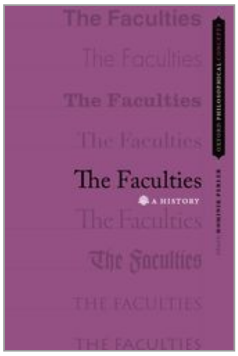

The Faculties: A History
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Faculties and Modularity

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Abstract and Keywords

While theorizing about mental faculties had been in decline throughout the nineteenth and early twentieth century, cognitivism and classical science brought back questions about the architecture of mind. Within this framework, Jerry Fodor developed a functionalist approach to what he called the “modularity of the mind.” While he believes that cognitive science can only explain the lower faculties of the mind, evolutionary psychology seizes on the notion of modularity and transforms it into the radical claim that the mind is modular all the way up. By comparison, recent approaches that take cognition to be embodied and situated have renewed the radical criticism of faculties or modules that was dominant from the nineteenth century onward. The concept of module is a naturalized successor of the traditional concept of faculty, as this chapter shows, and the debate about modules is centrally a debate about the possibility of naturalizing the mind.

Keywords: Fodor, modularity, evolutionary psychology, naturalism, embodied cognition

1. The Fate of the Faculties in the Nineteenth and Early Twentieth Centuries

Around 1800 the neuroanatomist Franz Joseph Gall (1758–1828) developed a research method that later on came to be known as phrenology. The program was based on the idea that the mind consists of several independent mental faculties that can be located in different parts or "organs" of the brain.[1] The kind of taxonomy of mental organs that includes, for example, an organ for poetic talent and a sense for architecture, looks strange to contemporary readers. What is more, the words "Gall" and "phrenology" immediately conjure up wild claims about how the mental abilities of a person are mirrored in the shape **(p.255)** and size of the brain (such that the skull of Kant would show a remarkably huge metaphysical organ).

Yet, Gall's work includes fundamental claims that, as we will aim to show in what follows, became part and parcel of the reasoning about mental faculties from the beginning of the nineteenth century onward. This becomes evident when comparing Gall's theory with the work of the anatomist Samuel Thomas Soemmerring (1755–1830), whose treatise *On the Organ of the Soul* was published at about the same time that Gall was developing his method. Soemmerring suggested that the organ of the soul was located in the fluid of the cerebral ventricles and thus attempted to offer a solution to the age-old question about the location of the soul inside the brain. The book stirred up some considerable controversy. (Kant himself wrote an afterword for the book in which he claimed that the soul cannot be located at all.)

Soemmerring's ideas about the soul's locus in the brain can be understood as the end point of a tradition and Gall's work on the multiple mental organs in the brain as the beginning of a new research program.[2] While Soemmerring joins the long tradition of authors who tried to locate the soul or the place of the interaction between body and soul in one particular part of the brain, Gall remained entirely agnostic about the mind-body problem. It seems that he simply took it for granted that the distinct mental faculties could be localized in the brain and that they altogether made up an intelligent system, even if constituting largely independent parts. Not only did Gall introduce the idea that the relation between mental functions and their location in specific brain areas should be subjected to an empirical investigation, he also rejected the speculative traditional faculties of imagination, reason, memory, and so on, and instead proposed more specific powers. This establishes Gall as the grandfather of the functional decomposition of the mind, as it grew influential in cognitive science from the middle of the twentieth century onward.

(p.256) While discussion about the localization of mental faculties in the brain remained alive in neuroanatomy all through the nineteenth century and the early twentieth, traditional accounts of the mental faculties lost their explanatory status and role in philosophy at the same time. The reasons for this decline are complex. Before we turn to the resurrection of faculty psychology in the second half of the twentieth century, we will sketch some of those reasons.

As was shown in chapter 4, there is an eliminativist tendency in Hume's account of the faculties. Hume's associationism leads him to propose a reduction of mental faculties to patterns of regularly succeeding perceptions and even compels him to deny that there should be any cognitive powers at all. The principle of the association of ideas, which was first introduced by John Locke,[3] states that mental processes are not to be explained as the products of the activity of mental powers, but instead in terms of the relation in which mental states stand with their mental successor states. David Hume's systematic and extensive use of this principle inspired the British associationist school (including David Hartley, James Brown, Alexander Bain, John Stuart Mill, and Herbert Spencer) to dismiss the faculties in favor of investigating the nature and laws of association.[4]

The principles of association explain both the formation and retrieval of different kinds of complex ideas, and the various kinds of relations obtaining between those ideas. Consequently, there does not appear to be any need for ascribing the formation and retrieval of ideas to faculties. A memory, for example, is not something formed by the relevant faculty and stored and retrieved by it, but is an idea or chain of ideas related to past events, which is produced in response to a certain external stimulus or an occurrent internal mental state. Of course, one might still want to call the set of ideas so produced the "faculty of **(p.257)** memory"—however, this concept would no longer refer to an underlying power. Thus, associationism did away with inborn faculties (e.g., memory) and, instead, investigated how the functions allegedly performed by the traditional faculties could emerge from a combination of elementary psychic elements like ideas or sense impressions. Moreover, once the faculties were dismissed, there was no need for supposing any longer a soul or a mind acting as a vehicle for the faculties, while remaining itself inaccessible to empirical investigation. Associationism was conceived as offering something like a paradigm for scientific psychology, because it allowed getting rid of the faculties of the mind—just as Newtonian physics was regarded as the paradigm for a science built on a few mechanical laws, because it eliminated the need for ascribing active powers and qualities to matter. Moreover, associationism was able to provide a framework for the emerging experimental study of the mind. In the second half of the nineteenth century the highly influential psychologist Théodule Ribot provided the foundations for a scientific psychology by taking associationism as a starting point.[5] He amended this empiricist foundation, first, by focusing on heredity as a mechanism for producing innate dispositions that favor certain kinds of association,[6] and second, by proposing the scientific study of mental diseases.[7] Ribot thus founded the French school of psychology, which was subsequently developed by his followers Jean-Marie Charcot and Pierre Janet.

By the end of the nineteenth century associationist psychology was thus very much aligned with experimental psychology and the introspective method. Significantly, however, proponents of the introspective method were not much in favor of mental faculties either. Wilhelm **(p.258)** Wundt, one of the founders of introspection, identifies consciousness with immediate inner experience. Consequently, he holds that the sole aim of experimental psychology is the exact description of consciousness.[8] Experience, and nothing above or beyond it, constitutes the subject matter of psychology. Accordingly, the objects of inquiry are introspectible mental *contents*, and not a mental substance or mental faculties. Introspection detects and identifies nothing but conscious thoughts and experiences, where previously mental faculties were supposed to be the powers that produce these conscious mental states in a structured way.[9] The mental faculties are not viewed as powers that produced the mental phenomena, but as nominal sets uniting a group of inner experiences. Thus, when talking about imagination or memory, authors such as Hume, James, and Wundt do not refer to mental powers as producers of different kinds of mental states, but rather to terms for unifying classes of inner experiences.

At the beginning of the twentieth century critical voices against the introspective method grew increasingly louder and, with behaviorism, a method turned mainstream that was quite opposed to introspective psychology. According to behaviorism in the strict sense, psychology is not a science of the mind, but rather a science of behavior.[10] In principle, behavior can be described and explained without any reference to internal mental powers and processes. Concepts for the mental should be replaced by descriptions of the input and behavior patterns that are observable. While introspective psychology relied on the introspection of one’s own perceptions and experiences, behaviorism decried this procedure as a pseudoscientific method and sought to define **(p.259)** scientific approaches to the mind restrictively in terms of phenomena, such as sensory input and behavioral output, that are observable from a third person point of view. Although behaviorism can be seen as radically opposed to introspective psychology, it avoids any reference to traditional faculty psychology just as much as introspective psychology does, though for slightly different reasons.

As we have shown, the status of the concept of mental faculties has been steadily in decline throughout the development of modern psychology. The same is true in relation to the major currents of philosophy in the twentieth century, albeit for rather different driving forces. Many influential philosophical movements of the twentieth century can be characterized roughly by a reorientation toward the practical on the one hand and by what is called the “linguistic turn,” on the other. Pragmatism and existentialism can claim to be the philosophical movements that mediate theory and praxis in the aftermath of Hegelian thought.[11] The principle of pragmatism identifies the “practical consequences” of a theory, concept, or hypothesis by describing how it functions as an instrument in thought, analysis, and practical deliberation. It is the practical consequences that determine the nature of thoughts and concepts, and not their origins in mental faculties. The existentialism of Heidegger and Sartre rejects the assumption of faculties, because it prioritizes existence over essence. What is essential to human beings is not fixed by their essence but by what they do and make of themselves, in contrast to other entities whose properties and dispositions are determined by the kind of thing they are. Human consciousness amounts to a practical interaction with the world and is not the result of the actions of some inner powers.

Analytic philosophy, in turn, can be characterized by its focus on language. Michael Dummett famously defined analytic philosophy in claiming “that a philosophical account of thought can be attained **(p.260)** through a philosophical account of language, and, secondly, that a comprehensive account can only be so attained.”[12] Once the philosophy of language is accorded primacy in philosophical investigations, the mental faculties inevitably lose their status as the *explanans* of the mental, if for quite a different reason: it is now due to the methodological decision to account for all kinds of mental states predominantly by reference to linguistic systems or linguistic practices. Putting language first in terms of taking into account linguistic practices calls for a blend of the practical orientation and the “linguistic turn.”[13] This combination, in alliance with the behaviorist turn in psychology, led to a widespread rejection of the view that thought and other mental processes were based in mental faculties. A very influential example of this approach and, consequently, of a complete rejection of mental faculties is provided in Gilbert Ryle’s book *The Concept of Mind*. Ryle devoted his philosophical work to contesting the unhappy tendency of philosophers to hypostatize the supposed referents of their own concepts. He opposes the idea that minds and mental faculties must exist if there is to be a causal explanation of intelligent behavior, and the book is therefore an examination of various mental concepts, such as knowing, learning, imagining, pretending, hoping, wanting, doing voluntarily, doing deliberately, perceiving, remembering, and so on. As an alternative, Ryle tries to establish connections between mental predicates and behavior by proposing that statements involving mental terms can be translated into subjunctive conditionals about what the individual will do in various circumstances. Thus, Ryle offers a dispositional analysis of statements involving mental terms into dispositional-behavioral **(p.261)** statements and tries to show that, in using dispositional predicates, we do not refer to certain internal mental powers. A radical scientific version of behaviorism was also developed by Burrhus Frederic Skinner.

