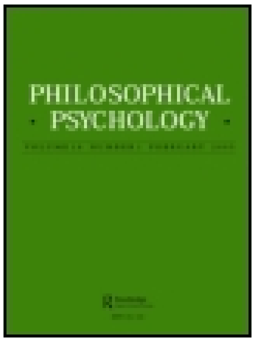

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Innateness as a natural cognitive kind

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ABSTRACT
Innate cognitive capacities are widely posited in cognitive science, yet both philosophers and scientists have criticized the concept of innateness as being hopelessly confused. Despite a number of recent attempts to define or characterize innateness, critics have charged that it is associated with a diverse set of properties and encourages unwarranted inferences among properties that are frequently unrelated. This criticism can be countered by showing that the properties associated with innateness cluster together in reliable ways, at least in the context of the study of cognition (though perhaps not in other scientific domains). Even though the causal connections between these cognitive properties are not always strict, they are robust enough to warrant considering innateness to be a natural kind as used in contemporary cognitive science.

KEYWORDS
Cognitive science; innateness; nativism; natural kind

1. Innateness as a Scientific Concept

Though it originated as a folk or vernacular concept, innateness has featured prominently in contemporary controversies in cognitive science.[1] There are ongoing debates concerning whether the linguistic faculty is innate to the human species, the extent to which numerical, spatial, and causal cognition are innate, and the degree of innateness of moral rules and religious concepts, among others. Yet, in addition to these first-order debates about the innateness of some of our basic cognitive capacities, there is a second-order debate about the viability of the innateness concept in the first place. Some scientists and philosophers have voiced reservations about the very concept of innateness, questioning its suitability for rigorous scientific theorizing and doubting that it corresponds to a genuine natural kind. If they are right, then that would mean that the debates about the nature and extent of our innate cognitive endowment are pointless, since they revolve around a discredited concept. In response, I will attempt in this paper to defend the concept of innateness against its critics and to establish that it is a useful scientific concept. Moreover, if we take science to be our most dependable guide to natural kinds, the utility and unity of the concept of innateness in contemporary cognitive science is a reliable indicator that it picks out a natural cognitive kind, that is to say a natural kind in cognitive science.

To appreciate the objections to the concept of innateness, it is necessary first to be acquainted with some recent efforts to define or characterize the concept of innateness. What is it for a cognitive capacity to be innate? Various attempts have been made to provide an explication of innateness that accords with contemporary scientific theorizing. Recent accounts of innateness include the following:

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Canalization. Innateness is canalization, where a phenotypic endstate is canalized to the degree to which the development of that endstate is insensitive to a range of environmental conditions under which the endstate emerges. (Ariew, 1999, 2006; Collins, 2005)

Entrenchment. Innate traits are generatively entrenched, in the sense that they appear early in development and have a number of later developing traits dependent on them (the degree of entrenchment is correlated with the number of traits depending on them). (Wimsatt, 1999)

Psychological primitiveness. Innate traits are explanatorily primitive in the domain of psychology, that is, the proper explanation of their acquisition lies outside of the domain of psychology. (Cowie, 1999; Samuels, 2002)

Triggering. An innate cognitive capacity has a disposition or tendency to be triggered on the basis of an environmental input that is informationally impoverished by comparison to the resultant cognitive capacity. (Khalidi, 2002, 2007; Stich, 1975)

Closed process invariance. An innate trait develops across a range of normal environments, and the proximal cause of its development is a closed process or processes, where a closed process is one that tends to produce one or very few outcomes (and where closure is a matter of degree). (Mallon & Weinberg, 2006; Weinberg & Mallon, 2008)

Some of these proposals attempt to account for uses of innateness in a wide array of sciences, including microbiology, genetics, evolutionary biology, and so on, while others are intended to be more restricted to cognitive science. In what follows, I will be concerned with trying to rehabilitate a concept of innateness that applies primarily to the cognitive sciences. Rather than trying to characterize innate traits or phenotypic endstates in general, I will attempt to explain what it is for a cognitive capacity to be innate. As will become clear in due course, the characterization applies primarily to representational or information-bearing cognitive states. So it is quite possible that the innateness concept has outlived its usefulness in many areas of biology, yet continues to be of value in cognitive science.

It needs to be emphasized at the outset that this defense of innateness as a natural kind is not intended to persuade anyone who would deny that there are any natural kinds in the cognitive sciences, much less someone who thinks that there are no natural kinds in the special sciences more generally. Instead, I will assume a naturalist view that considers science to be our surest guide to identifying natural kinds. On this view, categories can defeasibly be considered to correspond to natural kinds if they pertain to our settled scientific theories, are projectable, and are genuinely explanatory. Of course, any given scientific category may be rejected or replaced in the course of inquiry, and any such claims are corrigible in light of future scientific developments. But bearing that important caveat in mind, I will try to show that INNATENESS is a good example of a scientific category that picks out a natural kind. In other words, assuming that there are at least some natural *cognitive* kinds, my aim will be to argue that given our current state of knowledge, innateness is on a par with other prime candidates for natural kinds in the cognitive sciences. In doing so, I am in agreement with a number of recent authors who have argued that the ontological basis of natural kinds, and what makes them projectable and central to scientific inquiry, is that they are grounded in causality.[2]

2. Critiques of the Innateness Concept

All the attempts to elucidate innateness mentioned in the previous section have been deemed misguided by other theorists on two principal grounds. The first criticism of the innateness concept has to do with its alleged association with discredited essentialist and typological ideas in biology, while the second criticism claims that the concept of innateness runs together a number of unrelated features or properties. Though these critiques are often combined, I think that they are distinct and will only focus here on the second criticism.[3]

