1 Introduction: nativism past and present

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Nativist theorizing is thriving. Present in the works of Plato, although much neglected since, nativism is once more at the forefront of contemporary developmental and cognitive theory. This resurgence owes much to the pioneering arguments of Noam Chomsky, which have stimulated a huge amount of productive work in linguistics and cognitive psychology over the past half century. But nativist theorizing has also received a powerful impetus from work in genetics and evolutionary biology, as biological thinking has begun to permeate psychology and philosophy of mind. Consequently, a broad range of research across the cognitive sciences over the past twenty years or more has been inspired by nativist theorizing. There have also been some revolutionary results.

This book is the first of three volumes that present some of these results and discuss their implications. These volumes will draw together research and arguments from philosophers, psychologists, linguists, anthropologists, primatologists and other cognitive scientists to provide an integrated and detailed picture of where nativist theory currently stands and of what its future holds. Taken together these volumes present a detailed and wide-ranging study of the current state and the possible future development of 21st century nativism. In so doing, they also provide unparalleled insight into what we, as humans, are.

This first volume focuses on the fundamental architecture of the mind, and on some of its innate contents. The papers contained herein investigate such questions as: What capacities, processes, representations, biases, and connections are innate? What role do these innate elements play in the development of our mature cognitive capacities? Which of these elements are shared with other members of the animal kingdom? What, in short, is the structure of the innate mind? A summary of these investigations, and of the answers that they provide, can be found in the final section of this Introduction. First, however, we will briefly review some of the recent (and not so recent) debates in philosophy, psychology, anthropology, evolutionary theory, and other cognitive sciences that provide a background for the topics with which this volume is concerned.
1 A brief history of nativism

Philosophical consideration of the innate structure of the mind has a long and complex history.\(^1\) Plato was one of the earliest—and most extreme—nativists. In the *Phaedo* and the *Meno* Plato argued that, since we have knowledge and abilities for which experience is insufficient, these things must not have been taught to us, but rather must have been present in us at birth. Plato’s extreme, and highly implausible, form of nativism essentially took all knowledge to be innate. For Plato all genuine knowledge is something that we ‘recollect’ from what we already know.

Philosophers of the Enlightenment also examined the questions that Plato had addressed. This time, however, discussion concerned not only why certain things may be innate and what in particular these things may be, but also what we should take the very term ‘innate’ to mean. In his *Essay Concerning Human Understanding* John Locke argued that there can be ‘no innate principles in the mind’ because, amongst other things, no useful sense can be given to the notion of innateness itself. Locke argued that if innateness literally means ‘in the mind at birth’, then innate principles must play *from birth* the same kinds of role that such principles play in our minds later in life. But this, Locke claimed, is clearly not the case, since many supposedly innate principles play no role in the mental lives of infants and ‘idiots’. However, Locke continued, if the innateness of certain principles is to be read merely as the claim that such principles are somehow potentially or *dispositionally* in our minds at birth, then we require some criteria by which we may distinguish those principles that are innate from those that are not. According to Locke, such criteria cannot be found. Locke concluded that there is therefore no reasonable way in which the notion of innateness can be deployed, and thus no way to be a nativist about the origins of the principles in question.

Few have found this particular argument of Locke’s convincing. Presence at birth is merely *evidence* for innateness,\(^2\) it is not criterial. There are many physical features of our bodies that are plainly innate, of course, but that aren’t present at birth. Facial hair in men would be one example. There is no reason to think that innate features of our minds should be

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\(^1\) A clear and informative summary of the history of this debate can be found in Stich (1975).

\(^2\) Likewise for a variety of other characteristics often linked to innateness, such as universality. And just as universality is only a defeasible guide to innateness (belief that the sky is blue may well be universal, but it is not innate), so presence at birth is only a defeasible guide to innateness—some learning appears to happen in the womb. This explains, for example, newborns’ preference for stories repeatedly read to them in the final trimester of pregnancy (DeCasper & Spence 1986).
any different. This is fortunate for Locke, for he too will need at least some basic innate machinery to get things off the ground—truly blank slates cannot learn anything.

This means that the burden of characterizing what it is for something to be innate is as much a problem for empiricists as it is for nativists. How much of a burden this is, however, is not entirely clear. Scientific progress in investigating a kind does not generally depend on having an airtight characterization of that kind. Just as we can investigate the phenomena of locomotion, memory, chemical interaction, or planetary movement without fully explicit characterizations of the kinds involved, so too with innateness. If one is wanted, a first pass characterization of innateness might take a cognitive mechanism, representation, bias, or connection to be innate to the extent that it emerges at some point in the course of normal development, but is not a product of learning. In any case the nativism/empiricism dispute is not about what innateness is. Rather, it is about what, and what sorts of things, we should take to be innate.

