question of cognitive becoming or the question of the constitution of agency. Enactive theory has, in addition, deeper reasons. These are the issues that permeate all aspects of cognition for this approach. However, this does not mean that it is not possible sometimes to assume that some of these theoretical worries will have limited impact in specific cases of interest. Whether this is a good epistemological move or not, however, necessitates a theoretically loaded framework to justify it, very much in the same way as the theory of relativity itself provides the justification of what conditions validate the applicability of Newtonian mechanics.

We then turn to reviewing these deeper reasons in the next sections.

Autopoiesis

The enactive view of life and mind derives from the theory of autopoiesis—if by derivation we mean the historical sense of progression of ideas and not the logical sense of entailment. In fact, much of what is predicated by enactivists, especially in relation to norms, agency, and social interaction, is different and even quite at odds with classical autopoietic theory (Maturana and Varela 1980; Maturana 2002). I will not rehearse the technical arguments but will highlight some of these differences as we proceed.

The theory of autopoiesis emerged in the 1970s as a response to prevailing views in biology, neuroscience, and psychology, which lacked deep scientific conceptions of applied to the case of mindshaping, it need not be *metarepresentationalist*. That is, it provides the resources required to define mindshaping without presupposing a capacity to represent mental states. I define mindshaping as a relation between a target mind (the mind being shaped), a cognitive mechanism (the proper function of which involves shaping that mind), and a model that the mindshaping mechanism works to make the target mind match. Thus, mindshaping occurs when a cognitive mechanism selected in evolution for making target minds match models performs its proper function, in Millikan's sense.[6] Clearly, normal conditions on this must include representing the model accurately, but this need not involve the attribution of mental states. The reason is that mindshaping can occur simply in virtue of making the target mind disposed to match a pattern of behavior. Thus, all that needs to be represented is the model's behavior.[7] If there are mechanisms that use such representations to alter the dispositions of target minds in ways that make them more likely to match model behavior, they constitute mindshaping mechanisms that require no representation of mental states.

Let us make this more concrete by applying it to a specific example. A human infant observes an adult model turn on a light panel resting on a table by leaning over and touching it with her forehead (Meltzoff 1988). After seeing this, the infant is disposed to do the same when put in similar circumstances. This early form of infantile imitation clearly fits the definition of mindshaping. There is some cognitive mechanism in the infant that treats the behavior of the adult as a model to be matched, and disposes the infant to match it. However, there appears to be no reason to assume that the infant need represent the adult's intentions or other mental states in order to shape its mind in this way.[8] On this definition, mindshaping is widespread among nonhuman animals. For example, it applies to baby rats learning which foods to favor based on odors they smell on their mother's breath (Galef et al. 1983). In all such cases, it is arguable that there are cognitive mechanisms involved that alter behavioral dispositions to approximate behavioral patterns observed in social models.

Such a minimalist understanding of mindshaping raises another problem, however. If mindshaping is so widespread among nonhuman animals, how can it be used to explain what is distinctive about human social cognition? Here, there is again a temptation to collapse the distinction between the mindshaping hypothesis and the received view that human social cognition is distinctive in its reliance on sophisticated mindreading. How else can human-specific mindshaping be distinguished from other varieties? A brief survey of recent empirical work on human social learning shows that there are actually at least four ways of distinguishing human-specific mindshaping from other varieties, without assuming that it relies on sophisticated mindreading.

First, the developmental and comparative literature on imitation provides overwhelming evidence of a clear distinction in the *scope* of human vs. nonhuman imitation. Most nonhuman species are limited to acquiring *new goals* from observing the behavior of others, while selecting their *own methods* of accomplishing those goals. For example, many bird species can learn from observing conspecifics that food can be extracted from a particular location, but then go on to discover their own method of extracting it, ignoring the method used by their model (Zentall 2006). The one nonhuman exception to this appears to be chimpanzees (Horner and Whiten 2005). They can sometimes acquire both goal and method from a model, but only when there is no alternative method available to them. If they come to discover a different, more efficient method to accomplish the goal, chimpanzees immediately switch to it, ignoring the model's method. Surprisingly, this is *not* the case with human children. When shown a method to accomplish some goal by an adult model, human children persist in using that method, even after they are made aware of a more efficient method, through demonstrations that components of the modeled method are superfluous or irrelevant to accomplishing the goal. They persist in the modeled method, even when the adult model is not present and they think they are alone and unobserved, so fear of contradicting an adult cannot explain this phenomenon. Such "overimitation" (Lyons et al. 2007; Nielsen and Tomaselli 2010) is a distinctively human form of mindshaping. Yet, it does not appear to require sophisticated mindreading, like the attribution of propositional attitudes. Human children need only represent the goal of an adult model's behavior and the precise sequence of behavioral steps used by her in accomplishing the goal.

A second distinctive feature of human mindshaping is a plausible explanation of phenomena like overimitation. Matching model behavior, for humans but not nonhumans, appears to be its own reward. Nonhumans will imitate a target to the extent that it helps accomplish some further goal, like extracting food from a novel location (Zentall 2006). Humans, on the other hand, seem to find matching a model's goal intrinsically rewarding. This explains overimitation: children imitate the precise means of accomplishing a desired goal even if they are aware of more efficient means of accomplishing the same goal. It is plausible that this is due to the fact that they experience some kind of reward signal for matching model behavior precisely that outweighs the value of accomplishing the goal as efficiently as possible. There are other forms of mindshaping that also appear to show intrinsic motivation. For example, the costly punishment of norm flouters appears widespread in human populations (Henrich et al. 2006). Since this involves incurring a cost in order to punish counter-normative behavior, it suggests that shaping minds to respect norms is intrinsically motivating (Sripada and Stich 2006). Thus, the fact that human mindshaping appears intrinsically motivating is another feature that sets it apart from nonhuman varieties.