The second criticism of the concept of INNATENESS charges that, rather than being a unified concept, INNATENESS is a multivalent category, combining a number of disparate criteria (Bateson & Mameli, 2007; Griffiths, 2002; Mameli, 2008; Mameli & Bateson, 2011; Shea, 2012a). Closely related to this criticism is the contention that the different factors that influence people's judgments about innateness are not always correlated, leading to unwarranted inferences from one of those features to one or more of the others. The objection here is not that the features themselves are problematic but that the features, some of which are scientifically respectable taken individually, are not always correlated. The natural response to this objection consists in pointing out both that innateness may be a polythetic category or a cluster concept that combines several of the features posited by the analyses mentioned and that these features are imperfectly correlated. By contrast with a monothetic concept, the features are not singly necessary and jointly sufficient for the application of the concept. Many other scientific concepts, especially biological concepts, are of this kind (e.g., biological species or diseases that do not have a single cause, like cancer). Since scientific categories often appear in exception-prone empirical generalizations, there is usually a risk of making an unsuccessful inference from one of the features associated with a scientific concept to another.

But the claim has also been made that the innateness concept consists of a "clutter" rather than a cluster of criteria (Bateson & Mameli, 2007; Mameli, 2008; Mameli & Bateson, 2011). Though these critics do not give a precise way of distinguishing a clutter from a cluster, they have likened the concept of innateness to the pre-theoretical concept JADE. As is now well known, jade comprises two distinct minerals, jadeite and nephrite, with entirely different chemical compositions. These substances share some of the same macro-properties (e.g., color, hardness) by sheer coincidence, but there is no superordinate kind JADE that unites them. To escape the fate of jade, these critics state that a cluster theorist "has to give an account of the … properties that constitute the cluster, of the causal processes that connect such properties and cause them to tend to co-occur" (Mameli & Bateson, 2011, p. 441). These researchers argue that some of the properties associated with innateness are scientifically sound but are not always reliably correlated or causally linked to one another. In what follows, I will try to respond to the challenge posed by the critics of innateness and will both outline the main properties associated with innateness and give a preliminary account of some of the causal connections among these properties. These properties are conceptually distinct, and the causal connections among them may not be obvious, but I will maintain that there is considerable empirical evidence to suggest that they are reliably causally linked, enough to provide grounds for thinking that innateness constitutes a cluster category rather than a clutter.[4]

3. Innateness as a Cluster Category

A cluster category, with probabilistic causal relations among the properties included in the cluster, is just what we would expect in a theoretical category in the biological and cognitive sciences. The question is, what are the associated properties in the case of INNATENESS, and how are they related? We have already encountered some of them, and others can be readily gleaned from recent research in cognitive science. What follows is a tentative list of properties or features associated with innate cognitive capacities, which may not be exhaustive:

Triggering (or more properly, **triggerability**). Can be acquired in conditions of relative informational impoverishment.

Lack of learning. Need not be acquired as a result of processes such as inference, memorization, conditioning, association, exploration, experimentation, repeated observation, and imitation.

Early onset. Acquired relatively early in ontogeny.

Invariance. Acquired across a broad range of environments.

Canalization. Buffered against environmental variation.

Pancultural. Present in all cultures, even though it may not be universal or monomorphic.

Informational encapsulation. Insulated from other cognitive content, functions independently of other cognitive systems.

Cognitive impenetrability. Resists modification by other cognitive capacities.

Critical period. Acquired only or most effectively within a developmental window.

In this section, I will try to show that, at least according to some prominent research programs in cognitive science, there are robust causal links among these properties. Cognitive scientists regularly make inferences and provide explanations that posit causal relations that situate these properties in a web or network, with some of these properties being causally prior to other properties in the network. Although I will not offer a comprehensive account of this causal network, I will try to provide enough examples to make a plausible case for the existence of such causal connections. Many of these examples will be drawn from a prominent nativist research program in developmental psychology, the "Core Cognition" research program championed by Carey, Spelke, and others. This is obviously not the only research program in cognitive science to use the concept of innateness, but it is one of the most prominent ones to do so, and at least some of its results concerning the development of human cognition have been widely accepted. It is therefore convenient as a relatively established scientific paradigm that has made widespread use of the category of innateness.

3.1. Triggering and Lack of Learning

If a cognitive capacity can be acquired on the basis of a trigger, that is to say that it can be acquired as a result of an impoverished input. While it may not make sense to say that an input is impoverished in an absolute sense, it is possible to rule that an input is impoverished relative to the resulting output, the output being the cognitive state or capacity that is acquired as a result of that input (Khalidi, 2002, 2007). One of the most widely used argumentative strategies in cognitive science, the argument from the "poverty of the stimulus," relies on just such considerations to reach the conclusion that some particular cognitive state is innate (Laurence & Margolis, 2001). But if something is disposed to be acquired as a result of an impoverished input, then it is plausible to say that it need not be acquired as a result of a learning process on the part of the agent, including trial-and-error, extensive observation, imitation, inference, or "any process that treats information derived from the world as evidence" (Carey, 2009, p. 453). The reason is that treating the world as evidence involves a sequence of psychological events wherein information is processed, and this generally involves something more than minimal input from the environment. To be sure, the difference between learning something on the basis of information derived from the environment and having something triggered by an environmental input may be a matter of degree. Yet, learning and triggering can be thought to represent two ends of a continuum. To the extent that a cognitive capacity is disposed to be triggered, it can be acquired without learning. That is why some cognitive scientists believe that when a cognitive capacity has been acquired on the basis of an impoverished input, that is evidence that that capacity has not been learned (and hence that it has a substantive innate component). As Carey puts it in discussing infants' capacity to represent agency: "In some cases the age of the infants, *along with considerations of limitations on the inputs they could possibly have experienced* [emphasis added], casts doubt on some plausible learning accounts" (2009, p. 196). If one thinks of a trigger as an input that is impoverished relative to the resulting output, then it will lead to the acquisition of a cognitive capacity without the need for learning. Many research programs in the cognitive sciences treat innateness and learning as complementary notions, and though some also countenance degrees of innateness, it is safe to say that there is a negative correlation between degree of innateness and amount of learning.