“Nativism” and “empiricism” are, of course, labels for broad families of views, and there is no such thing as “the nativist position” or “the empiricist position”. Moreover, a theorist might be more or less nativist with respect to one domain or type of structure, but not another. As a result, there is a great deal of healthy disagreement amongst those who would take themselves to be broadly sympathetic to nativism—as will be evident in this volume. We can nonetheless characterize, in general terms, the ways in which nativist views tend to differ from empiricist views. Nativists are inclined to see the mind as the product of a relatively large number of innately specified, relatively complex, domain-specific structures and processes. Their empiricist counterparts incline toward the view that much less of the content of the mind exists prior to worldly experience, and that the processes that operate upon this experience are of a much more domain-general nature. In other words, empiricists favor an initial cognitive architecture that is largely content-free, and in which general purpose learning mechanisms operate on the input from the senses so as to build up the contents of the mind from the cognizer’s experience of the world. Nativists, in contrast, favor an architecture that is both more detailed and more content-laden, containing, for example, faculties or principles of inference that are specifically designed for the acquisition and performance of particular cognitive tasks. This is what the nativist/empiricist debate is really about.

We now come (via a somewhat lengthy stride) to the work of twentieth century theorists. As Chomsky notes, contemporary nativists and empiricists agree that “the question is not whether innate structure is a prerequisite for learning, but rather what it is” (1980, p. 310). Where they differ is over the existence, richness and complexity of the pre-specified
contents, structures and processes of the mind. What is perhaps most significant and characteristic of the contemporary debate, is that empirical data is now being brought to bear on the debate in a systematic way. This is strikingly evident in Chomsky’s own work, and is undoubtedly at the heart of the resurgence of nativism. Unlike some nativists of the past who were more inclined to argue on broadly aprioristic grounds for nativism, contemporary nativists embracing broadly empirical arguments for innateness recognize that there is no incompatibility between empirical argumentation and nativist conclusions. Moreover, we now have, for the first time in this debate, a large body of data gained from decades of systematic, sustained, empirical research which bears on the questions at hand. While this research is solidly empirical in nature, the results that it has supplied have brought increasing discomfort to theorists of an empiricist persuasion. So let us now undertake a brief tour of some of its more salient aspects.

2 The poverty of the stimulus

Historically, the most important domain in the contemporary debate surrounding nativism is natural language. In the face of widespread empiricist conviction that children acquired language through instruction or conditioning and that the mechanisms of acquisition were both simple and entirely domain general, Chomsky argued that language acquisition is strongly innately guided—so much so that language acquisition would be better described as involving a process of maturation rather than one of learning or instruction (1957, 1965, 1967). Though Chomsky offered many arguments to support this view, perhaps the most important type of argument that he offered was a version of the Poverty of the Stimulus argument (1967, 1975, 1988).

The central idea behind Poverty of the Stimulus arguments is that the knowledge\(^3\) that cognizers acquire, to underpin certain cognitive abilities, is radically underdetermined by the input available to the cognizer in her developmental environment. In other words, arguments from the poverty of the stimulus claim, roughly, that the information available to a cognizer is too impoverished to provide her with the knowledge that the performance of certain cognitive abilities requires. Nativists conclude from such arguments that the required knowledge must thus originate elsewhere. If the information is not in the environment, then it

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\(^3\) In most of what follows the term ‘knowledge’ should be interpreted loosely, to mean whatever faculties, capacities, representations, beliefs, etc. are appropriate to the cognitive task at hand. It should not be interpreted in the strict sense of justified true beliefs, unless explicitly stated.
is plausible to suppose that it is somehow innate. In particular, it is plausible to assume that a richer innate endowment than that posited by the empiricist is required to interact with the environmental information. Empiricists, in contrast, conclude that such arguments must be unsound. They argue, for example, that there is more information in the environment than the nativist allows, or that the child is a better learner than the nativist supposes.

In the case of language, a powerful version of the Poverty of the Stimulus Argument can be constructed against the background of contemporary linguistic theory. The history of contemporary linguistic theory is, in part, one of discovering an enormous number of subtle regularities in our linguistic behavior—regularities which prior to contemporary linguistic theory simply were not noticed. In attempting to come to grips with this huge (and growing) body of data, linguists have put forward many different theories concerning the structure of language. This immediately suggests that the environmental input is extremely unlikely to lead children equipped only with the empiricist’s simple, domain general learning strategies to the correct hypothesis. There are too many tempting alternative hypotheses.

Indeed, if we truly suppose that children are empiricist learners, then it is not at all obvious how they would come to even some of the most basic assumptions about language: that it is a system of communication, that meanings are associated with words as opposed to individual sounds, that strings of sounds can be assigned more than one meaning and more than one syntactic structure, and so on. There are also theoretical decisions that need to be made, which linguists themselves have struggled with for years: are rules construction specific (e.g., is there a rule for forming a yes/no question from a declarative sentence) or is sentence structure dictated by a number of non-construction-specific rules interacting? Are rules optional or mandatory? Do rules apply in a fixed order, or are they unordered? And so on. Faced with all these possibilities, it would be a miracle if children were able to reliably arrive at the correct grammar using only the empiricist’s few, simple, domain general learning mechanisms.

Moreover, these considerations are supported by a variety of further arguments. To take just one example, one would naturally suppose that if children were empiricist learners,

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4 For a detailed version of this argument, see Laurence & Margolis (2001). See also Baker (2001), Crain & Thornton (1998), and Pinker (1994).