Cognitive science challenged both the behaviorist outlook and the primacy of linguistic analysis and language use, on which philosophers like Ryle and tough-minded behaviorists like Skinner had relied, and instead offered a new framework for understanding the mind—a framework, nonetheless, that made space once again for the concept of mental faculties.[14] In the 1950s researchers in psychology, computer science, and linguistics began to develop theories of the mind that were based on the idea that the mind is a symbol-processing machine akin to the computer. Pioneers of computer science, such as John McCarthy, Marvin Minsky, Allen Newell, and Herbert Simon, developed programs, for example the General Problem Solver,[15] that were meant to imitate human reasoning. At about the same time, Noam Chomsky rejected the behaviorist idea that language could be an acquired habit and proposed that one could only explain language comprehension in terms of innate mental grammars.[16] The main argument he marshaled in favor of this claim and in opposition to behaviorism was concerned with the concept of the "poverty of the stimulus": Chomsky argued that the spoken linguistic data that children are exposed to while learning a language hardly suffice for inferring grammatical rules. He suggested that children would be unable to distinguish grammatically correct from incorrect statements if they did not dispose of some kind of innate grammatical knowledge. This illustrates **(p.262)** how the return to rationalist assumptions about the mental had partly an explanatory purpose: Chomsky claimed that behaviorist theories have no satisfying explanation to offer for how we acquire language and that we need to presuppose some inner structure of the mind in order to construct a better theory. However, this particular attack on Skinner's behaviorist theory of language use was not the only reason for the decline of behaviorism during the second half of the twentieth century. Quite generally, scientists working on human psychology and animal ethology grew increasingly interested in cognitive states that do not entertain a direct relation with overt behavioral patterns and in cognitive activities that do not depend on prior learning (as exemplified in many animals).[17] Vision science is a case in point, as there are many phenomena in visual perception (such as visual illusions, constancy mechanisms, and depth perception) that can be explained purely by reference to the mechanisms that underlie visual perception.[18]

The return to the inner in early cognitive science was also motivated by developments in computer science and artificial intelligence. Pioneers in this field, such as Newell and Simon, maintained that the latest computer models were symbol-processing machines and, as such, could be understood as concrete proof for the nature of the mind: the mind is a symbol-processing software and the brain its machine implementation. The respective developments in artificial intelligence can therefore be seen as the background for new naturalistic approaches to the mind. Whereas nineteenth- and early twentieth-century psychology had been trying to come up with scientific methods for **(p.263)** observing the mind (from an inner or outer point of view), artificial intelligence offered an entirely novel model for thinking about the mind: by trying to rebuild it, or rather, by the method of reverse engineering as a way of analyzing the mind. Consequently, proponents of early cognitive science put forward metaphysical claims about the nature of the mind that were based on their strong engineering convictions. As a result, the inner did not seem to be mysterious anymore.

The computer theory of the mind, that is, the idea that thinking is a kind of syntactically structured symbol-processing, comes hand in hand with theorizing about the "cognitive architecture" of the mind, understood in the same way as the architecture of computers. More specifically, talk about cognitive architecture refers to the functional decomposition of the mind, the architecture's relation to the realizing brain (conceived as a machine) and the general constraints that this machine/brain puts on what the mind is able to accomplish.[19] In many early artificial intelligence models, the famous von Neumann architecture functions as the prototype for the basic architecture of the mind, consisting of input and output units, a memory unit, and a central processing unit.[20]

Discussions revolving around "cognitive architecture" can be understood as a modern and naturalized version of talk about mental faculties. Nevertheless, apart from the analogy with the computer, this way of thinking about the architecture or structure of the mind also involves a distinctly different approach, given its focus on subconscious processing levels. These levels can be partly reconstructed theoretically by employing research methods based on an objective third person perspective, as in neuroanatomical research on brain damage and resultant cognitive impairments of, for example, speech perception and face recognition; in psychological studies focusing on unconscious, subpersonal processing, for example different kinds of memory; and so on. **(p.264)** Traditional faculty psychology drew intuitive distinctions between different mental states like imagining and memorizing and hypothesized that they would originate in different faculties of the soul. Cognitive science claims instead that, for example, speech perception must be a distinct mental ability residing in a particular part of the brain, given that it can be lost due to brain damage while all other abilities remain intact. In the context of twentieth-century cognitive science, this shift from the personal to the subpersonal level is probably the most significant change in theorizing about the faculties.

We have provided a short sketch of the reasons for the decline of faculty psychology in the late nineteenth and early twentieth centuries. In the aftermath of Hume's empiricist program, psychology—in the shape of associationism, introspective psychology, and behaviorism—dismissed mental faculties. The same was true for the major currents in philosophy in the twentieth century, due to their practical or linguistic orientation or both. Yet, within the framework of the cognitivist paradigm in the cognitive science of the mind, the mind's supposedly innate powers, inner structure, and architecture moved, once again, to the center of interest. Gall's core idea to correlate mental faculties, that are also more fine-grained than traditionally assumed, with identifiable segments of a given cognitive architecture (which is itself localized in some specific brain areas, as empirically established), reemerges emphatically within the framework of cognitive science. The birth of cognitive science as well as of contemporary philosophy of mind marked the renaissance of a robust philosophical interest in the mind and its powers. In contrast to the philosophical investigations of the mind during past centuries, theorizing about the faculties is now taking place within the framework of cognitive science. This new orientation offers the opportunity for establishing a naturalistic understanding of the mind and the mental faculties.[21]

(p.265) 2. Modularity, Cognitive Science, and Naturalism

We now want to argue that the notions of module and modularity, as they are currently used in cognitive science, are naturalized successor concepts that replace the traditional mental faculties. This claim should be understood in the following way: In the broad Aristotelian tradition that runs from ancient to early modern philosophy, the faculties of the soul can be divided into the lower ones, namely the sensory and the appetitive faculties, and the higher ones, namely the intellectual and volitional faculties.[22] The lower faculties comprise not only the appetites and the passions as well as the visual, auditory, tactile, and other kinds of perception but also memory, imagination, and estimation.[23] The higher faculties comprise the capacities for forming concepts, beliefs, and inferences; for making choices and for taking decisions. The subdivision is real because each faculty is supposed to be dedicated to specific objects; in modern parlance, the faculties are "domain-specific."[24] For instance, the visual faculty deals with colors, the auditory faculty with sounds, the intellectual faculty with concepts, and so on. Roughly, humans and the higher animals share the lower faculties, yet the human mind is distinctive in that it also features the higher faculties. There has been some debate in early modern philosophy about whether the **(p.266)** higher faculties characteristic of the human mind are part of the natural (material) world. Descartes and Malebranche were opposed to this idea, while Hobbes and Hume were its defenders. As we will show, this question is still pertinent within the naturalistic framework of the contemporary philosophy of mind. While Jerry Fodor argues that higher cognitive abilities cannot be understood as modular and that cognitive science has so far no means at its disposal for properly conceptualizing the central cognitive system, Peter Carruthers and other authors claim that, in order to understand the mind in a naturalistic framework, one needs to assume that it is modular all the way up.[25]

Within contemporary cognitive science, the traditional division between higher and lower faculties is reproduced in the distinction between low-level and high-level cognitive systems. As we have already shown, the important difference between traditional theorizing about higher and lower faculties and modern proposals about higher and lower cognition is that modern cognitive science focuses most of all on third person methods of investigating subpersonal processes in order to try and verify claims about the underlying realizing mechanisms.

One important reason for supposing that there exists a specific difference, for example, between perception and higher cognition, stems from research on perceptual illusions, which typically persist even when the viewer knows the real character of the stimulus. For example, if a subject knows that the two lines of the Mueller-Lyer illusion are the same length, the subject still persists in perceiving them to be of unequal length. The perceptual representation of the stimulus by the visual system is, as is aptly said, "cognitively impenetrable" by the subject's knowledge stored in the central cognitive systems.[26] The visual system apparently operates in isolation and produces the percept of the **(p.267)** Mueller-Lyer illusion untouched by the potential influence of reason or some other higher-level system(s).

Attempts at capturing phenomena, such as the independence of visual processing, and the respective theorizing about independent faculties or relatively independent functional units have led to the concept of the modularity of the mind. Within this paradigm, the functional units of the mind that realize certain abilities, like speech perception or face recognition, have now been labeled "modules." In effect, those modules can be understood as the naturalized successor concepts of the concept of the faculties. They are what constitutes today's supposed architecture of the mind, even if they reside at a subconscious and more fine-grained level than the traditionally supposed faculties of the soul.