3.2. Lack of Learning and Early Onset

If a cognitive capacity does not need to be learned then it can be expected to be acquired relatively early in development. If the acquisition of a cognitive capacity does not involve a process of deriving evidence from the world, then there is less of an obstacle to acquiring that capacity early in development. Developmental psychologists often argue from the early onset of certain cognitive capacities to the conclusion that they have not been learned, at least given other circumstantial evidence. For example, Carey (2009) holds that one of our core cognitive capacities includes a capacity to recognize others as agents and to represent others' mental states. Moreover, she thinks that this capacity of "core cognition" is not learned partly on the grounds of early onset and the lack of sufficient perceptual input. As Carey puts it in a passage already quoted above: "In some cases the age of the infants … casts doubt on some plausible learning accounts" (2009, p. 196). Even though the causal link from innateness to early onset may be weak, inference in the other direction is stronger, since it is unlikely that a cognitive capacity could be acquired so early in development by a process of learning. In other words, there is a causal link between lack of learning and early acquisition, and there is also an inference to the best explanation from early acquisition to lack of learning. This causal link is taken for granted in so much recent psychological research in the past two decades that it explains the explosion of experimental work on infants younger than six months old, as well as the development of elaborate techniques for appraising the mental states of such preverbal and unreliable participants (most famously, the “violation of expectation” experimental paradigm).

3.3. *Triggering and Invariance*

Even though there are crucial exceptions, there is a natural link between triggering and invariance. If a capacity is capable of being triggered, manifesting itself on the basis of a relatively impoverished input, then it is likely to emerge in a variety of different circumstances and will therefore be relatively invariant across a range of environments (compare Khalidi, 2007, p. 109). This causal relationship can be illustrated by various types of studies, but it is perhaps most clearly revealed in research on animal cognition in which animals are reared in a variety of environments. For obvious ethical reasons, these types of experiments, which involve raising infant animals in a range of different environmental settings, are conducted primarily on non-humans. The idea behind these experimental manipulations is to determine whether a cognitive capacity is relatively invariant across environments. If a capacity emerges in all or a wide range of different environmental contexts, this is regularly taken to show that it does not require specific experiences with the environment, and hence that it is merely triggered by the environment.

There has been considerable research into spatial orientation in a variety of animal species, specifically regarding whether they use geometric or non-geometric information to orient themselves in unfamiliar environments, or to re-orient themselves when disoriented in familiar environments (e.g., Hermer & Spelke, 1996). In non-human animals, this aspect of spatial cognition is often investigated by raising animals in environments with a variety of different spatial configurations to ascertain whether this leads to important differences in their abilities to spatially orient themselves. Consider recent research into spatial orientation in chicks, which concludes that the cognitive capacity to re-orient using geometric information is largely innate. Chiandetti and Valortigara observe: “No differences between chicks reared in circular-, rectangular, or c-shaped cages were apparent in the ability to reorient using purely geometric information (i.e. in the absence of any featural cues)” (2008, p. 144). Partly on this basis, they conclude that “the results reported here for chicks … suggest that animals encode geometric information in the absence of (or with minimal) experience of surfaces of different lengths connected together at right angles” (Chiandetti & Valortigara, 2008, p. 144). That is, they infer that the cognitive capacity is triggered based on invariance across a range of training environments, since there is a causal link between a capacity’s being capable of being triggered and its emerging across a wide range of environments. Again, the *inferential* link between invariance and triggering rests on a *causal* link in the opposite direction.

3.4. *Invariance and Canalization*

A cognitive capacity that is invariant is not always canalized, but one prominent way of achieving invariance in a cognitive capacity is by means of the ontogenetic device of canalization. A cognitive capacity that is canalized is buffered against environmental variation and develops according to a relatively fixed developmental pathway or a small set of such pathways. It is “programmed” to proceed along a finite number of different “channels” in such a way that precludes intermediate or hybrid developmental outcomes. Invariance in a biological setting can be achieved by means of a process of canalization, as in the acquisition of birdsong in many species of birds. In bird species in which the development of song is highly canalized, being buffered against environmental variation, the outcome (acquiring the species-specific adult song) will be invariant across a range of environments. Invariance can be achieved de facto in other bird species where acquisition is not canalized, but it is so achieved only if a wide range of environments will contain the input needed in order to lead reliably to acquisition. It is worth observing that canalization does not lead to invariance in the sense of constancy of outcome, much less constancy of outcome across all possible environments. Rather, canalization produces a relatively *limited number* of outcomes across a very *wide range* of environments (i.e., relative rather than absolute invariance). In this case, as in some of the subsequent causal links to be explored below, invariance is not strictly causally linked to canalization, but given certain background conditions and plausible assumptions about implementation in a biological system, one prominent way of achieving invariance is by means of canalization. The causal link here is a functional one in the sense that canalization has the "function" of bringing about invariance. As in the case of other causal-functional links, the effect (invariance) raises the probability of the reproduction of the cause (canalization), which in turn produces (another token of) the same effect, in a positive feedback loop.