5 A similar point could be made concerning the study of vision, which has also been intensively investigated in the past 50 years. Indeed, the complexity of vision shows that even empiricist models which assume the existence of “only” perceptual systems and general purpose learning mechanisms are committed to a great deal of innate machinery.
then collectively they would try out a huge number of different grammars, and that the types of mistakes they would make would be highly variable. In fact, though, the sorts of errors children make are highly circumscribed (Pinker 1994; Crain et al this volume). This provides further evidence that there is a rich innate endowment underwriting language acquisition.

If empiricist learners can’t be expected to reliably arrive at the correct hypothesis concerning the structure of their language, the natural thing to assume is that children have a richer innate endowment than empiricists have assumed. And in fact, the real debate about language acquisition is not about whether a nativist model is correct, but rather about which sort of nativist model is correct. Language is acquired on the basis of a rich, and significantly domain specific set of cognitive capacities, representations, or biases. Further research will help us to determine exactly which such cognitive structures are involved and just how rich and domain specific they are.

In spite of the strength and influence of Chomsky’s Poverty of the Stimulus argument, such arguments are not the only ones for nativism. Indeed, it is important to recognize that nativism in a given domain is perfectly compatible with there being ample environmental evidence concerning that domain. So, for example, mallard ducks seem to have innate knowledge of their species typical courtship behavior—in spite of the fact that one can easily imagine a domain general mechanism for acquiring this behavior from the many exemplars that the ducks are exposed to under normal circumstances. Our evidence for this is based on a type of Poverty of the Stimulus Argument. Female mallard ducks that are raised exclusively with pintail ducks and have never seen the species typical courtship behavior characteristic of female mallards, spontaneously display this behavior when they encounter a male mallard duck for the first time (Lorenz 1957; Ariew 1999). But though our evidence for this trait being innate comes through a Poverty of the Stimulus Argument, under normal circumstances the stimuli are not at all impoverished—without the experimenters’ intervention female mallards would see many other female mallards engaging in their species typical courtship behavior. There is no incompatibility between a trait being innate and there being ample environmental evidence for the trait to be acquired through learning.

It is sometimes suggested that empiricism is the default position concerning cognitive development, and that we should only be nativists as a last resort—or that nativists are somehow lazy, taking the easy way out and avoiding the hard job of spelling out how a cognitive structure could be acquired. There is, however, no reason to accept either of these charges. For any given domain, the question is simply what the best model of acquisition is, all things considered. There is no more reason to suppose that such models should proceed, if
at all possible, only on the basis of some set of simple domain general processes identified by the empiricist, than there is to suppose that in building a television or a car engine we should only be allowed nuts and bolts and no other materials. Nativist theorizing isn’t lazy, it’s just that nativists prefer to work without their hands tied by arbitrary strictures on what sorts of materials they should work with. The methodological principle at work here is one all theorists should embrace: build the best model you can using whatever materials you need, in order to best accommodate all the known data (including developmental trajectory, evolutionary history, developmental dissociations, and so on).

While language is an important case for nativism, it is by no means the only area where nativist research has proved fruitful. We will now briefly consider some relevant results from developmental psychology and the other cognitive sciences, and some of the other sources of evidence that provide the backdrop to this volume.

3 Psychology and anthropology

Perhaps the most striking aspect of human cognition is also the one that is easiest to miss; namely, its widespread uniformity and predictability. In our daily lives we tend to focus on the differences between individuals, and these differences can be the source of huge reward or suffering in both our personal and professional lives. However, if we take a step back from this high resolution image, the similarities between all the members of our species become clear (Chomsky 1975; Brown 1991; Botterill and Caruthers 1999). So too, indeed, do the similarities between humans and many other species of animal on our planet (Gould and Gould, 1994; Byrne, 1995; Tomasello and Call, 1997). Moreover, a century of work in the cognitive sciences has shown just how widespread and fundamental these similarities actually are.

Detailed empirical evidence that normal human cognitive development follows a largely uniform and structured pattern has been present since the work of Piaget (e.g., Piaget 1936, 1937, 1959; Piaget and Inhelder 1941, 1948, 1966). Piaget proposed a model of children’s cognitive development that involved steady, across-the-board improvement in an individual’s cognitive abilities, where this improvement was driven partly by the action of environmental stimuli, and partly by the unfolding in development of a suite of domain-general learning mechanisms.

However, work since, and in response to, Piaget has shown that development is in fact a much less unified affair within an individual, even though uniformity across individuals remains the norm. In other words, we now know that each individual’s cognitive
development follows a domain-specific trajectory for each cognitive domain (see for example, Baillargeon 1994; Carey 1985; Karmiloff-Smith 1992; Spelke 2003; Stromswold 2000; Wellman 1990). However, we also know that within each domain there exists a well-ordered pattern of development, and that this pattern is uniform for all normal members of our species (again, see for example, Baillargeon 1994; Carey 1985; Karmiloff-Smith 1992; Spelke 2003; Stromswold 2000; Wellman 1990).