A third distinctive feature of human mindshaping is the socially extended nature of many human mindshaping mechanisms. For example, although there are some limited examples of pedagogy among nonhuman species (Thornton and McAuliffe 2006), none component of distinctively human social cognition. It is also central to most current explanations of most sophisticated, human social capacities. The distinctively human mindshaping mechanisms and practices I discussed in the second section are no exception. Consider overimitation. The capacity of human infants to imitate adult models who switch on light panels lying on tables with their foreheads is a classic example of overimitation: they learn an inefficient method of accomplishing a goal which they could accomplish much more easily, i.e., by switching the light on by hand. Subsequent experiments show that this is not mere blind copying (Gergely et al. 2002). If the adult model's hands are otherwise occupied or out of view when she switches on the light panel with her forehead, infants learn to switch on the light panel using the most efficient method available to them: with their hands. A natural interpretation of this is that infant imitators rely on the attribution of intentions to adult models. When an adult model switches on the light panel with her forehead while her hands are free, she must intend specifically to use her forehead, since she could more easily switch it on with one of her hands. But when an adult model switches on the light panel with her forehead while her hands are occupied, she must intend to switch it on by the most efficient method available to her.

Natural pedagogy is also typically explained in terms of sophisticated infant mindreading. For example, Csibra (2010) argues that natural pedagogy relies on the capacity to attribute higher-order intentions. On this explanation, infants interpret eye contact as expressing the communicative intention that immediately ensuing behavior be interpreted as intending to inform the infant of novel information concerning some salient object. On this view, natural pedagogy relies on infant capacities to attribute second-order propositional attitudes.

Finally, in the second section I suggested that our capacity to copy non-actual patterns of behavior by fictional agents encoded in public language is one of the most sophisticated forms of distinctively human mindshaping. But mastering a public language is routinely explained in terms of capacities to attribute complex propositional attitudes. For example, according to Sperber and Wilson (2002), all linguistic communication presupposes the capacity to attribute nested intentions and beliefs. And, according to Bloom (2002), word learning requires the capacity to attribute referential intentions to adult models. Thus, it would seem that any mindshaping reliant on the representation of model behavior in public language presupposes sophisticated mindreading. If these theories of overimitation, natural pedagogy, and language use are correct, then the distinctively human mindshaping practices and mechanisms discussed in the second section presuppose sophisticated mindreading, and hence cannot constitute an alternative to the received view of what makes human social cognition distinctive.

This whole question turns on what we mean by "sophisticated mindreading" and "propositional attitude attribution." Most philosophers of psychology follow Wilfrid

Sellars (1956/1997) when interpreting these concepts. Propositional attitudes are treated as states of an unobservable causal nexus responsible for an agent's behavior: the agent's mind. Furthermore, as I noted earlier, their relations to observable circumstances and behavior are holistically constrained: what one does in specific circumstances depends on indefinitely broad networks of propositional attitudes; hence, it should be difficult to determine an agent's propositional attitudes based on observations of finite bouts of behavior, and an agent's future behavior based on attributions of finite sets of propositional attitudes. Finally, if we take the Sellarsian picture seriously, and think of propositional attitude attribution on the model of scientific hypotheses about unobservable causal factors, then propositional attitude attribution should involve a strong appearance/reality distinction. Think of medical diagnosis here. Because the causes of symptoms, e.g., bacteria, are unobservable factors independent of the symptoms, it is always possible that two qualitatively similar sets of observable symptoms are products of radically different unobservable factors. Appearance does not determine reality. If propositional attitude attribution is supposed to be like this, then it requires an appreciation of the possibility that two qualitatively indistinguishable patterns of observable behavior are caused by radically different sets of propositional attitudes.

If we conceive of propositional attitude attribution along these lines, there is good reason to doubt that sophisticated human mindshaping, like overimitation, natural pedagogy, and language-assisted mindshaping presuppose propositional attitude attribution. For one thing, the speed and fluency with which infants overimitate, interpret pedagogical interactions, and engage in linguistic interactions suggest that they are not engaging in scientific reasoning about unobservable causes with tenuous connections to observable behavior. Second, it is very unlikely that such mindshaping capacities rely on an appreciation of a strong behavioral appearance/mental reality distinction. There is no evidence that human infants can conceptualize the possibility that qualitatively indistinguishable patterns of behavior might be products of radically different sets of propositional attitudes. Typically, when tested for capacities to interpret behavior, infants and children show no hesitation: they see behavior as unambiguously directed at specific goals and informed by specific situations. Thus, if we think of sophisticated mindreading and propositional attitude attribution along Sellarsian lines, there is no reason to suppose that distinctively human mindshaping depends on them.

How else might we conceive of the sociocognitive capacities underlying distinctively human mindshaping? One possibility is to think of human mindshapers and "mindshapees" as operating with an ontology of informed, goal-directed bouts of behavior. To be goal-directed, a bout of behavior must be predictable on the assumption that it constitutes the most efficient of observable means to some observable end state. To be informed by some (possibly non-actual) situation, a bout of

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