Fodor was the first to establish the notion of the modularity of the mind in philosophy, with the explicit goal of reviving faculty psychology. Very roughly, a module can be characterized as a dissociable and relatively autonomous cognitive mechanism with a certain function or purpose. It is central to Fodor, but not to other defenders of modularity, that the lower cognitive systems do not receive input from the higher cognitive systems. They are, in this sense, cognitively impenetrable. Yet the higher cognitive systems are not modular, for they do receive informational input from the low-level systems and other higher systems. His proposal can therefore be labeled the "moderate modularity" hypothesis.[27]

According to other philosophers and cognitive scientists,[28] however, the (human) mind consists more or less exclusively of numerous **(p.268)** cognitive systems, both low-level and high-level. Each system communicates with a limited number of other systems while having little influence on the processes going on inside other systems. Put differently, the (human) mind is entirely made up of modules. This means that both peripheral low-level cognitive systems and central high-level cognitive systems are modular. This is called the “massive modularity” hypothesis or, more critically, the “promiscuous modularity” hypothesis.[29] As will become clear, the concept of massive modularity both weakens the notion of what a module is and blurs the traditional distinction between lower and higher faculties. The difference between defenders of moderate modularity—most notably Fodor himself—and defenders of massive modularity is that the latter apply adaptationist reasoning to the structure of the mind, while the former shrink back from Darwinian interpretations of modularity.

Despite these differences, both theories of modularity agree that the faculties have to be explained naturalistically and both agree that all or at least some of the traditional and the folk-psychological notions of the faculties refer to subpersonal (and perhaps naturally purposeful) mechanisms that account for the cognitive capacities of higher animals and humans. In addition, there may be modules that do not feature in folk-psychological or traditional theories of the mental faculties, such as modules for speech perception, mind reading, and the notorious “cheater-detection-module.” In general, current theorizing in cognitive science about the architecture of the mind differs most significantly from traditional approaches in its tendency to multiply mental faculties at the subpersonal level. This tendency can ultimately be traced back to Gall and the dawn of phrenology in the late eighteenth century.

(p.269) The connection with the traditional concept of the mental faculties seems obvious: The moderate modularity thesis claims that the traditional lower faculties are modular (in the strong sense) whereas the traditional higher faculties are not. By contrast, the massive modularity thesis claims that both the lower and the higher faculties are modular (in the weak sense). All contemporary theories of modularity deny that the traditional lower and higher faculties are faculties of the *soul*, since souls of any kind are not a proper part of a naturalistic picture. Modularity theories conceive of faculties as psychological capacities of organisms (higher animals and humans) that are realized in the brain. Moreover, both the moderate and the massive modularity theses claim that the faculties referred to by folk-psychological notions are constituted by subpersonal capacities.

Hence, "modules" is a *successor* concept to the traditional "mental faculties," though modules tend to be defined in a more fine-grained manner and are said to be located at the subpersonal level. But what about the idea that "modules" is a *naturalized* successor concept? First, one should acknowledge that the term "naturalism" does not have a precise meaning. Generally speaking, naturalists hold that reality entirely consists of nature as specifically defined by the natural sciences and hold that scientific methods must be used for investigating any part of reality, including the human mind. Thus, naturalism entails both an ontological and a methodological claim. The ontological aspect revolves around the idea that reality has no place for "supernatural" entities; the methodological aspect involves attributing a kind of general authority to the scientific method over other methods in investigating reality. Both aspects are captured in the slogan that philosophy has to be continuous with the natural sciences. Thus, for mental faculties to form a part of nature, as understood by the natural sciences, they have to be able to make a causal difference in the spatiotemporal world. And for the mental faculties to be natural faculties, they have to be realized by concrete mechanisms in living organisms.

Traditionally, the mental faculties denominate specific capacities with a cognitive purpose. However, from a naturalistic perspective, **(p.270)** discussions about cognitive capacities and cognitive purpose remain superficial as long as no account is provided of the particular mechanisms that supposedly realize the cognitive capacities in question. As we showed in the preceding section, the particular framework employed in cognitive science facilitates investigations of the mind in terms of cognitive architecture rather than mental faculties and thus encourages research into different kinds of information processing units that are realized in the brain and can solve certain tasks.

The representational states produced by modular cognitive systems are said to be sensitive only to certain kinds of information and to operate in relative isolation from other cognitive systems. As discussed previously, a module can be very roughly characterized as a dissociable and relatively autonomous cognitive mechanism with a certain function or purpose. This idea of a module is well embedded in traditional cognitive science, given that it is firmly committed to the modular approach in the study of cognition. The mind is taken to be a computational device composed of functionally specifiable and detachable mechanisms, and functional decomposition is therefore a central aim of classical cognitive science.[30]

Yet, despite the fact that the notion of modularity is well embedded in cognitive science, there seems to be no generally accepted understanding of what a module is and what the thesis of the modularity of mind is supposed to amount to.[31] We have already seen that there are two versions of the modularity thesis: *moderate modularity* and *massive modularity*. However, there are also two interpretations of what a module is supposed to be: a weaker and a stronger one, both of which **(p.271)** we will discuss later in more detail. Finally, there are also two different ways of integrating modules into a naturalistic framework: either one emphasizes that modules are cognitive *mechanisms* and, hence, relies methodologically on *cognitive psychology* in realizing the naturalization project; or one highlights that modules must have a *purpose* and therefore relies on *evolutionary biology* in accomplishing the naturalization project.

So, what exactly is meant by the term “module”? And what precisely is the thesis of the modularity of the mind? We will first sketch an answer to both of these questions in the terms of moderate modularity, as it is defended by Fodor. Subsequently, we will turn to the standard reply given by defenders of massive modularity, and specifically by Carruthers.

3. Fodor: The Modularity of (Some Parts of the) Mind

The most prominent attempt of reestablishing faculty psychology within philosophy of mind and cognitive science in recent decades has been the approach developed by Jerry Fodor in his *The Modularity of Mind*. The modularity thesis defended by Fodor represents a particular version of faculty psychology, which emphasizes how the “lower” faculties have only restricted access to information, and distinguishes them from more global “higher” cognitive processes.

According to Fodor, the variety and special functions of our cognitive activities can be explained with reference to the existence of such subpersonal task-specific modules. Fodor subscribes to the idea that, in order to explain specific cognitive activities, one needs to appeal to the “functional architecture” of the mind as the engine of all these activities. The building blocks for such an architecture comprise faculties that can be individuated with respect to their causes and effects (rather than with regard to their location in the brain or the kind of innate ideas they might entail). Classical functionalist approaches to the mind characterize cognitive states in terms of their causal roles. (To give a **(p.272)** somewhat simplified example, pain is the neuronal state that is caused by nociceptive input and normally causes pain behavior. If there is pain perception without actual nociceptive input, perhaps accompanied by abnormal behavior, pain is identified with the activation of those neuronal states that usually mediate between pain inputs and outputs.) Fodor straightforwardly applies this view to faculties, claiming that “the language faculty is whatever is the normal cause of one’s ability to speak.”[32] However, such a claim should not lead to the conclusion that a faculty exists for every single capacity we possess. This would evidently lead to the absurd consequence that we would need to stipulate a faculty that underlies, say, the ability for adding one and one, and another ability for adding one and two, and so on. For not every behavior we display differs in its function and etiology fundamentally from every other one. A functionalist faculty psychology is therefore tasked to find the causal uniformities in behavior underneath the heterogeneity of surface appearances. The guiding idea in the background, therefore, is to apply a kind of reverse engineering to the mind: while we could of course conceive of a single machine or mechanism that accomplishes all kinds of additions and even arithmetic operations, it would appear unlikely that this very mechanism should also be able to detect colors or trigger flight behavior.

While the insistence on the mind’s functional architecture distinguishes Fodor’s view from other approaches, such as Chomsky’s theory, not all functionalists are committed to the kind of faculties that Fodor stipulates. However, what would appear to be uncontroversial among functionalists is the claim that the mind shows a kind of functional decomposition, that is, that the mind contains systems that can be distinguished by the functions they serve. Nevertheless, even though Fodor's modularity hypothesis is a claim about what kinds of systems there are and what they are like and, therefore, can only be developed **(p.273)** within a functionalist framework, his proposal is not the only interpretation that such a functionalist framework permits.

Fodor suggests capturing the architecture of the mind by way of a threefold functional taxonomy that distinguishes transducers, input systems, and central systems, as follows.

Transducers are subsidiary systems that have the function of providing the system with information about changes in the environment. While a Turing machine, for example, is a closed system operating merely on the restricted amount of information that it receives from its tape, living organisms steadily exchange information with their environments and, thus, their computations are continuously affected by what happens around them. Such transducers are always organs that convert energy impinging on the organism's surface, such as the retina or cochlea, into nerve signals. The outputs of transducer systems specify the distribution of proximal stimuli at the organism's surfaces, without producing inferences about the distal objects causing the stimulation.

Input systems are designed to deliver information to the central systems; more specifically, they mediate between transducer outputs and central cognitive mechanisms by producing mental representations out of the data delivered by the transducers and presenting them to the central cognitive mechanisms for further processing. According to this view, there are substantially more mechanisms that can be identified as different input systems than just the five senses. What Fodor has in mind are highly specialized computational mechanisms that generate hypotheses about the distal sources of proximal stimulation, such as mechanisms for color perception or the analysis of shapes or three-dimensional relations, for example in the case of vision.[33]

Such input systems constitute a natural kind, that is, a class of entities that share many scientifically interesting properties and cannot be **(p.274)** reduced to other more fundamental faculties of the mind. What input systems have in common as a natural kind can be summarized in a simple phrase: input systems are modules. That is, input systems are exactly the kind of objects Gall was right about. Fodor lists specifically nine characteristic criteria that identify a module:

1. *Domain specific*: Fodor harks back to Gall's idea that there are distinct psychological mechanisms corresponding to distinct stimulus domains and argues that Gall was correct with regard to the input processing systems.[34] The question of how many modules there are (partly) depends on the question of how many mechanisms there are that respond only to stimuli from a certain domain. The latter is essentially an empirical question.
2. *Informationally encapsulated*: Modules are restricted with regard to the information they take into account before producing an output. A perceptual hypothesis, for example, about the distance or size of an object, may be based on considerably less data than the organism as a whole has access to. The operations of input systems are effectively unaffected by top-down feedback, such as theoretical knowledge with regard to how the distance and size of objects tend to vary under certain perceptual conditions. Informational encapsulation therefore explains the persistence of perceptual illusions. Domain specificity and informational encapsulation are different features of a module and could, at least in principle, come apart. There could be a system that only reacts to a certain kind of stimulus but is sensitive to all kinds of top-down feedback; yet there could also be a system that reacts to all kinds of stimulus without, however, integrating **(p.275)** any top-down feedback concerning the system's background knowledge. According to Fodor, the intriguing aspect about modules is that they always display both features concurrently.
3. *Mandatory*: Modules operate in an automatic mode. An individual cannot help but read the letters she sees, hear an utterance as an utterance, and be afraid when hearing a sudden loud noise. Input systems are constrained to operate unfailingly whenever an opportunity presents itself. This is what distinguishes them from central representational capacities that are under "executive control": we apply them in a manner

that is conducive to the satisfaction of our goals, while perception operates purely automatically without regard to any immediate concerns.