Moreover, there has been a striking trend in the developmental psychology of the past 25 years or so, finding that very young infants are much more like adults, cognitively, than was supposed by Piaget. With more sophisticated experimental techniques, cognitive capacities have been shown to exist at a much younger age than was previously thought. In some cases, these experiments seem to demonstrate a poverty of the stimulus, with infants showing capacities and preferences literally from birth. Johnson and Morton (1991), for example, have shown that infants only hours old have a preferential interest in face-like shapes, and Meltzoff and Moore (1995), working with infants as young as 42 minutes old, have shown that newborns have the ability to imitate facial gestures. In other cases, capacities have been demonstrated at much younger ages than Piaget hypothesized, but where in principle infants may have gleaned the information from the environment. For example, Elizabeth Spelke and her colleagues have demonstrated that four-month old babies have expectations and make inferences about the unity, solidity and normal movements of objects (Spelke et al. 1994; Baillargeon 1994). In one such experiment, Baillargeon et al (1985) habituated 5 1/2 month old infants to a screen rotating back 180° away from them on a flat surface. Following this, infants were tested under two conditions. One condition involved the same 180° movement of the screen but where an object which was occluded as the screen rotated back was in the path of the rotating screen. Since the object should have blocked the screen’s rotation, this condition is an “impossible event condition”. The other condition involved a novel movement of the screen to less than 180° where it encountered the blocking object. This condition is a “possible event condition” (see figure 1).
Piaget took infants of this age to not represent the existence, or properties, of occluded objects. Thus, he should expect the infants to dishabituate more to the “possible event”, which involves a novel movement of the screen. In fact, infants as young as 5 1/2 months old dishabituate more to the “impossible event”, suggesting that they do in fact represent the existence of the occluded object. Later experiments found similar results for 4 1/2 mo olds, and at least some infants as young as 3 1/2 months (see Baillargeon 1987).

There is also now strong evidence that such domain-specific patterning occurs even when environmental input during the developmental process is highly restricted. For example, children develop normal linguistic abilities and at the normal rate even in cultures that address little if any speech either directly or indirectly to developing infants (Marcus 1993; Pinker 1994; Pye 1992). Similarly, blind children acquire language at the same pace and with same developmental pattern as other children (Landau and Gleitman 1985). This kind of evidence points strongly toward the existence of a uniform, species-wide, innate cognitive endowment which consists (at least in part) of various domain-specific faculties. Developmental psychology has thus filled in some of the details of the uniform pattern which Piaget observed, but in a way radically different to that which he would have expected.

In addition to the evidence for cognitive uniformity from developmental psychology, there is increasing evidence in similar vein from anthropological investigation (Atran 1990, 2002; Boyer 1994; Brown 1991; Sperber 1996). For example, Scott Atran argues that comparative data from studies of Maya Indians and rural North Americans support the existence of a common cognitive system specific to our folk-biology – our understanding of
the taxonomy of the natural world and of the inter-relations of life-forms within it (Atran,, 2002). Similarly, Pascal Boyer has shown that while religious concepts and practice may appear to be both culturally diverse and individually idiosyncratic, such concepts and practices are in fact strongly constrained by universally shared systems for folk-psychology, naïve-physics, folk-biology and understandings of artifacts (Boyer 1994, 2000).

What we find, therefore, is that both anthropology and developmental psychology are now converging on a model of human cognition which employs the same notion of innate and universal cognitive faculties that philosophers and linguists initially proposed. Moreover, there is increasing reason to believe that this convergence is not simply fortuitous.

4 Evolution

Evolutionary biology has proved an overwhelmingly successful twentieth-century descendant of Darwin’s (1859, 1871, 1872) nineteenth-century work. Consequently, the latter half of the twentieth century has seen two significant attempts to apply the theory and methodology of evolutionary biology to human behavior and cognition. The first of these was sociobiology (Alexander 1974; Wilson 1975, 1978), which in turn gave rise to what is now called ‘behavioral ecology’. Advocates of sociobiology argue that much of human behavior is as it is because it exhibits ‘adaptive function’. That is, it has been beneficial to humans over evolutionary time and has therefore evolved and been retained due to natural selection. Understanding human behavior in this way has led to plausible explanations of many individual and group-level behavioral phenomena, including conflict resolution, mate choice, parental investment and foraging strategies (Barrett et al., 2002; Dunbar 1999; Smith and Winterhalder 1992). However, socio-biologists explicitly restricted themselves to explanations of behavior at the functional level. That is, they focused exclusively on the purpose that any given behavior serves in the life-history of an individual organism, and made no claims about the underlying causes of the adaptive behaviors thus observed. At the time sociobiology was first developed, even this limited application of evolutionary theory to human behavior was controversial enough.