3.5. Invariance and Panculturality

There is reason to expect, and considerable evidence to suggest, that capacities that are relatively invariant across environments will emerge in all human cultures. A pancultural capacity need not be monomorphic in the species, since it is quite compatible with its arising in all cultures that it be polymorphic or indeed that is a rare trait arising in a few select individuals. Still, invariance across a range of environments suggests that it would be compatible with the whole range of human *cultural* environments. Features of our core cognition are regularly claimed to be impervious to cultural differences in this way. Consider, for instance, recent work on concepts of object and substance, as manifested in human participants in the United States and Taiwan, native speakers of English and Mandarin, respectively. Since Mandarin is a classifier language while English is a count-mass noun language, some research has suggested that speakers of the former will tend to assume that a new word refers to a kind of substance while speakers of the former will tend to assume that it refers to a kind of object. But Li, Dunham, and Carey (2009) claim that though such effects can be observed in linguistic tasks, they do not occur in at least some non-linguistic tasks. They conclude:

> The distinction between object kind and substance kind is a central piece of our core ontology, integral to our ability to make sense of and navigate a complex and shifting world. As such, it may not be surprising that, far from being highly malleable, it should prove itself quite resistant to linguistic or cultural influence, part of the shared conceptual endowment of our species. (Li, Dunham, & Carey, 2009, p. 518)

Whether or not they are right to draw this conclusion, it is clear that the authors think that their nativist account of ontological categories links invariance to resistance to cultural influence. The fact that this cognitive capacity is regarded as invariant or not malleable is taken to imply that it is pancultural.

3.6. Canalization and Cognitive Impenetrability

If a cognitive capacity is canalized then it is buffered against environmental variation, and this will often imply that it is impervious to input from other cognitive systems or that it is cognitively impenetrable. A canalized cognitive system needs to be protected from being modified, which means that its representational content should be resistant to being overwritten by other systems. One way of achieving this is by making the system cognitively impenetrable. Carey considers one of the main properties of innate "core cognition" to be that it "is never overturned or lost, in contrast to later developing intuitive theories" (2009, p. 68). Canalization may not always lead to cognitive impenetrability, but unless a canalized system is cognitively impenetrable, it may not be sufficiently buffered against information from the environment that contradicts the information represented in that system. It is plausible that any genuinely canalized cognitive capacity would be shielded from being altered in this way.

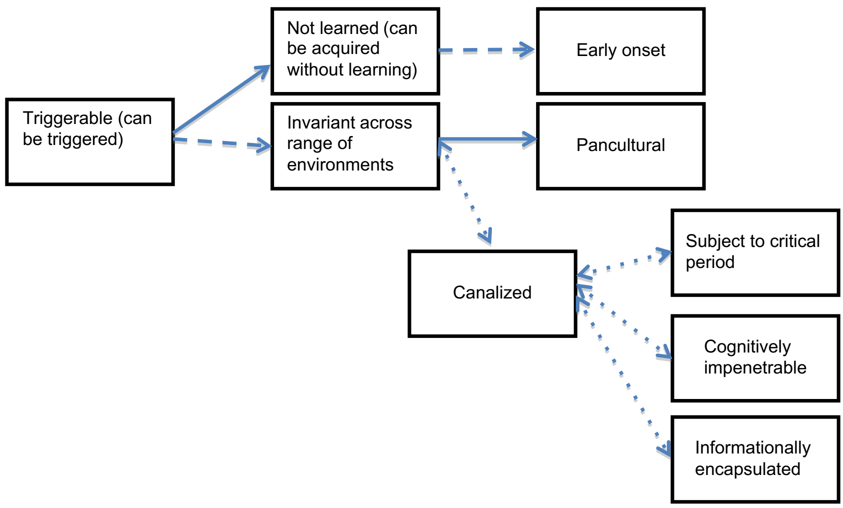

Figure 1. Causal network associated with the category *INNATE COGNITIVE CAPACITY*. Solid lines indicate strong causal links, broken lines weak causal links, and dotted lines causal-functional links.

3.7. Canalization and Informational Encapsulation

Similar considerations suggest that canalization among cognitive capacities may also be achieved by means of informational encapsulation. A cognitive capacity that is informationally encapsulated is one that does not depend on other informational systems to perform its function.[5] If a cognitive capacity is canalized, then it may emerge regularly after other systems and in roughly the same order, but if that capacity is itself one that appears early in development, then it ought not to depend on more developed cognitive systems to perform its function, on pain of being inoperative. Such appears to be the case with the system of spatial orientation in humans, which is dependent only on basic perceptual information to perform its function, as opposed to "higher" cognitive functions. Hermer and Spelke (1996) found that while human adults use both geometric and non-geometric information to reorient themselves in a novel room after being turned around several times to disorient them, children (aged 18 to 24 months) rely only on geometric information. Even though this geometric capacity for reorientation is informationally encapsulated, in the sense that it is largely self-contained and independent of other cognitive systems, by the time humans reach adulthood, they are also able to use other, non-geometric information to reorient themselves.

This encapsulation of the capacity for spatial orientation in very young children and its task specificity are taken by Hermer and Spelke (1996) to imply that this capacity is an innate module. As Hermer and Spelke put it, "both the task specificity and the relative encapsulation of the reorientation process suggest, to a first approximation, that children's reorientation process depends on a 'geometric module'" (1996, pp. 227–228). Though they have not tested directly whether this geometric module would emerge in a range of environmental settings, Spelke and Newport argue that this too is plausible, on the grounds that the developmental environment for the subjects in these experiments is different from that of their evolutionary ancestors:

> Because the laboratory animals and American children in these studies have not spent their lives in outdoor environments where hills and valleys uniquely specify object positions, but rather in rectangular environments where many symmetries make geometry-based reorientation prone to error, it is likely that this process has been shaped more by evolutionary history than by learning. (1998, p. 315)

Researchers infer from the informational encapsulation of this capacity to its modularity, as well as its canalization and lack of learning.

3.8. Canalization and Critical Period

Yet another way of bringing about canalization is by means of a critical period.[6] A cognitive capacity that is subject to a critical period is likely to be canalized at least in the following sense: an organism that receives the appropriate input or inputs within the critical period is then sent along a specific developmental pathway, whereas one that does not receive the appropriate inputs fails to be launched on that pathway. The critical period can be thought of as the entrance to a developmental pathway, without which the organism fails to proceed along that pathway or "channel." In some instances, there may even be two or more types of input, which when received during the critical period, determine different developmental pathways. This is one way of understanding language acquisition in humans on the principles-and-parameters account (e.g., Baker, 2001). Depending on the type of input received from language speakers in their environment during the first few years of life (the critical period), the parameters are set in a certain way and human infants then go on to acquire the syntax of the appropriate language. Canalization occurs because the input received during the critical period directs one along one pathway or another (or in the case in which no input is received, fails to proceed along a pathway at all).