4. *Fast*: Processing in input systems is fast when compared with the relatively slow processing occurring in paradigmatic central systems like problem-solving. Fodor classifies cognitive processes as fast if they take place in half a second, at most. Remarkably, according to this claim, being fast is a direct result of being mandatory and informationally encapsulated. However, automatic processes are therefore in a certain sense unintelligent—they can operate fast because they merely consider a stereotyped subset of the whole range of computational options available to the organism.

5. *Inaccessible*: Input analysis typically involves mediated mappings from transducer outputs onto percepts. A system is inaccessible if these intermediate levels of processing are not available to consciousness and explicit reports. Central systems like memory can freely access the content of modules only at their output level. Inaccessibility and encapsulation are therefore two sides of the same coin: while inaccessibility involves restrictions on the flow of information emanating **(p.276)** from a module, encapsulation involves restrictions on the information flow entering the mechanism.[35]

6. *Shallow*: Since modules are informationally encapsulated, we should not expect their outputs to be theoretically demanding concepts. The output of the visual detectors, for example, is shallow, that is, there should be visual output representations that do not categorize visual stimuli in terms of biological or chemical kinds, but form a level of representation by some criterion independent of theoretical knowledge. Fodor suggests that the outputs of modular systems are understood as basic-level concepts,[36] which can be acquired during direct observation rather than by inferential reasoning.

7. *Localized:* Fodor assumes that there is a characteristic neural architecture associated with the input systems. Hardwired connections are supposed to facilitate the information flow between different neural structures inside a module, but they thereby also restrict it to the module. Neural architecture is therefore the natural concomitant of informational encapsulation.
8. *Subject to characteristic and specific breakdown patterns*: A suitable criterion for a system's functionally dissociable character is whether it can be impaired, for example as the result of a brain lesion, without other cognitive systems being significantly impacted. Disorders such as prosopognosia (impaired face recognition), achromatopsia (total color blindness), and agrammatism (loss of syntax) occur in individuals independently of any other impairments.[37] Specific breakdown patterns are also good evidence for neural **(p.277)** localizability, since the breakdown of one particular module in the course of a lesion in a certain part of the brain renders it highly likely not only that the system in question is localized in the area in question but also that this area is dedicated *exclusively* to the realization of the very system.[38]
9. *Ontogenetically determined:* The ontogeny of input systems exhibits a characteristic pace and sequencing. Modules are innate faculties that are either present already shortly after birth, as seems the case with visual categorization, or develop "according to specific, endogenously determined patterns under the impact of environmental releasers."[39] The commitment to strong claims about innateness forms part and parcel of faculty psychology from Gall through to Chomsky.

Central systems are the nonmodular systems that constitute the "higher cognitive mind" and enable creative and holistic reasoning processes. Fodor assumes that in addition to the input systems there must also be nonmodular systems that evaluate and exploit the information provided by the input systems. These higher cognitive systems are neither domain-specific nor encapsulated, but instead cut across domains and also have global access to information. Even though candidates might include, for example, choice formation and decision-making systems or what was traditionally called "the will," Fodor focuses entirely on the formation of belief based on prior perceptual processing, which he describes as an evaluation of how things look in the light of background information.

Fodor takes it that, given the cognitive abilities we have, it is necessary to assume the existence of nonmodular systems where the representations **(p.278)** provided by input systems can interface. The mechanisms of belief formation cannot be modular because it is precisely the point of such mechanisms to ensure that what the organism believes is determined by a process that tests and corrects the information that is provided by the input systems in the light of all the background knowledge the individual has.

The problem is that in the case of a domain-general system where every representation is sensitive to any other one we have no conception of how to build such a structure. Given how clueless reverse engineering appears to be when faced with a global mechanism of belief formation, Fodor postulates what he—with a twinkle in the eye—calls "Fodor's First Law of the Nonexistence of Cognitive Science," namely that "the more global … a process is, the less anybody understands it."[40]

The main function of a threefold architecture, such as the one just sketched, is to isolate perceptual analysis from certain effects of background belief. Input analysis is therefore thought to take place in modules, which, according to Fodor, represent a functionally definable subset of the mind and share a certain functional role. They receive input from a transducer and integrate this information in order to produce a distal representation of the external stimulus.

Fodor's explicit goal is to come up with "an overall taxonomy of cognitive systems,"[41] as a way of developing a contemporary version of faculty psychology. Yet, when comparing Fodor's results with traditional positions, it is striking that his account is mainly dedicated to drawing a distinction between perceptual input analysis and belief formation. Fodor therefore leaves many questions entirely unanswered as regards the individuation of faculties. First of all, it is unclear how many modules there are supposed to be. It seems patent that modules do not mirror common-sense psychology and that we should expect modules **(p.279)** to represent mechanisms that are more fine-grained than, for example, the five senses, memory, imagination, and so on. Examples of modules that Fodor mentions include mechanisms dedicated to color perception, mechanisms that assign grammatical descriptions to token utterances, and mechanisms for face-recognition.[42]

Even leaving to one side the question of how to individuate input systems, there might also be modules with entirely different functions beyond input analysis, such as those involved in triggering motoric behavior. While these systems would probably share some characteristics with input systems, in terms of being fast, automatic, and domain-specific, other standard criteria simply do not seem to apply to motor behavior systems, such as the property of "producing shallow output." Fodor does not say anything about how to individuate these systems and where to situate them in his threefold architecture.

Furthermore, Fodor remains silent about the conative aspect of the higher cognitive mechanisms, such as different kinds of choice formation and decision-making, or what has traditionally been labeled "the will." Finally, there are the traditional lower faculties in addition to the senses or input-systems, such as memory and imagination, where it is hard to see how they could fit into Fodor's architecture of the mind at all. According to traditional faculty psychology, they belong to the lower faculties, yet they hardly fit Fodor's central criteria for being a module, namely, that they should be domain-specific and informationally encapsulated. But even if Fodor would alternatively include them with the higher cognitive faculties, he would need to say something more about how their particular function distinguishes them from belief formation. However, Fodor does not touch on any of these questions.

It should be evident from the foregoing remarks that Fodor does not really aim at a complete taxonomy of the mental faculties. He is rather *using* faculty psychology as a background theory for establishing two **(p.280)** claims: first, that perception is cognitively impenetrable and, second, that cognitive science cannot account for higher cognitive processing.

As regards the first claim, Fodor employs faculty psychology in drawing a clear-cut distinction between perception and cognition, thereby accounting for the cognitive impenetrability of perception. Such a clear-cut distinction is meant as an argument against cognitivist tendencies in psychology that focus on top-down processing running from cognition to perception.[43] Fodor objects that such an account blurs the difference between perception and cognition and suggests instead that perception should be perceived as a *tertium quid*: Perception is "smart," like cognition, in that it is usually inferential, yet it is also "dumb," like reflexes, in that it is informationally encapsulated.[44] The functional conflict between inference and encapsulation that might arise from this situation is resolved by assuming that such mechanisms have only sharply delimited access to background theories. The essential criterion of modularity, that is, informational encapsulation, therefore remains the key feature in explaining why and how perception must be strictly distinguished from global cognitive processing. What Fodor is objecting to here is the idea that perception could be theory-relative, namely, in itself biased by the background knowledge the individual has. Relativism, Fodor argues, overlooks the predetermined structure of human nature and underestimates our capacity for securing objective information about the world via our perceptual systems.[45]

The second claim to the effect that cognitive science cannot account for higher cognitive processing is articulated in the already mentioned **(p.281)** "Law of the Nonexistence of Cognitive Science." Cognitive science, according to Fodor, has made good progress in explaining how modules work. But central systems cannot be explained as modular systems, since:

(1) Central systems are in charge of belief formation.

(2) Belief formation is a global process that can access all the information the system has.

(3) Global processes cannot be modular since modules are domain-specific and encapsulated.

(4) Therefore, the central system cannot be modular.

The problem with cognitive science seems to be that it has often treated central systems as if they were modular: "Intellectual capacities were divided into what seem, in retrospect, to be quite arbitrary sub-departments (proving theorems of elementary logic; pushing blocks around; ordering hamburgers). … What emerged was a picture of the mind that looked rather embarrassingly like a Sears catalogue."[46] It is therefore not surprising that Fodor does not distinguish different kinds of higher cognitive faculties and their functions. According to Fodor, such finer taxonomies can be tentatively devised in relation to modules by taking the relevant psychological research into account. However, psychological reasoning about the higher cognitive abilities of the mind appears to be so unconvincing in Fodor's view that he prefers to remain altogether silent about the details of higher cognitive processing, adhering instead to the maxim: better no explanation than a bad explanation.