The eventual extension of socio-biological ideas to the likely causes of observed behavior resulted in the development of what is termed ‘evolutionary psychology’ (Tooby and Cosmides 1992; Barkow et al. 1992; Pinker 1997, 2002). Here the focus is not on behavior per se, but on the cognitive mechanisms that underwrite it. Evolutionary psychologists argue that natural selection has equipped us with numerous evolved, domain-specific cognitive adaptations, and that these adaptations enable us as individuals to produce
rapidly a variety of behaviors, which are more or less appropriate to whatever our current situation requires. Under this interpretation, what have been selected for over evolutionary time are cognitive mechanisms whose interactions can reliably generate behaviors that are positively correlated with our evolutionary fitness. And while these cognitive mechanisms evolved as a result of selective pressures in our distant past, they can nonetheless generate behaviors appropriate to more contemporary environments. In other words, evolution has provided us with certain innate, domain-specific faculties and mechanisms which then interact with our current beliefs in local conditions to cause our behavior. Human behavior and cognition are thus both enabled and constrained by our evolutionary history and the selective pressures that this involved.

One consequence of the evolutionary psychology perspective is that the evolved cognitive mechanisms that it proposes may generate behaviors which, while they were adaptive at one time in our evolutionary history, are now non-adaptive due to novel factors in our current circumstances. This is the cognitive equivalent of the well-known fact that our evolutionary drive to consume and store fats and sugars whenever possible now underwrites the high levels of obesity in the modern world resulting from the easy availability of fat-and-sugar-rich diets. We have, to put it simply, “stone-age minds in a space-aged environment” (Dunbar 1999, p. 784), and consequently there is the potential for a mismatch between our cognitive capabilities and our environmental circumstances. However, this potential mismatch has positive research implications, since empirical evidence of such a disparity will offer support for the claims of evolutionary psychologists.

Critics often argue that the claims of evolutionary psychologists are in fact little more than post-hoc or ‘just-so’ story-telling (Gould 1997; Rose and Rose 2000). As these critics point out, reconstructions of our past environments are inherently speculative, and they claim that it is therefore a mistake to use the imagined properties of these environments as the basis for psychological theorizing. However, while our knowledge of past environments is indeed rather sparse in comparison to our knowledge of more contemporary circumstances, archaeologists are now providing increasing evidence of both the nature of these environments and of the kinds of cognitive behavior that (proto-)humans engaged in within them (e.g., Mithen 1996, 2000; Wynn 1991, 2000).

Moreover, despite the current sparseness of the archaeological record, there are very many properties of our human ancestors and their environments of which we can be (almost) certain. For example: they had two sexes; they chose mates; they lived in a world where self-propelled motion reliably predicted that an entity was an animal and where objects
conformed to the principles of kinematic geometry; they had faces; they had color vision; they interacted with conspecifics; they were predated upon; and so on (Tooby and Cosmides, 1992). All of these properties can be used to generate novel hypotheses concerning the cognitive mechanisms we may now possess, and there is no *a priori* reason to think that these hypotheses will be any less productive than those that are evolutionarily agnostic. There may well be no reason to think that hypotheses driven by evolutionary considerations are likely to be any *more* productive than agnostic ones (though we doubt this), but this is at best an argument for pursuing research programs driven by both kinds of consideration, rather than for ignoring or rejecting the proposals of evolutionary psychologists.

By and large, therefore, there is broad agreement that evolutionary pressures have played some role in determining the content of our innate cognitive endowment. There is also much healthy disagreement over the exact nature of the innate faculties and mechanisms that have evolved (Carruthers and Chamberlain 2000; Heyes and Huber 2000). Suffice to say that all the authors in this volume, and indeed most other nativists, endorse some degree of evolutionary explanation of the contents and structure of our innate cognitive endowment. And, while there exist significant and important differences in just *how much* of this content and structure can or should be thus explained, there is also a universally shared belief that it is work of precisely the kind that this volume presents that will enable us to resolve these differences.

5 Modularity

Throughout the preceding sections we have spoken of domain-specific cognition, and of the domain-specific faculties, mechanisms and structures that underwrite our cognitive abilities. We will now say a little more about this, and about the increasingly vexed issue of *cognitive modularity*.

That normal adult cognition consists, to some extent, in domain-specific faculties, mechanisms and structures is beyond any doubt. The sheer volume of data to this effect, derived from studies into the cognitive abilities of normal subjects, subjects who have suffered brain lesions or other trauma, and subjects with abnormal developmental profiles, can admit of no other explanation (REFS). However, the extent to which this domain specificity is indicative of cognitive modularity is much more contentious.

Fodor (1983) provides the modern origins of modular models of cognition. Fodor argues that our ‘peripheral’ cognitive systems – those involved in our senses and our language ability – are modular. What Fodor means is that these systems are innate,
mandatory, fast, domain-specific, subject to characteristic patterns of development and breakdown, have proprietary inputs and shallow outputs and, most importantly for Fodor, are informationally encapsulated: their internal processes are impervious to influence from other parts of cognition. The rest of our cognition, Fodor argues, is a-modular, a fact easily demonstrated by the holistic or domain-general, i.e., unencapsulated, nature of our conceptual processing. Since this original definition, he has softened his requirements a little, but for Fodor a module remains “a computational system with a proprietary database...[where] this device operates to map its characteristic inputs onto its characteristic outputs...[and] in the course of doing so, its informational resources are restricted to what is in the proprietary database” (Fodor 2000, p. 63). For Fodor, then, modular cognitive systems exhibit encapsulation, and central cognition remains resolutely a-modular.