This phenomenon is evident in research on the human phonetic repertoire. In many instances, young infants can discriminate a wider range of phonetic contrasts than are made in their native language. If their native language makes a certain distinction, they receive input that observes the phonetic distinction within the critical period and it is consolidated; if it does not, then they receive no such input and their ability to make the distinction is lost. The consolidation of some phonetic discriminations in turn influences the acquisition of yet others, in what has been described as "cascading" critical periods, each constraining and directing the next (Werker & Tees, 2005). These successive critical periods can act as channels along which phonetic development takes place.

These connections among the properties associated with innateness suggest a causal network in which the instantiation of some of these properties leads reliably, though not inevitably, to the instantiation of others (see figure 1). Moreover, in some of these cases, the links are causal-functional, in the sense that the property in question does not lead in a linear manner to the production of the effect. Rather, it does so precisely because it was selected to do so and in doing so raises the probability that the cause will be reproduced. Hence, in some of these cases (indicated in figure 1), there is a causal feedback loop between cause and effect rather than a simple linear relationship.[7] Complex causal interactions among the properties associated with innate cognitive capacities clearly signal a difference with a category such as JADE, which is given as a paradigmatic example of a "clutter" category by Mameli and Bateson (2011). Unlike the macro-properties of jadeite and nephrite, which are accidentally correlated, the properties of innate cognitive capacities are causally connected in various intricate ways.

4. Is Innateness a Homeostatic Property Cluster?

Given the characterization of innateness in the previous section, it is natural to regard the category of an innate cognitive capacity as corresponding to a homeostatic property cluster (HPC), which conforms to the account of natural kinds developed by Boyd (1989), according to which natural kinds are clusters of properties kept in equilibrium by a certain causal mechanism. A similar proposal has been made by Samuels (2007), who explicitly identifies innateness as an HPC kind. As outlined by Samuels, HPC kinds satisfy three conditions: (i) they are associated with a number of features that tend to be co-instantiated, none of which is necessary for membership in the kind; (ii) a causal mechanism explains the co-instantiation of these features; and (iii) it is the causal mechanism, rather than the associated features, that constitutes the essence of the kind and defines membership in it (Samuels, 2007, p. 23). There is a superficial similarity between my account of innateness as a natural cognitive kind and Samuels' account, but I will argue in this section that my proposal differs from Samuels' in three important respects.

The first difference with Samuels' account concerns the particular features that I have proposed are associated with innateness. Though there is some overlap among the features we associate with the kind INNATENESS, there is also some crucial divergence. Most significantly, Samuels considers the central property of innateness, to which other properties are evidentially related, to be psychological primitiveness, where a cognitive capacity is psychologically primitive if there is no psychological account of its acquisition. But far from being the central feature of innateness, I would argue that this is not a feature of innate cognitive capacities at all, since it has to do with the type of scientific explanation offered for the acquisition of an innate capacity rather than anything about the capacity itself.[8] Moreover, several of the other features that Samuels associates with innateness, such as being *present at birth*, *adaptive*, and *monomorphic*, are ones that I do not consider to be associated with innateness with any regularity. Being present at birth is widely considered in the developmental literature not to be sufficient for innateness, since significant learning is now known to occur in the womb in humans and other organisms (see, e.g., Partanen, Kujala, Tervaniemi, & Huotilainen, 2013). It is clearly also not necessary, since many if not most innate characteristics, in cognition and elsewhere, are manifested well beyond birth, even in late adulthood. Being adaptive is also not strongly correlated with innateness; to think so is to risk committing a kind of adaptationist fallacy, since many innate cognitive and psychiatric disorders (though perhaps not all) are clearly maladaptive. Finally, monomorphism is no more associated with innate features than polymorphism, since in humans as in many other organisms, there are a large number of significant dimorphic or polymorphic innate traits, from innate sexual traits to other phenotypic traits like eye color, hair color, blood type, and lactose tolerance. It is likely that some innate cognitive features may be similarly polymorphic.

A second major difference with Samuels' proposal is that he does not attempt to reconstruct the actual causal links that obtain between the features associated with the kind INNATENESS, contenting himself with discussing "evidential relations" between these features. Although evidential relations are presumably grounded in causal connections, evidential relations can obtain between a cause and one of its effects, between an effect and one of its causes, as well as between two effects of a common cause. To say that features I_1 and I_2 are evidentially linked is to leave open the precise causal relationship between them. Instead, I have tried in the previous section to delineate these causal connections, at least in light of the current state of scientific research. While some of these causal links are straightforwardly linear, others appear to involve feedback loops and complex interactions between distinct properties. In order to justify the claim that innateness is a genuine cognitive kind, it is not enough to specify evidential or inferential relations among its associated features. One must show how these features relate ontologically to one another, as I have tried to do by means of causal links. This causal theory of innateness does not conform to the template outlined in Boyd's HPC theory of natural kinds, but it is consistent with two more recent approaches to natural kinds: the "simple causal theory" of natural kinds (Craver, 2009) and a conception of natural kinds as "nodes in causal networks" (Khalidi, 2013).