Nevertheless, such a radical line of argument raises more questions than it seems to answer. In dividing cognitive faculties into input systems that can be explained by reverse engineering and higher cognitive faculties that cannot be explained at all, Fodor's account shows a **(p.282)** remarkable resemblance to Descartes's distinction between the body-dependent and the pure cognitive faculties.[47] It seems rather surprising, however, that such a resemblance should emerge from within a naturalistic framework. For Descartes, the pure intellect is part of a distinct substance, namely, the *res cogitans*, which is immortal and not extended in space. Fodor certainly does not aim at reestablishing Cartesianism in this comprehensive sense. Yet, again, the only thing this point illustrates is that Fodor does not aim at establishing any comprehensive approach to the faculties of the mind at all. Instead his concept of modules is meant to establish that input systems cannot be penetrated by global cognition and that we are far away from having a plausible theory of how global cognition works.

4. Massive Modularity

It is remarkable that Fodor's outlook should not only question the explanatory power of cognitive science but also the naturalist framework of explanation. This approach is based on his idea that there can be no cognitive science explanation of the central system and that computational-cum-representational explanations are the only viable scientific explanations of mental processes. If it is true that we do not have the slightest idea of how to describe the structure of higher cognitive processes in terms of reverse engineering, then at least those parts of the mind that are central or global simply cannot be captured in terms of computation. And, according to Fodor, cognitive scientists who have tried to explain the whole mind in computational terms have so far just chased it back further into the machine without really understanding its way of functioning.[48]

(p.283) Evolutionary psychologists have questioned this view by arguing that higher cognitive abilities might likewise be described as modular, once we just loosen the criteria for what it takes to be a module. The basic argument for massive modularity applies the general structure of evolutionary and adaptive processes to the architecture of the mind.[49] Accordingly, we should not expect the mind to have one central system running on one general-purpose rule of reasoning or one kind of representational format, since "different adaptive problems frequently have different optimal solutions, and can therefore be solved more efficiently by the application of different problem-solving procedures."[50] According to this view, natural selection is likely to have produced many different specialized mental rules for reasoning about various evolutionarily important domains.

The main argument for massive modularity can therefore be called the "argument from design";[51] it can be represented in the following form:

(1) Biological systems are designed systems that are constructed incrementally.
(2) Such systems, if complex, need to have massively modular organization.
(3) The human mind is a biological system, and it is complex.

(4) So, the human mind will be massively modularly organized.

(p.284) According to Carruthers, the design argument relies on a further argument, which states that our minds have evolved gradually from the minds of other animals. It can therefore be labeled “the continuity argument”:

(1) The minds of nonhuman animals are massively modular in their organization.

(2) Evolution is characteristically conservative, preserving and modifying existing structures rather than starting afresh.

(3) We can expect that the human mind should be organized along massively modular lines.

By stressing the continuity between animal and human minds, the continuity argument supports the central claim advanced in the third step of the argument from design, namely, that the human mind is a biological system. A central system, such as the one described by Fodor, is not completely impossible but is highly unlikely, according to this kind of reasoning, since it would require higher cognition to have been the product of one single macro-mutation, instead of being the result of a complex incremental process that developed many task-specific mechanisms over time.

While it seems plausible that the principles of evolutionary development speak in favor of a mental architecture that is modular all the way up, one might wonder about how Fodor’s notion of modularity relates to Carruthers’s claims. As we have shown, Fodor’s notion is meant to fit only input systems. By contrast, advocates of massive modularity tend to use the notion of modularity in a much weaker sense. The weakest sense that underlies many accounts in evolutionary psychology takes a module simply to be a dissociable functional component of the mind. Such a conception of modularity is not even restricted to the mind, but is rather meant to describe the whole living organism as an organization composed of functional components that themselves consist of assemblies of subcomponents, reaching from individual **(p.285)** organs at the top level down to cellular assemblies and processes involving genes at the bottom level.

Once we define a module in this way, however, it is questionable whether the proposal that the mind is modular all the way up remains a controversial claim. Fodor might perfectly well agree that higher cognitive abilities divide into subparts, such as the intellect and the will, and that these parts have different functions—provided only that these functional components of the mind are not perceived as domain-specific, encapsulated, and so on, but instead as global general-purpose mechanisms. It turns out therefore that the conclusions of Carruthers's arguments, instead of directly contradicting Fodor's approach, in fact use a weaker notion of modularity.

Nevertheless, the concept of massive modularity is far from being uncontroversial and is explicitly rejected not only by Fodor but by several others. As we will show, however, massive modularity is not controversial merely because of how modules are defined, but because of the way the concept is used in dividing up the whole mind—including higher cognition—into a range of different systems and subsystems that are perceived as adaptations to particular problems that our ancestors faced. What renders massive modularity controversial is therefore not the claim that the mind is modular all the way up—since this claim simply relies on a weaker definition of what a module is—but rather the way in which specifically biological explanations are applied to reasoning about the architecture of the mind.

A closer look at the account developed by Carruthers will underline this point. He argues that our minds have the general structure of a perception-belief-desire-planning-motor-control architecture, which is of "ancient ancestry" and can already be found in insects and spiders.[52] To be a believer-desirer in this sense means that one possesses distinct content-bearing belief and desire states that are discrete, structured, and causally efficacious in virtue of their structural properties. **(p.286)** Just as does Fodor, Carruthers therefore subscribes both to a realist position with regard to belief-desire psychology and to an overall model of the mind that Susan Hurley has labeled "the sandwich model of mind."[53] This model takes perception and action to be distinct units (or peripheral systems) and cognition to be interposed between these two units. In claiming that the belief-desire psychology is realized in the brain, both Fodor and Carruthers offer strong, rich ontological claims about the localization and structure of the mental faculties. According to Carruthers, such a rich mental structure must in fact be ascribed to all organisms that show at least some behavior that does not reduce to fixed action patterns.[54] The fact that even bees and spiders show apparently various forms of spatial reasoning and planning forces us to conceive of them as believers-desirers in the minimal sense, including any ontological consequences that such a claim might entail. Belief-desire architectures, in the sense of distinct, causally efficacious structures, must be ascribed to all organisms with a central nervous system in order to account for the flexibility of their behavior. Mental capacities cannot be explained merely as a result of associations, nor flexible behaviors as fixed action patterns or conditioned responses. As an approach to the overall structure of the mind, behaviorism and associationism are therefore already excluded at the level of insects. Elucidating the capacity for learning and the various abilities of organisms with a central nervous system presupposes that we assume a rich inner structure.

This then raises the question of what the structure of the mind looks like at a more fine-grained level. Perception, belief formation, desire, planning, and motor control systems can be understood to represent systems that are reminiscent of the traditional faculties. Yet, even if all of these decompose into many different functional subsystems, such modules should not be thought of as physically distinct objects, but **(p.287)** instead need to be understood as cognitive systems. However, this does not entail that modules should not be localizable in the brain; on the contrary, even though they must not be assumed to be localizable in one single place, they can be spread over various parts of the brain. While modules are supposed to be realized somewhere in the brain, however, they are still individuated by their function and not by their location in the brain. Up to this point, then, Carruthers's and Fodor's accounts are in agreement.

A major difference between Fodor and Carruthers opens up, however, when it comes to Carruthers's particular focus on the general rules of evolutionary design processes and the way he extrapolates from this background model several design constraints with regard to the mind's architecture. When thinking about the design of modules, we have to keep in mind, according to Carruthers, that modules are biologically derived systems that developed by co-opting and connecting resources in novel ways. Evolution needs to be able to add new functions without disrupting existing ones; and it needs to be able to tinker with the operations of a given functional subsystem. We should expect different modules therefore to have complex input and output connections with one another and in fact to be sharing parts on a massive scale. Since brain processing is relatively slow, we should furthermore expect massive parallelism and duplication of structure whenever signaling distances increase beyond a certain point or different sorts of information need to be processed within the same restricted time frame.

According to Carruthers, Fodor’s criteria of a module’s having proprietary transducers and shallow outputs will have to be dropped simply because they only apply to input systems. Carruthers furthermore denies that fast processing is an interesting criterion for distinguishing between different mental systems. Although he is in favor of strong nativism, Carruthers also drops innateness as a necessary criterion, simply because there *might* be *some* modules that are to a large degree acquired through learning. Nevertheless, interestingly, Carruthers adopts **(p.288)** Fodor’s criteria that modules are domain-specific, that is, that they process only a certain kind of input and are mandatory in the sense that they automatically process any input that matches their target domain.[55] In claiming that all modules work in this way, including those that are part of higher cognitive decision-making, Carruthers effectively denies that there is any interesting concept of free will or any significant difference between mandatory cognitive processing on lower and higher levels.

In his most important departure from Fodor, however, Carruthers also rejects the claim that encapsulation is necessary, where of course Fodor very clearly insists that encapsulation is the most important property identifying a module.[56] Nevertheless, on closer inspection, it turns out that Carruthers merely modifies Fodor’s claim rather than denying it outright: both Carruthers and Fodor agree that we should think of the design of the mind in terms of “computational frugality.” It is impossible that every system of the mind should have access to every kind of information processed elsewhere.

Nevertheless, Carruthers doubts that frugality requires encapsulation in such a strong sense. The idea of encapsulation derives from a tradition of thinking about the mind according to which information search was deemed to be exhaustive and algorithms were supposed to be designed so as to be optimally reliable. With reference to the work of Gerd Gigerenzer and his colleagues,[57] Carruthers suggests that we instead think about mental processes in terms of simple heuristics. Processing rules of the mind have been designed to be good enough, but not perfect. To **(p.289)** repeat, while Carruthers's notion of a module is much weaker than Fodor's, the background idea is to suppose certain design constraints and then produce a model of the mind that satisfies them. In this context, heuristics is seen as the outcome of selective processes that mediate a compromise between speed and reliability. Certain memory systems or social skills are encapsulated not in the narrow sense of having no access at all to information external to the system. Rather, these modules need to be described as being encapsulated in a wide sense: they have access to a very limited amount of information outside the system, which they access via structure-sensitive searching rules. According to Carruthers, the Fodorian argument for computational tractability does not warrant a claim about encapsulation as traditionally understood. It merely warrants what could be labeled "the wide-scope version" of the encapsulation claim: The mind should be constructed entirely out of systems that are frugal in the way they access information of other systems.