Other researchers have increasingly argued otherwise (Tooby and Cosmides, 1992; Pinker, 1997; Scholl and Leslie, 1999; Carruthers, 2003). However, in so doing they have been required to adjust the definition of a module somewhat. Samuels (2000) provides an examination of such adjustments and of the most prominent and successful current notions of cognitive modularity. So too do many of the papers in this volume. We will therefore restrict ourselves here to a summary of the most salient aspects of this issue.

It is clear that cognitive faculties can theoretically exhibit domain-specificity and/or encapsulation with regard to both the information that they draw on when processing and the computational processes by which such processing is implemented. This therefore allows us to distinguish between representational modules and computational modules respectively. To a first approximation, representational modules are domain-specific bodies of data (organized and integrated in the right kind of way); computational modules are domain-specific processing devices. Thus, for instance, “a parser might be conceived of as a computational module that deploys the contents of a [representational] module devoted to linguistic information in order to generate syntactic and semantic representations of physical sentence forms” (Samuels 2000, p. 19). Similar points could be made for other cognitive domains.

However, we can also see that while these two kinds of module may (often) occur together in some given cognitive domain, it isn’t necessary that they do so. Domain specific cognitive abilities could in theory depend upon representational modules to provide domain-specific information which is then manipulated by various domain-general processes (that is, processes which don’t have the domain-specificity required for them to be considered as computational modules). Conversely, one could imagine that for some domain there exists a computational module designed to take as input the output from other modules so as to
generate the representational module for that particular domain. The point to remember, therefore, is that representational modules and computational modules are modules of significantly different kinds, and a given cognitive domain might well involve one sort of module but not the other.

One consequence of this distinction is that for any given domain, the contents of either or both kinds of module may be innate. Thus it behooves both nativists and their opponents to be clear about which kind or kinds of module their claims concern. One purpose of this volume, and of the project of which it is a part, is to provide precisely the clarity required in this regard. Discussions and explanations of the extent to which cognitive development is modular must also take care to observe the representational/computational distinction, and to be equally clear on what precisely is being claimed. Again, many of the papers in this volume have this as an implicit aim.

Further adjustments to the post-Fodorian notion of modularity concern the properties required for a cognitive structure to be modular. In order for the domain-specific faculties found in central cognition to be modular, it is clearly the case that input to these faculties must be (at least partly) conceptual and that their output may be much deeper than that of peripheral systems. Also, such faculties may be more open to influence from other faculties (i.e. to be less encapsulated) than peripheral modules appear to be. However, most of Fodor’s other criteria, e.g., that such faculties are mandatory, fast (relative to other systems), domain-specific, and subject to characteristic patterns of development and breakdown, all remain. So, too, does the claim that at least some of these modules are innate. Thus central cognition can exhibit modularity in a meaningful and powerful sense, even if such modularity is not identical to that which Fodor initially proposed.

There remains, however, a question over just how modular central cognition is. Some theorists defend what is referred to as the ‘massive modularity hypothesis’ – the claim that the human mind consists (almost) entirely of cognitive modules (Sperber 1994; Tooby and Cosmides 1992). Others argue for a ‘less massive’ picture (REFS). On this view certain cognitive abilities are indeed implemented by modular central systems, e.g., our Theory of Mind (Baron-Cohen 1995; Leslie 1994). However, there is also no explicit denial of (and indeed some explicit defense of) the existence of some kind of ‘central executive’ or otherwise ‘integrative’ cognitive mechanism which is domain-general, and perhaps initially largely content-free, and which operates on the outputs of these cognitive modules. Finally, there are those who follow Fodor in steadfastly maintaining that only our peripheral systems are modular, and that the rest of our cognition is entirely a-modal.
Why do certain theorists, and particularly Fodor, resist the pull of the ‘more massive’ accounts? What underwrites Fodor’s skepticism is what he terms the ‘Abduction Problem’ (Fodor 2000). And, in fact, this problem is an instance of the more general question of how an explanation of human cognition in terms of domain-specific cognitive modules can be squared with the apparently domain-general flexibility of human cognition. This ‘Flexibility Problem’ lies, in various disguises, at the heart of a number of worries, suggestions and theories of many theorists who are nonetheless inclined to different degrees of ‘more massive’ hypotheses. Moreover, it is clearly a problem that needs to be solved if anything more than a moderately modular conception of cognition is correct. However, since some of the chapters in this book deal explicitly with this question (Sperber ch. 4; Carruthers ch. 5; Samuels ch. 7), further discussion can be put to one side. Suffice it to say that many of the authors in this volume endorse some degree of central systems modularity, while nonetheless healthily disagreeing over the extent to which such modularity will ultimately provide the whole story.