The third difference with Samuels' account, and perhaps the most important, has to do with the fact that I deny the existence of a causal mechanism that keeps the cluster of properties associated with innateness in homeostasis, as specified by the HPC account of natural kinds. Whereas Samuels regards the "mechanism" as the causal essence of the kind, I think it is problematic to posit a causal mechanism that defines the kind or constitutes its underlying essence, at least if the term 'mechanism' is used with anything like its standard meaning. Sometimes, the term 'mechanism' is used so loosely that it is roughly synonymous with 'cause', but there is a more precise usage that has become very widely accepted, according to which it refers to "entities and activities organized such that they are productive of regular changes from start or set-up to finish or termination conditions" (Machamer, Darden, & Craver, 2000, p. 3).

On Boyd's account of natural kinds, there is typically a causal mechanism that keeps the properties associated with any given kind in a state of equilibrium or homeostasis, understood roughly along these lines. In the case of innateness, a natural suggestion would be that the mechanism that keeps the properties in the cluster in a state of homeostasis is *genetic*, and that the entities and activities that produce the innate cognitive capacities are genetic in nature. However, there are two related problems with this suggestion. The first is that the genetic cause is likely to be so far upstream from the cognitive capacity that it does not seem possible, in general, to think of it as the single mechanism that keeps the properties in homeostasis. That is simply because there is a looseness of fit between the genetic factors that may contribute causally to the emergence of an innate cognitive capacity and that capacity itself, since there are numerous intermediate processes that may contribute to the outcome. As Spelke and Newport observed over two decades ago,

> the central accomplishments of recent research in developmental neurobiology are to reveal a host of epigenetic processes through which neural structures develop in accord with a species-typical, intrinsic plan, without either shaping by the environment external to the organism or detailed genetic instructions. (1991, p. 291)

The second problem with positing a genetic cause common to all innate cognitive capacities is that it is unlikely that all innate capacities will be underwritten by the same type of genetic substratum. The point is not merely that there is likely to be a different genetic substratum that brings about the innateness of cognitive capacity C_1 and cognitive capacity C_2, but that the genetic substrata in question may not themselves share any important properties in common (beyond being somehow genetically instantiated). This is not to rule out that we may, in the case of some particular cognitive capacity, find that a certain genetic mechanism codes for that capacity. In the most idealized scenario, there may be a specific nucleotide sequence that codes for a protein, which then encourages the formation of synaptic connections between groups of neurons, which in turn are the neural substrate for a putatively innate cognitive capacity, such as the capacity to represent object permanence or analog numerical magnitude. But there may well be other innate capacities for which the causal story is far more complicated, involving multiple regions in the genome, regulatory mechanisms, epigenetic processes, interactions with the environment, and so on.

An analogy with innate diseases may help: consider two diseases that are largely innate, Huntington's chorea and cystic fibrosis, but for quite different reasons and as a result of very diverse causal pathways. Huntington's results from an abnormally long trinucleotide repeat near the tip of chromosome 4, while cystic fibrosis turns out to involve a more heterogeneous collection of mutations (Kitcher, 1997, p. 60). Hence, what it is for a disease to be innate (or partly innate) can be the result of different types of genetic (and epigenetic) processes. The situation is likely to be similar in the case of innate cognitive capacities: what it is for each of them to be innate at the genetic level may differ considerably, so there is little prospect of locating a single type of genetically-based mechanism that is common to the development of all innate cognitive capacities.[9] In the absence of a single type of genetic mechanism underwriting all innate cognitive capacities, the regularly co-occurring properties associated with an innate cognitive capacity may be understood not as having a single underlying cause, but rather as being themselves causally interconnected in various ways. As Boyd himself acknowledges at times, there need not be a single mechanism to keep them in homeostasis.[10]

These three differences with Samuels' account show why I do not think that *innateness* conforms to the standard elaboration of HPC kinds as clusters of properties kept in equilibrium by a causal mechanism. Instead, according to the position that I have outlined, INNATE COGNITIVE CAPACITY is a natural kind associated with a cluster of properties related to one another by intricate causal connections, though not held together by a single causal mechanism. This account also allows us to respond to a recent critique of the innateness concept that has been put forward by Shea (2012b). One of his principal reasons for rejecting the proposal is that the clustering of properties associated with innateness is especially unreliable when it comes to human beings, mainly on the grounds that inherited representations are not necessarily genetic but can also be epigenetic, cultural, and so on. The idea seems to be that some of the properties associated with innate cognitive capacities may be the result not of inherited *genetic* representations, but of (say) inherited *cultural* representations, and this may lead us to conclude falsely that a cognitive capacity is innate when it is not. To use an illustration of my own, suppose that the cognitive capacity to read and write is a human cultural invention that has been transmitted as a result of imitation. If we observe that reading and writing are pancultural and highly canalized, we might be tempted to infer that they are innate. But we would be rash to conclude this, since panculturality and canalization may in fact be the result of an inherited cultural representation and therefore not innate.

If that is the worry about innateness, then it seems misplaced. Even if there are other causal properties that tend to generate some of the same properties in the innateness cluster, as I have identified them, that should not lead us to conclude that innateness is not a genuine cognitive kind, though it may make it harder to distinguish innate from non-innate cognitive capacities. There is a rough analogy here with the case of jade, considered earlier, but with the following crucial difference. The fact that the macro-properties of jadeite and nephrite largely coincide for accidental reasons tells against counting JADE as a natural kind, but it surely does not undermine the case for considering either JADEITE or NEPHRITE separately as natural kinds. Just because many of the properties in the jadeite cluster coincide with those in the nephrite cluster, that should not deter us from thinking that either of them is a natural kind in its own right. Similarly, INNATE COGNITIVE CAPACITY may well be a natural kind even though some of the properties that are causally associated with it are also associated with cognitive capacities that are culturally transmitted and not innate.

In this section, I have tried to show that there are three important differences between this account and Samuels', differences that would rule out considering innateness a natural kind along the lines of Boyd's homeostatic property cluster kinds. Still, innateness can be considered a natural kind along the lines of causal theories of natural kinds (e.g., Craver, 2009; Khalidi, 2013).