These design constraints also shed light on how modules should be individuated in principle. Each reliably recurring function that the human mind is requested to perform is apparently realized by an underlying system. Whenever an executed function is complex, the system in question is structured as an array of subsystems.

It is impossible to specify precisely how many modules there are, since the traditional faculties all divide into multiple subsystems. Not only can the memory system already be partitioned into working memory and long-term memory, but long-term memory can again be divided into explicit and implicit memory; explicit memory in turn separates out into episodic and semantic memory, where semantic memory, once again, splits off into multiple subsystems, and so on. Such a multiplication of faculties at the subpersonal level mirrors a general tendency in modern cognitive science when compared with traditional faculty psychology. Nowadays, traditional faculties, such as memory, tend to be divided into more fine-grained subsystems, which are not meant to be accessible from the first person perspective but are **(p.290)** instead presupposed with respect to certain theoretical background assumptions and empirical research methods.

While the tendency to trade in traditional faculties for more fine-grained, subpersonal mechanisms is already present in Fodor, and in cognitive science quite generally, massive modularists depart from faculty psychology in yet another sense. Where Fodor left the distinction between higher and lower cognitive faculties untouched and mirrored Cartesianism in the belief that higher faculties cannot be explained as computational mechanisms, massive modularists tend to blur the distinction between lower and higher faculties by suggesting instead a system of gradual differences extending between human and animal minds. Rather than simply assuming one central system, Carruthers lists more than twenty uniquely human capacities that point to various specifically human adaptations of the mental structure. The capacities that Carruthers cites range from a capacity for folk-physics, which facilitates deeper causal reasoning, to the ability to produce gossip, learn social norms, or acquire complex skills.

The most important additions to the human brain that account for the anthropological difference are a mind-reading system, capable of attributing mental states to others and oneself; a language learning system, designed to build modular production and comprehension systems suited to the surrounding language; and a normative reasoning and motivation system, which assists in forming judgments about what is permitted or prohibited and also generates relevant motivations. Furthermore, humans have an innate disposition for creatively generating and rehearsing action plans by utilizing a variety of heuristics and constraints.

The general reasoning capacity, which, according to Fodor, is implemented by the central system, is mainly realized in operational cycles of existing modular systems and their mutual interactions. The language module plays a particularly prominent role in this process, since Carruthers takes it to be responsible for the seemingly unlimited content flexibility of the human mind. The particular human kind of **(p.291)** reasoning is also slower, and conscious reasoning is accomplished in virtue of the "global broadcasting" of sensory representations of utterances in inner speech as well as other action rehearsals.

Carruthers manages to develop a comprehensive account of the mental architecture mainly by applying adaptationist reasoning. His particular strategy involves multiplying traditional faculties in terms of task-specific mechanisms that can only be individuated at a subpersonal level and redirecting the theoretical focus away from the strict traditional distinction between lower and higher faculties and toward an architecture of the mind that is incremental all the way up. Yet Carruthers's account and the approach to modularity of evolutionary psychology in general has not remained unchallenged.

5. The Critique of Modularity and Contemporary Reasoning about Faculties

Many people argue that, while Fodor's notion of a module is too strong, proponents of massive modularity, like Carruthers, Daniel Sperber, and Leda Cosmides and John Tooby, are weakening this notion to such a degree that to claim that the mind is modular becomes uninformative. Evolutionary psychology has been, furthermore, heavily criticized quite generally for its highly speculative approach to the mind.[58] It is therefore not surprising that the notion of the mental module has rarely been deployed in recent years. Yet the question of how to carve up the mind remains an open project. While there has been little explicit debate about mental faculties lately, many discussions have instead revolved around the details of functional decomposition, realizing mechanisms, and the supervenience base of mental abilities. These debates take place in newly transformed scientific contexts that now rely on neuroscientific studies and biological research on niche construction, **(p.292)** or form part of the work on embodied and situated cognition. These debates also open up new ways of thinking about mental faculties, and we will therefore provide a brief sketch of these developments in the following.

Jesse Prinz articulates a critique both of the Fodorian approach and evolutionary psychology, arguing that the neuroscientific perspective suggests instead that the mammalian brain uses the same areas for different functions and that neither domain-specific rules nor many interesting cases of encapsulation are to be found. Significantly, sensory cells have turned out to be often bimodal and to be used, for example, for both vision and touch. There is also plenty of evidence on cross-modal perception, on top-down effects in perception, and so on.[59] An ability such as mind reading, which, according to Carruthers and others, represents a prime example of a module, has been shown in neuroimaging studies to recruit language centers in the left frontal cortex, visuo-spatial areas in the right temporal-parietal regions, the amygdala, and the precuneus (involved in mental image assessments)—that is, mind reading seems to exploit a large network of structures that contribute also to many other capacities. The upshot of Prinz's argument is that neither Fodor nor Carruthers carve out interesting divisions within the mind. Instead, the mind ought to be described as a network of interconnected systems and subsystems and not as a collection of encapsulated domain-specific modules.

Many people have criticized the method of evolutionary psychology quite generally and its assumptions about the modularity of the mind more particularly. It has been argued that brain evolution would not design a brain that consisted of numerous prefabricated adaptations, as evolutionary psychology would have it, but instead has produced a brain that is capable of adapting to its local environment.[60] In this vein, **(p.293)** various authors have pointed out that evolutionary psychology both overestimates the role of hardwired, genetically determined mechanisms and underestimates the roles of the ecological niche, of learning abilities, and of cooperative foraging being practiced across generations within an ecological niche.[61]

While Prinz criticizes mainly the narrow notion of a module, suggesting a more liberal way of conceiving of the functional decomposition of the mind, recent years have also seen a more radical critique of the modularity approach. This criticism is part of a general turn in cognitive science away from the computationalist paradigm and toward a focus on the interrelation between brain, body, and world. Embodied and situated cognition approaches have criticized the attitude of identifying the mind with the brain only and of conceptualizing the brain as a symbol-processing computer. The mind, according to these approaches, should rather be understood as a collection of abilities that evolved in agents being endowed with particular bodies within specific surroundings: accordingly, language development is claimed to be dependent on the use of material symbols and the bodily ability of gesturing, perception is said to be closely intertwined with action, and memory to be bounded by certain contexts, including distinct social relations.[62] This way of thinking about the mind calls the traditional view about the architecture of the mind and also the concept of a module into question. Dynamical systems theory rejects the decomposition of the mind into separate modules and instead highlights the close couplings between various parts of the brain and between the **(p.294)** body and the environment.[63] It has been suggested in this vein that on the subpersonal level the distinction between cognition and emotion would not make any sense since emotional and cognitive activities both result from the activity of a variety of brain areas, none of which is exclusively dedicated to emotional or cognitive processing.[64] The general idea that traditional faculties, such as emotion and cognition, have no counterpart at the subpersonal level has been developed in the work of Hurley, who has established this claim with respect to perception and action.[65] Hurley, furthermore, criticizes what she calls the “sandwich model” of the mind, that is, the view that perception and action are distinct elements each lodged at the periphery of the mind while cognition forms the “hearty filling.” Hurley argues that perception and action need to interact closely in order for percepts and intentions to have any content at all. She furthermore suggests that we might think of the modularity of the mind not so much in terms of, for example, perception, cognition, and action being separate parts of the mind that process information in a one-way linear order. (She labels this concept “vertical modularity” and attributes it to Fodor.) According to Hurley, we should rather conceive domain-specific modules as being “horizontally modular,” namely, consider the quite different notion of a module such that our various mental abilities can be described as “layers” of the mind that will both engage action and perception systems and involve certain environmental conditions.[66]

Hurley’s idea, which originates in dynamical systems theory, is reformulated in a more modest version by William Bechtel, who suggests that we should think of the whole organism as an autonomous system aimed at maintaining itself, being separated from its environments yet **(p.295)** closely interacting with it.[67] Such an organism comprises component mechanisms that perform the necessary operations for maintaining themselves and are organized in such a way that they can also operate in unison. According to Bechtel, we should carve up the mind in terms of these incrementally evolved mechanisms that might interact closely with each other and their environment. Such mechanisms differ from encapsulated modules, however, because they allow for a much greater degree of crosstalk between the systems. Yet they also present a clear functional structure of the mind that can be said to be responsible for all kinds of intelligent behavior that we display.

It is eye-catching that the critique of the faculties, as it has been articulated in recent research, resembles ideas put forward by pragmatists and existentialists in the late nineteenth and early twentieth centuries. Their central idea was that the interaction between subject and world is prior to an “internal structure” or “essence” of the mind. The recent turn back to pragmatist ideas is largely due to the role that the neurosciences have started to play. Research on the location of the faculties in the brain was prominent all along in the neurosciences through the nineteenth century and large parts of the twentieth. While these studies have been central for the modularity hypothesis, the philosophical critique of modularity derives its main impulse from neuroscientific studies, which suggest that there are no faculty-specific areas in the brain. Recent critique of the modularity hypothesis is not a critique of neuroscientific approaches to the architecture of the mind per se. It is rather a critique that uses insights from neuroscience itself to criticize traditional accounts of the faculties and current versions of the modularity hypothesis alike. These new developments might make it seem as if theorizing about the modularity of mind might have been nothing but a brief interlude in the long decline of the faculties throughout modern times.