Research in philosophy, psychology, anthropology and evolutionary theory thus all offer support for nativist theorizing. However, while we have emphasized the connections and similarities between the results from these disciplines, it is important to remember that such connections aren’t necessary ones. That is, one can be a nativist but also reject (many) evolutionary explanations of the innate structures we possess. Similarly, one can accept varying degrees and definitions of cognitive modularity while remaining well within the nativist camp. Cognitive science is a multidisciplinary enterprise, and the results of each part of this enterprise are important and defensible independently of the whole. However, as with all scientific inquiry, when evidence from disparate sources converges one should be inclined to see this as offering increasing support for the convergent view. We believe that this volume provides evidence of just such a convergence, and what we hope is that previously skeptical readers will become as inclined as we are to support the resultant convergent view: that nativist theorizing offers the best understanding of our cognitive abilities, and thus of our place in the natural world.

6 A guide through this volume
In the latter half of the twentieth century, then, nativism has gained increasing support from theoretical and empirical work in philosophy, psychology, linguistics, anthropology, evolutionary theory and other cognitive sciences. This work provides the background for the papers in this volume, and also for the larger project of which all three volumes are a part.
We will now say a few words about each of the chapters constituting this first volume, highlighting various recurring themes and issues.

6.1 Architecture

The essays in part one all focus on architectural issues, with many of them discussing the question of massive modularity and the problems that the latter view has in accounting for cognitive flexibility.

Marcus (ch. 2) examines an apparent tension created by recent research on neurological development and genetics, on the one hand, and cognitive development, on the other. Work on brain development shows it to be surprisingly flexible, and the human genome appears far too small to specify brain structure to any fine degree of detail. But on the other hand, work on cognitive development shows that many aspects of cognition are partly or largely pre-specified (see sections 1-4 above). Marcus reviews a number of ways in which the apparent tension between these facts can be resolved. He also presents several models and computer simulations of the ways in which genes code for neural development, showing how such a resolution can be achieved in practice.

Scholl (ch. 3), too, discusses and resolves an apparent tension: this time between innate pre-specification and learning. He focuses on aspects of the human visual system as his key example, showing how the processes involved can be understood in terms of a form of Bayesian inference, in which some aspects are innate and some set by experience, or in which innate ‘default settings’ can be modified by experience. He suggests that this sort of result may generalize to central cognitive systems.

Our first discussion of the flexibility problem for massive modularity is provided by Sperber (ch. 4). He builds on his earlier work on Relevance Theory in linguistics (Sperber and Wilson, 1986/1995) and argues here that massively modular architectures exhibit flexibility largely as a result of context-sensitive competition between modules for the allocation of cognitive resources. It is thus the cognitive system as a whole that exhibits flexibility, rather than any particular sub-system within it.

Carruthers (ch. 5), too, addresses the flexibility problem, sketching an account in which various cognitive modules combine to provide (the appearance of) domain-general thinking. In particular, he argues that various specific properties of a modular language faculty, in combination with the capacity for imagination and for the generation of cycles of cognitive activity, can enable humans to integrate information across cognitive domains without the need for a distinct, domain-general, central processor.
Shusterman and Spelke (ch. 6), too, defend the view that it is the language faculty that permits information from different modular domains to be combined. They focus on the integration of geometric and object-property information in particular. Building on previous experimental results, they discuss their recent language training study which appears to demonstrate a causal role for language in enabling the integration of information across these two domains.

Samuels (ch. 7) provides a critical examination of one set of arguments that are thought to support massive modularity, which turn on the claim that modular mental organization is required for cognitive processes to be computationally tractable. While insisting that much in cognition must be innately specified, he doubts whether this particular claim (and hence the massively modular version of nativism that it supports) can be adequately defended.

Simpson (ch. 8) attempts to sketch the outlines of what a reasonable form of nativism might look like. He is particularly concerned that the sort of view he develops shouldn’t be confused with the set of more extreme nativist claims that are often attributed to nativists by their opponents.

6.2 Language and Concepts

The essays in part two focus on a variety of nativist claims relating to language and concept acquisition.

Atran (ch. 9) draws a distinction between two kinds of adaptationist methodology. Strong adaptationism holds that complex design is best explained by task-specific adaptations to particular ancestral environments; whereas weak adaptationism claims that we should not assume that complex design is the result of such narrowly determined task- or niche-specific evolutionary pressures in the absence of substantial corroborating evidence. Atran argues that in certain cognitive domains, particularly folk-biology, strong adaptationism has proved extremely useful for advancing research. But in other domains, particularly language, weak adaptationism has proved the better strategy.

Baker (ch. 10) focuses on two different views of universal grammar (one innately endowed component of the language faculty). Most linguists assume that universal grammar is under-specified – providing us with an incomplete grammar to be elaborated by learning. But the alternative (defended by Chomsky) is that it is over-specified – providing us with a full range of possible grammars from which we select one on the basis of environmental input. Under-specification is now the dominant view in the developmental sciences, and is
often treated as the null hypothesis on grounds of greater possibility, parsimony and simplicity. Baker takes issue with each of these grounds, and concludes that we have in fact no reason to prefer under-specification to over-specification in the context of linguistic development.

Crain et al. (ch. 11) present detailed empirical work on several aspects of children’s linguistic performance, focusing in particular on evidence that even two-year-old children understand that the meanings of Determiners are ‘conservative’, that the meaning of natural language disjunction is ‘inclusive-or’, and that the structural notion of ‘c-command’ governs a range of linguistic phenomena. They employ this and other work to defend three related versions of the argument from the poverty of the stimulus, each of which strongly supports the existence of an innate language faculty.