5. Objections and Replies

One objection to the argument that I have presented pertains to the very identity of the concept that I have tried to articulate The revamped concept of innateness that I have tried to defend might be said to bear little resemblance to the original folk concept of innateness, suggesting that we should scrap it and start anew rather than attempt to brush up a tired vernacular concept. In this vein, Mameli (2008) compares the concept INNATENESS to the concept MASS, which the special theory of relativity allegedly eliminated and replaced with two concepts, REST MASS and RELATIVISTIC MASS, neither of which coincides with the concept MASS as found in classical mechanics.[11]

A response to this objection must address the question of conceptual change and continuity, as well as the relationship between scientific concepts and lay concepts (albeit briefly). The descriptive question as to when a concept has been retained and when it has been replaced, and the related prescriptive question as to when we ought to retain a concept and when to replace it, are controversial to say the least. But it seems safe to say that when there is significant continuity between a lay concept and a scientific concept, retention is usually the outcome. Moreover, there are two prominent prescriptive considerations that would tend to favor retention in many cases. First, an entrenched lay concept is sometimes difficult to abandon entirely, and attempts to expunge it are often counter-productive and likely to be met with resistance. Second, as long as there is some continuity, it is more conducive to the comprehension and communication of scientific results to express them mainly in terms of existing concepts (wherever possible) rather than to introduce altogether new concepts.

These points can be illustrated using the concept HEAT as it was used by both scientists and laypersons in the western world until the mid-eighteenth century, that is, until Joseph Black's proposal of the theory of latent heat. Until this time, scientists had not clearly differentiated the concepts of KINETIC ENERGY and TEMPERATURE (Carey, 2009, p. 372; compare Wiser, 1988; Wiser & Carey, 1983). Whereas kinetic energy is an extensive and additive quantity, temperature is intensive. If two cups of water at the same temperature are added together, the quantity of kinetic energy in the mixture is increased, but the temperature of the water remains the same. Once this differentiation was made, all subsequent scientific theorizing on the subject proceeded to distinguish the two concepts.

How should we describe this episode in intellectual history or the history of science: is it one of elimination or modification? We could say that the folk concept HEAT was abandoned in rigorous scientific thought and replaced by two distinct concepts, KINETIC ENERGY and TEMPERATURE. Alternatively, we could (and often do) say that the scientific concept KINETIC ENERGY is roughly equivalent to the vernacular concept HEAT, and that the latter concept has been modified to differentiate it from the concept TEMPERATURE. In the former case, we have eliminated a folk concept in favor of two scientific concepts, and in the latter case, we have modified a folk concept and rendered it roughly equivalent to a scientific concept. If our linguistic practices are anything to go by, in this case, it would seem that elimination has lost out to modification. The term 'heat' in English, like related terms in other languages, survives today and is commonly regarded as a loose synonym for the scientific term 'kinetic energy' in certain contexts.

If this is the correct way to describe the situation, we can still ask a prescriptive question as to whether this was the right course of action, or whether it might not have been preferable to abandon the folk concept in favor of the two scientific concepts. Though it might still give rise to misconceptions among the folk and lead to occasional mistaken inferences, there are advantages to modifying an existing concept rather than eliminating it altogether. Again, there are two considerations that favor retention. First, since the concept HEAT was highly entrenched, it might not have been feasible to eliminate it altogether. Second, as long as there is some continuity, the sciences are often better served when they can relate their findings to our pre-scientific theories rather than when they introduce new jargon or specialized language that is not readily accessible to the lay public. We do not normally say that there is no such thing as heat, but teach schoolchildren that heat is different from temperature. Similarly, in the case of innateness, it might be more productive to frame our scientific findings in terms of innateness rather than to try to purge it from our vocabulary. Moreover, there is sufficient continuity that it seems feasible here to express our scientific findings in terms of an existing concept. Rather than saying that there is no such thing as innateness, it may be more illuminating to point out, say, that while it is true that what is innate is not learned, it is not the case that what is innate is always present at birth.[12]

Another, not unrelated, objection suggests itself here. If we attach the label of 'innateness' or 'innate cognitive capacity' to the entire causal network that I sketched out in section 3 (and represented in figure 1), it may be said that this cluster of causal properties corresponds more closely to the presumptive natural kind COGNITIVE MODULE, roughly in the sense first articulated in Fodor (1983), rather than the natural kind INNATE COGNITIVE CAPACITY. In other words, the kind I have described might seem to have a number of distinguishing features that go well beyond the bare kind INNATENESS, even INNATE COGNITIVE CAPACITY.

There is likely to be some overlap between the kind INNATE COGNITIVE CAPACITY and the kind COGNITIVE MODULE (assuming the latter is also a cognitive kind), and the latter may indeed be a subordinate kind of the former. Though there may be some cognitive modules that are not innate, many of the cognitive modules now posited in cognitive science are in fact thought to be innate adaptations (though they may be far fewer in number than the hundreds posited by some evolutionary psychologists). Similarly, there may be some innate cognitive capacities that are not full-blown modules, but few philosophers and cognitive scientists nowadays think that there will be isolated innate concepts. If innateness pertains primarily to innate cognitive capacities, then, I have argued, they will tend to have a cluster of features in common (e.g., canalized, not learned, informationally encapsulated), given what we know about human cognition. When Fodor posited modules, he also associated them with other properties that I have not associated with innate cognitive capacities (e.g., fast, automatic, mandatory), though perhaps a weak causal link with some of these properties may also be discovered. Be that as it may, there will be exceptions to most of these properties in any given instance, and the clustering of these properties will not be perfect. In explicating the kind INNATE COGNITIVE CAPACITY, I have drawn the boundary around a range of properties that are often, but not always, co-instantiated, and one could draw it more strictly around a smaller subset of properties that are more strongly associated with one another. But then one would miss some causal processes and neglect a number of (exception-ridden) empirical generalizations.