(p.296) 6. Conclusion

We have seen that, while theorizing about the faculties and their locations in the brain has been prominent in the neurosciences all through the nineteenth and early twentieth centuries, such theorizing was frowned on at the very same time by philosophers and psychologists. The tide turned with the rise of cognitivism and a return to the inner structures of the mind from the 1960s onward. The discussion about the modularity of the mind has its roots there. Modules, as we have pointed out, represent successor concepts of traditional faculties within current naturalistic theories about the architecture of the mind. In the work of Fodor, Carruthers, and others, modules are defined as those parts of the mind that can be individuated according to their function and, therefore, need to be understood as underlying our mental abilities. Modules do not capture folk-psychological categories but rather subpersonal mechanisms that are assumed by science. A main reason for introducing modules is the belief that behaviorist and associationist theorizing about the mind cannot explain our learning abilities on a broad scale, the way our cognitive states are content-sensitive, and how our mental abilities differ from one another.

Fodor and Carruthers are both functionalists and naturalists about the mind, yet each devises a rather different account. As we have shown, this is mainly due to the diverging naturalist paradigms operating in the background: While Fodor is arguing in the spirit of “good old-fashioned artificial intelligence,”[68] conceiving of input-systems as inference-producing encapsulated mechanisms, Carruthers applies adaptationist notions to the mental structure and therefore utilizes very different design principles.

The modularity debate is not only a debate that is situated *within* a naturalistic framework, it is also a debate *about* that very naturalistic framework. As we have shown, Fodor’s moderate modularity thesis **(p.297)** holds that the central cognitive systems are nonmodular and that cognitive science has no means of understanding the global processing of nonmodular systems. Yet since cognitive science is the only game in town when it comes to a naturalistic understanding of the mind, the prospects for naturalism look quite bleak. From a broader historical perspective, the debate initiated by Fodor is at its core a debate about our understanding of the higher mental faculties that are characteristic of the *human* mind. Are these faculties—the higher-level cognitive systems—to be explained within the naturalistic framework of cognitive science and evolutionary theory? Descartes thought that, in contrast to the lower faculties, the higher faculties of will and intellect cannot be explanatory targets within a general science of the material world. Fodor seems to agree. Evolutionary psychologists on the other hand aim to develop an account of the mind that is modular all the way up, since evolution forces us to conceive of the mind as a system that developed incrementally. Evolutionary psychologists therefore blur the distinction between lower and higher faculties. One might be skeptical about the kind of adaptationist reasoning that justifies massive modularity approaches. Yet it remains an interesting fact that evolutionary psychologists have started to doubt the unity of the higher faculties and to suggest splitting them up into specialized modules *because* they believe that the evolution of a global system such as "reason" is close to impossible in an evolutionary framework of explanation.

Current embodied approaches do not question the naturalist framework and stick with the idea that the mind developed incrementally, but they argue from a scientific perspective that assumes that there are no modules akin to task-specific locatable areas in the brain that realize mental abilities. Instead, embodied and dynamicist theories suggest that naturalist approaches to the mind fare better if they describe cognitive systems as systems that become established in the interaction between an embodied agent and a structured environment. In this way, they rekindle pragmatist ideas about the primacy of action and revive them in the framework of cognitive science. While the modularity **(p.298)** debate has been dominated by the question about whether the faculties can be understood in a naturalist framework, it seems that most sections of cognitive science are pretty efficient nowadays in describing the mechanisms that realize cognitive abilities without assuming modules or anything faculty-like in the background.[69]

Notes:

([1]) Franz Joseph Gall, "Des Herrn Dr. F. J. Gall Schreiben ueber seinen geendigten Prodromus ueber die Verrichtungen des Gehirns der Menschen und der Thiere, an Herrn Jos. Fr. von Retzer," *Wielands Neuer Teutscher Merkur* 12 (1798): 311–35.

([2]) For a more nuanced view Michael Hagner, *Homo cerebralis: Der Wandel vom Seelenorgan zum Gehirn* (Frankfurt: Suhrkamp, 1992).

([3]) The chapter “The association of ideas” was inserted in the fourth edition of the *Essay concerning Human Understanding* in 1700.

([4]) Théodule Ribot, *La psychologie anglaise contemporaine* (Paris: Librairie philosophique de Ladrange, 1870); Howard C. Warren, *A History of the Association Psychology* (New York: Scribner, 1921).

([5]) Théodule Ribot, *La psychologie anglaise contemporaine* (Paris: Librairie philosophique de Ladrange, 1870).

([6]) Théodule Ribot, *L’hérédité: Étude psychologique sur ses phénomènes, ses lois, ses causes, ses conséquences* (Paris: Librairie philosophique de Ladrange, 1873).

([7]) Théodule Ribot, *Les maladies de la mémoire* (Paris: Félix Alcan, 1881); Théodule Ribot, *Les maladies de la volonté* (Paris: Félix Alcan, 1882); Théodule Ribot, *Les maladies de la personnalité* (Paris; Félix Alcan, 1885).

([8]) Wilhelm Wundt, “Die Aufgaben der experimentellen Psychologie,” in *Unsere Zeit III* (Leipzig: F. A. Brockhaus, 1882).

([9]) Despite the fact that William James adopts a number of different methodological approaches in *The Principles of Psychology*, James tells the reader that he will follow the method of introspection, which he characterizes as “the looking into our own minds and reporting what we there discover” (see William James, *The Principles of Psychology* [New York: Dover, 1980], 185). Given this methodological starting point and the Jamesian conception of the mind as a stream of consciousness, it comes as no surprise that the mental faculties have no role to play in the *Principles*.

([10]) See John Watson, “Psychology as the Behaviorist Views It,” *Psychological Review* 20 (1913): 158–77.

([11]) Karl-Otto Apel, *Charles S. Peirce: From Pragmatism to Pragmaticism* (Amherst: University of Massachusetts Press, 1981).

([12]) Michael Dummett, *Origins of Analytical Philosophy* (London: Duckworth, 1993), 4.

([13]) This combination of theoretical commitments emerges clearly in Wilfrid Sellars's work. Sellars thinks that the revolutionary insight of classical pragmatism can be captured if its central doctrine is not confused with a rather abstruse instrumentalist theory about linguistic meaning and instead it "is reformulated as the thesis that the language we use has a much more intimate connection with conduct than we have yet suggested, and that this connection is intrinsic to its structure as language, rather than a 'use' to which it 'happens' to be put." Wilfrid Sellars, *Science, Perception and Reality* (London: Routledge and Kegan Paul, 1963), 340.

([14]) While today "cognitive science" is simply the label used for the interdisciplinary study of (the animal, human, and artificial) mind and intelligence, involving disciplines such as philosophy, psychology, artificial intelligence, neuroscience, linguistics, and anthropology, the aims and methods of this science were narrower in the beginning, mainly comprising psychological, linguistic, and computer science research.

([15]) See Allen Newell, John Shaw, and Herbert Simon, "Report on a General Problem-Solving Program," *Proceedings of the International Conference on Information Processing* (Paris: UNESCO, 1959), 256–64.

([16]) See Noam Chomsky's famous review of Skinner's *Verbal Behavior* in his "Review of *Verbal Behavior,*" *Language* 35 (1959): 26–58, and the subsequent development of his ideas about innate linguistic knowledge in Chomsky, *Aspects of the Theory of Syntax* (Cambridge, MA: MIT Press, 1964).

([17]) See the classical article by Breland and Breland, containing the following opening passage: "There seems to be a continuing realization by psychologists that perhaps the white rat cannot reveal everything there is to know about behavior. … Perhaps this reluctance is due in part to some dark precognition of what they might find in such investigations, for the ethologists Lorenz … and Tinbergen … have warned that if psychologists are to understand and predict the behavior of organisms, it is essential that they become thoroughly familiar with the instinctive behavior patterns of each new species they essay to study." Keller Breland and Marian Breland, "The Misbehavior of Organisms," *American Psychologist* 16 (1961): 681.

([18]) See Richard Gregory, *Eye and Brain: The Psychology of Seeing* (London: Weidenfeld and Nicolson, 1967).

([19]) Zenon Pylyshyn, *Computation and Cognition* (Cambridge, MA: MIT Press, 1984).

([20]) See John Von Neumann, *First Draft of a Report* (Philadelphia: Moore School of Electrical Engineering, University of Pennsylvania, 1945).

([21]) There are also other areas of research in contemporary philosophy that rely on mental faculties. Take, for example, contemporary virtue epistemology. Virtue epistemologists consider knowledge as something we obtain by exercising our intellectual virtues. In the broadest sense, a virtue is an excellence of some kind (normally an ability or a character trait). In epistemology, the relevant kind of excellence will be intellectual. Many virtue epistemologists characterize the intellectual virtues as mental faculties or powers for producing beliefs that are true (see John Greco and John Turri, *Virtue Epistemology: Contemporary Readings* [Cambridge, MA: MIT Press, 2012]). These faculties include good eyesight, well-functioning memory, introspection, and logical reasoning. More specifically, these faculties are virtues precisely because they are considered to be stable and reliable dispositions for producing true beliefs. What is more, their reliable character renders them virtues relative to the actual world—even if they are not considered to be reliable relative to any other possible world. Nevertheless, the mental faculties are only rarely discussed directly in virtue epistemology and instead tend to be merely presupposed. This contrasts markedly with discussions revolving around the modularity of the mind. We will therefore focus instead on modularity as a prime example of how the mental faculties have fared in contemporary philosophy.

([22]) To be sure, in the Aristotelian framework, there are vegetative faculties; however, they do not amount to cognitive faculties.

([23]) We will not deal with the question of the modularity of the passions and the emotions here; but see Luc Faucher, ed., *The Modularity of Emotions* (Calgary: University of Calgary Press, 2008).

([24]) On this criterion of division see chapter 3, section 3.

([25]) See Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983); Peter Carruthers, *The Architecture of Mind* (Oxford: Oxford University Press, 2006).

([26]) See Zenon Pylyshyn, "Is Vision Continuous with Cognition? The Case for Cognitive Impenetrability of Visual Perception," *Brain and Behavioral Sciences* 22 (1999): 341–423.