Associationist models of cognitive development come under fire from Gelman (ch. 12). She focuses on the development of naming in young children – the process by which young children learn or otherwise construct the meanings of words and concepts. She presents empirical evidence that by the age of 30 months children have an ‘insight’ into both essentialism and the generic / non-generic distinction, and that these insights are neither directly taught during development nor reducible to information in the child’s developmental environment.

Laurence and Margolis (ch. 13) take up the issue of the acquisition of number concepts, focusing on the innate mechanisms underlying our concepts for the positive integers. Some developmental psychologists hold that the positive integers are acquired on the basis of a domain-specific innate endowment that is transformed through the use of language. Laurence and Margolis argue that the best accounts of this sort have major shortcomings and are far from showing that language has this transforming power.

6.3 Theory of Mind

The essays in part three focus on innateness claims relating to our ability to attribute mental states to one another, which generally goes under the name of ‘theory of mind’.

Povinelli et al. (ch. 14) argue that the evolution of theory of mind in humans opened up much wider opportunities for parent-offspring conflict than had previously been available. In particular, they argue that human infants might have become increasingly skilled at exploiting adults’ capacity for theory of mind, even when the infants themselves have yet to develop such a capacity. By being innately disposed to exhibit certain social behaviors like smiling, pointing and gaze following, which increase adult care-givers’ erroneous attributions...
of higher-level or adult-like cognitive abilities to the infant, infants could induce care-givers to provide more and/or better care than they would otherwise have done.

Johnson (ch. 15) provides evidence that very young infants (c.12-14 months) distinguish agents on the basis of a number of cues, including conversation-like patterns of interaction with other agents. She also provides evidence that infants conceive of agents as possessing mental states like desire. *Inter alia* she takes up Povinelli *et al.*’s challenge, arguing that the data support her own interpretation better than the claimed existence of a set of ‘releasers’ for innate, but ‘uncomprehending’ social behaviors.

Tager-Flusberg (ch. 16) considers the role played by subjects with *neuro-developmental disorders* in our investigations of cognitive development. She begins by presenting an overview of the methodological reasons for and against using subjects with certain neuro-developmental disorders (e.g., autism and Williams syndrome) to inform debates about normal and abnormal cognitive architecture. She then argues that studies of subjects with these kinds of disorders do indeed have much to offer, and that in fact many useful results have been obtained from previous studies, especially pertaining to the innate basis of theory of mind.

6.4 Motivation

The essays in part four all focus on claims about the innate basis of human motivational systems.

Buss and Duntley (ch. 17) apply evolutionary theorizing to the domain of homicide. To provide a comprehensive explanation of homicide, they propose the existence of suite of *evolved homicide mechanisms* (many of which are motivational or emotional in nature). These are cognitive mechanisms shaped over evolutionary time by selective pressures across a range of adaptive problems to which homicide might often enough have provided the solution. The especially high homicide rates in hunter-gatherer societies suggests that there would have been powerful selective pressures in this domain.

Tooby and Cosmides (ch. 18) ask why it is that, despite the power of poverty of stimulus arguments, many cognitive and behavioral scientists have still not been forced to recognize the truth of nativism. They suggest that this is primarily because the domains in which these arguments have hitherto been applied, e.g., language or naïve-physics, are all ones in which the knowledge that children acquire is objectively present in their environment. So the possibility always remains open that children could somehow be acquiring this knowledge from the environment through general learning. In the case of motivation,
however, this last bastion of resistance is unavailable, since desires don’t serve to represent information that is already present in the environment. (The point of desire is to change the world, not to represent it.) The closest thing to a knock-down argument for nativism can therefore be developed in respect of innate motivational systems, Tooby and Cosmides argue.

Greene (ch. 19) and Nichols (ch. 20) both turn to consider what might be innate in the human capacity for moral thinking and feeling. Greene reviews a variety of sources of evidence for an innate moral faculty, before presenting brain-imaging data in support of the same conclusion. In his view, our moral thought is the product of an interaction between some ‘gut-reaction’ moral emotions (many of which might be shared with our primate cousins) and our capacity for abstract reflection. Nichols focuses on the question of what marks off moral norms from rules of other kinds, such as those of etiquette. He argues that what is distinctive of morality is the attachment to a norm of certain sorts of innate emotional reaction (including disgust).

6 Conclusion
These are exciting times for the study of cognition. An unprecedented volume of work is being undertaken, and an unparalleled degree of interdisciplinary discourse is taking place. And as these efforts continue, support for nativist theorizing is rapidly increasing. This volume shows how widespread this support now is, with many philosophers, psychologists, linguists, anthropologists, primatologists, archaeologists and other cognitive scientists all converging on nativist models of cognition and cognitive development. However, this volume also shows how much more work is still to be done, and points to a number of new directions for future research. We believe, therefore, that this book provides a substantial contribution to our understanding of cognition and of the nature of ourselves.

References