A third objection would question the comprehensiveness of the account that I have given, asking whether there may not be other features associated with innateness that I have failed to consider. In response, it bears repeating that there are various alleged features of innateness that I have already argued do not pertain properly to it, for example, several of those mentioned by Samuels, such as being present at birth, adaptive, and monomorphic. But that obviously does not rule out the existence of other properties that ought to have been included in my account but were not. Mameli and Bateson (2006) list 27 features commonly associated with innateness (in order to argue that none of them ought to be identified with innateness), but most of these features are either ones that I have included or ruled out. The latter category includes various properties that only pertain to the biological rather than the cognitive domain, or those involving genetic determination (e.g., being genetically encoded or genetically influenced), since I have argued that there need be no genetic mechanism that is responsible for the properties associated with innateness. There may yet be other features that I have not considered, which may prove to have causal links to the network I have elaborated. It is difficult to say with finality that no other properties are involved. But if there are other properties, then I submit that that would tend to enrich the causal network and strengthen this account of innateness.

6. Conclusion

The category of innateness has been criticized as incoherent and inappropriate for use in a mature cognitive science. In response, I have tried to argue that at least some of the properties associated with the category of innateness are causally linked in a manner that is generally characteristic of natural kinds. Like kinds in other sciences, both basic and special, kinds in the cognitive sciences are validated by the role that they play in causal networks. When the instantiation of a property or, more commonly, the co-instantiation of a cluster of properties leads causally to the instantiation of a multitude of other properties in recurring causal processes, we identify such a property or set of properties with a natural kind. At the current juncture in cognitive science, innate cognitive capacities seem to fit this template well.

Notes

1. The OED defines innate, as applied to "qualities, principles, etc. (esp. mental)," simply as "opposed to acquired." The earliest usage cited is from Thomas Hoccleve, *The Regiment of Princes* (c. 1420), who speaks of "innat[e] sapience [i.e., intelligence]."
2. A full-blown defense of this naturalist attitude towards natural kinds is beyond the scope of this paper, but see Craver (2009) and Khalidi (2013) for two recent accounts of natural kinds that consider them to be grounded in causality.
3. I will not try to respond here to the first criticism, which has been made in a number of papers (Griffiths, Machery & Linquist, 2009; see also Griffiths & Machery, 2008; Griffiths & Stotz, 2008; Linquist, Machery, Griffiths, & Stotz, 2011). But it is worth pointing out that even if the vernacular concept of innateness has some of the associations that these critics have identified, that may not render it unfit for scientific theorizing. Many scientific concepts originate as folk concepts before being refined and revised in order to make them suitable for scientific theorizing. In a recent empirical study of the innateness concept among laypersons and scientists, Knobe and Samuels (2013) argue that members of both groups can engage in a process of "filtering" tainted concepts, dissociating them from unwanted pre-scientific associations. Hence, even when vernacular concepts have been implicated in pre-scientific or discredited scientific theories, scientists (and the folk) are capable of jettisoning their problematic features, especially when thinking explicitly and making considered judgments (as opposed to making snap decisions under time constraints).
4. A similar proposal has been made by Samuels (2007), but the features he associates with innateness are somewhat different from those I posit. He continues to consider psychological primitiveness to be the primary feature associated with innateness, as I will go on to argue.
5. The terms 'informational encapsulation' and 'cognitive impenetrability' are sometimes used interchangeably, but I am using them here in different senses, based on the way that they appear to be used in the empirical research that I am relying on. It could be said that the sense of informational encapsulation at play here is a rough counterpart, in the cognitive domain, of the notion of 'entrenchment' used by Wimsatt (1999) mentioned in section 1.
6. A distinction is sometimes made between a *critical period* and a *sensitive period*, the difference being that the former entails a sharp cutoff in the ability to acquire a cognitive capacity while the latter involves a more gradual decline in that ability. However, as numerous researchers have pointed out, there are few if any sharp cutoffs

of this sort in cognitive development, so all such periods are more properly thought as sensitive periods. But since it is the more common terminology, I will use 'critical period', with the caveat that this does not imply a sharp developmental divide.

7. I am grateful to a referee for this journal for urging me to clarify this point.
8. I have put forward other criticisms of the primitiveness account elsewhere, see Khalidi (2007).
9. Shea (2013) has developed a notion of *inherited representation* that attempts to escape this problem of genetic and epigenetic heterogeneity. Without trying to rehearse this notion in any detail, it may serve to encompass a variety of different genetic and epigenetic mechanisms for encoding cognitive capacities so that they can be passed from one generation to the next. Thus, I would not rule out the possibility of a viable characterization of the mechanism that holds the features listed in homeostasis.
10. "Either the presence of some of the properties in [a family of properties] *F* tends (under appropriate conditions) to favor the presence of the others, or there are underlying mechanisms or processes which tend to maintain the presence of the properties in *F*, or both" (Boyd, 1989, p. 16).
11. Mameli's claim concerning the concept MASS is controversial and seems to endorse a view according to which the concept did not survive the theory change from classical to relativistic physics, a view that has been widely disputed. Many scientists and philosophers of science have argued instead that REST MASS should be identified with the classical concept MASS and that the latter concept has not been eliminated at all (see Earman, 1977; Earman & Friedman, 1973). Note also that it may be misguided to insist to an engineer that one should not talk about mass, but must always distinguish rest mass from relativistic mass.
12. Recent detailed investigations of the interactions between lay concepts and scientific concepts indicate that the relationship is more complex than some philosophers have hitherto believed, and may not always involve deference by laypersons to scientists. For instance, Radick (2012) relates that the late nineteenth- and early twentieth-century geneticist William Bateson resisted the concept HEREDITY but eventually succumbed to widespread usage, indicating that scientists sometimes defer to the lay public.

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