([27]) In principle, there is space for another option here. Cundall argues that cognition is best viewed as a continuum of cognitive processing stretching from modules into central systems as opposed to a discrete architectural division between peripheral and central systems; see Michael K. Cundall, "Rethinking the Divide: Modules and Central Systems," *Philosophia* 34 (2006): 379–93.

([28]) Leda Cosmides and John Tooby, "Cognitive Adaptations for Social Exchange," in *The Adapted Mind*, edited by Jerome Barkow, Leda Cosmides, and John Tooby (Oxford: Oxford University Press, 1992), 163–228. Henry Plotkin, *Evolution in Mind* (London: Alan Lane, 1997); Stephen Pinker, *How the Mind Works* (New York: Norton, 1997); Peter Carruthers, *The Architecture of the Mind* (Oxford: Oxford University Press, 2006), and "The Case for Massively Modular Models of the Mind," in *Contemporary Debates in Cognitive Science*, edited by Robert Stainton (Oxford: Blackwell, 2006), 3–21.

([29]) Richard Samuels, "Evolutionary Psychology and the Massive Modularity Hypothesis," *British Journal for the Philosophy of Science* 49 (1998): 575–602; Daniel Sperber, "In Defense of Massive Modularity," in *Language, Brain, and Cognitive Development: Essays in Honor of Jacques Mehler*, edited by Emmanuel Dupoux (Cambridge, MA: MIT Press, 2002), 47–57; Peter Carruthers, *The Architecture of Mind* (Oxford: Oxford University Press, 2006); David Buller and Valerie Hardcastle, "Evolutionary Psychology, Meet

Developmental Neurobiology: Against Promiscuous Modularity," *Brain and Mind* 1 (2000): 302–25.

([30]) Richard Samuels, "Is the Human Mind Massively Modular?," in *Contemporary Debates in Cognitive Science*, edited by Robert Stainton, 37–56 (Oxford: Blackwell, 2006).

([31]) For instance, Pylyshyn notes that his thesis about the cognitive impenetrability of visual perception "is closely related to what Fodor (*The Modularity of Mind*) has called the 'modularity of mind.' " And he adds: "Because there are several independent notions conflated in the general use of the term 'module', we shall not use this term to designate cognitively impenetrable systems in this article." Zenon Pylyshyn, "Is Vision Continuous with Cognition? The Case for Cognitive Impenetrability of Visual Perception," *Brain and Behavioral Sciences* 22 (1999): 364.

([32]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 26.

([33]) See Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 47.

([34]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 48.

([35]) Philip Robbins, "Modularity of Mind," in *Stanford Encyclopedia of Philosophy*, http://plato .stanford.edu/entries/modularity–mind/, 2009, accessed September 3, 2014.

([36]) Eleanor Rosch et al., "Basic Objects in Natural Categories," *Cognitive Psychology* 8 (1976): 382–439.

([37]) But see an objection in Jesse Prinz, "Is the Mind Really Modular?," in *Contemporary Debates in Cognitive Science*, edited by Robert Stainton (Oxford: Blackwell, 2006), 22–36.

([38]) Philip Robbins, "Modularity of Mind," in *Stanford Encyclopedia of Philosophy*, http://plato .stanford.edu/entries/modularity–mind/, 2009, accessed September 3, 2014.

([39]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 100.

([40]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 107.

([41]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 111.

([42]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 47.

([43]) Richard Gregory, *The Intelligent Eye* (New York: McGraw Hill, 1970); Jerome Bruner, "On Perceptual Readiness," in *Beyond the Information Given*, edited by Jeremy M. Anglin (New York: Norton, 1973), 7–42.

([44]) Jerry Fodor, "Precis of the Modularity of Mind," *Behavioral and Brain Sciences* 8 (1985): 1–42.

([45]) Jerry Fodor, "Precis of the Modularity of Mind," *Behavioral and Brain Sciences* 8 (1985): 1–42. For a discussion of whether perception is hard-wired and theory-neutral or plastic and theory-dependent and for the epistemological dimension of this question, see the debate between Jerry Fodor, "A Reply to Churchland's 'Perceptual Plasticity and Theoretical Neutrality,'" *Philosophy of Science* 55 (1988): 188–98, and Paul Churchland, "Perceptual Plasticity and Theoretical Neutrality: A Reply to Jerry Fodor," *Philosophy of Science* 55 (1988): 167–87.

([46]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 126.

([47]) A fairly similar argument for the irreducibility of global systems to underlying mechanisms can be found in Descartes's *Discourse on the Method*, part V; see Descartes, *The Philosophical Writings*, vol. 1, 43–46.

([48]) Jerry Fodor, *The Modularity of Mind: An Essay on Faculty Psychology* (Cambridge, MA: MIT Press, 1983), 127.

([49]) Leda Cosmides and John Tooby, "Cognitive Adaptations for Social Exchange," in *The Adapted Mind*, edited by Jerome Barkow, Leda Cosmides, and John Tooby (Oxford: Oxford University Press, 1992), 163–228; Daniel Sperber, "The Modularity of Thought and the Epidemiology of Representations," in *Mapping the Mind*, edited by Lawrence A. Hirschfeld and Susan A. Gelman (Cambridge: Cambridge University Press, 1994), 39–67; Daniel Sperber, *Explaining Culture: A Naturalistic Approach* (Oxford: Blackwell, 1996); Daniel Sperber, "In Defense of Massive Modularity," in

Language, Brain, and Cognitive Development: Essays in Honor of Jacques Mehler, edited by Emmanuel Dupoux (Cambridge, MA: MIT Press, 2002), 47–57; Stephen Pinker, *How the Mind Works* (New York: Norton, 1997); Harold Clark Barrett, "Enzymatic Computation and Cognitive Modularity," *Mind and Language* 20 (2005): 259–87.

([50]) Leda Cosmides and John Tooby, "Cognitive Adaptations for Social Exchange," in *The Adapted Mind*, edited by Jerome Barkow, Leda Cosmides, and John Tooby (Oxford: Oxford University Press, 1992), 179.

([51]) Peter Carruthers, *The Architecture of Mind* (Oxford: Oxford University Press, 2006).

([52]) Peter Carruthers, *The Architecture of Mind* (Oxford: Oxford University Press, 2006), 65.

([53]) Susan Hurley, "Action and Perception: Alternative Views," *Synthese* 129 (2001): 3–40.

([54]) Peter Carruthers, *The Architecture of Mind* (Oxford: Oxford University Press, 2006), 73.

([55]) Domain specificity becomes the most important criterion of a module in evolutionary psychology in general. See also Daniel Sperber, "The Modularity of Thought and the Epidemiology of Representations," in *Mapping the Mind*, edited by Lawrence A. Hirschfeld and Susan A. Gelman (Cambridge: Cambridge University Press, 1994), 39–67; Daniel Sperber, "Modularity and Relevance: How Can a Massively Modular Mind Be Flexible and Context Sensitive?," in *The Innate Mind: Structure and Content*, edited by Peter Carruthers, Stephen Laurence, and Stephen Stich (Oxford: Oxford University Press, 2005), 53–69.

([56]) Jerry Fodor, *The Mind Doesn't Work That Way* (Cambridge, MA: MIT Press, 2000).

([57]) Gerd Gigerenzer, Peter Todd, and the ABC Research Group, *Simple Heuristics That Make Us Smart* (Oxford: Oxford University Press, 1999).

([58]) Jesse Prinz, "Is the Mind Really Modular?," in *Contemporary Debates in Cognitive Science*, edited by Robert

Stainton (Oxford: Blackwell, 2006), 22–36; Fiona Cowie, “Us, Them and It: Modules, Genes, Environments and Evolution,” *Mind and Language* 23 (2008): 284–92.

([59]) Jesse Prinz, “Is the Mind Really Modular?,” in *Contemporary Debates in Cognitive Science*, edited by Robert Stainton (Oxford: Blackwell, 2006), 22–36.

([60]) David Buller, *Adapting Minds* (Cambridge, MA: MIT Press, 2005).

([61]) Fiona Cowie, “Us, Them and It: Modules, Genes, Environments and Evolution,” *Mind and Language* 23 (2008): 284–92; Sterelny, “Language, Modularity and Evolution,” in *Teleosemantics*, edited by Graham MacDonald and David Papineau (Oxford: Oxford University Press, 2003), 23-41; Kim Sterelny, *The Evolved Apprentice: How Evolution Made Us Human* (Cambridge, MA: MIT Press, 2012).

([62]) Andy Clark, *Supersizing the Mind: Embodiment, Action, and Cognitive Extension* (Oxford: Oxford University Press, 2008); Susan Hurley, *Consciousness in Action* (Cambridge, MA: Harvard University Press, 2002); John Sutton and Kelly Williamson, “Embodied Remembering,” in *Handbook of Embodied Cognition*, edited by Lawrence Shapiro (New York: Routledge, 2014), 315–26.

([63]) Esther Thelen and Linda Smith, *A Dynamic Systems Approach to the Development of Cognition and Action* (Cambridge, MA: MIT Press, 1994); J. A. Scott Kelso, *Dynamic Patterns: The Self-Organization of Brain and Behavior* (Cambridge, MA: MIT Press, 1995).

([64]) Giovanna Colombetti, *The Feeling Body: Affective Science Meets the Enactive Mind* (Cambridge, MA: MIT Press, 2014), 98–100.

([65]) Susan Hurley, “Perception and Action: Alternative Views,” Synthese 129 (2001): 3–40.

([66]) Susan Hurley, *Consciousness in Action* (Cambridge, MA: Harvard University Press, 2002).

([67]) William Bechtel, “Explanation: Mechanism, Modularity, and Situated Cognition,” in *The Cambridge Handbook of*

Situated Cognition, edited by Robbins Ayede (Cambridge: Cambridge University Press, 2009), 155–70.

(68) This label was coined by John Haugeland, *Artificial Intelligence: The Very Idea* (Cambridge, MA: MIT Press, 1986), 112.

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