The Vernacular Concept of Innateness

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Abstract

The proposal that the concept of innateness expresses a 'folk biological' theory of the 'inner natures' of organisms was tested by examining the response of biologically naive participants to a series of realistic scenarios concerning the development of birdsong. Our results explain the intuitive appeal of existing philosophical analyses of the innateness concept. They simultaneously explain why these analyses are subject to compelling counterexamples. We argue that this explanation undermines the appeal of these analyses, whether understood as analyses of the vernacular concept or as explications of that concept for the purposes of science.

1. **Introduction**

It is a truism that the term 'innate' is vague and ambiguous. According to ethologist Patrick Bateson, "[a]t least six meanings are attached to the term: present at birth; a behavioral difference caused by a genetic difference; adapted over the course of evolution; unchanging throughout development; shared by all members of a species; and not learned. … Say what you mean (even if it uses a bit more space) rather than unintentionally confuse your readers by employing a word such as innate that carries so many different connotations" (Bateson, 1991, p. 21-22; see Mameli and Bateson, 2006 for further argument). The rejection of the term 'innate' on these grounds has a long and distinguished history in behavioral biology (Lehrman, 1953; Hinde, 1968;

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Tinbergen, 1963), although some biologists think that the harm done by these ambiguities has been exaggerated (Marler, 2004, p. 25-33).

The term ‘innate’ nevertheless remains popular in psychology and cognitive science. Some philosophers have proposed that in these contexts it is primarily a device to say ‘not my department – ask a biologist’ (Cowie 1999; Samuels, 2002). But many philosophers continue to propose analyses of the concept of innateness which purport to show that there is a single, coherent notion of innateness that either does or should underlie the use of the term in the sciences of the mind (recent examples include Mallon and Weinberg, 2006; Ariew, 2006; Khalidi, 2007). These analyses are typically subject to intuitively compelling counterexamples from the proponents of alternative analyses (see Section 5).

Our aim in this article is to show that these philosophical analyses of the concept each pick out one feature of the vernacular concept of innateness but ignore other equally real features. This fact explains both the intuitive appeal of these analyses and their vulnerability to equally intuitive counterexamples. We further argue that this undermines these attempts to defend the coherence and continuing value of the notion of innateness. Our argument is supported by some new evidence which we provide about the pre-scientific or ‘vernacular’ understanding of innateness As Mameli and Bateson (2006, p. 156) note, despite the longstanding debate over the meaning of ‘innate’ there has been no previous empirical examination of what ordinary English speakers understand by this term.

Here is how we proceed. In section 2, we outline some ideas about ‘folk biology’, and in Section 3 we make a specific proposal about the structure of the vernacular innateness concept based on these ideas. Section 4 reports two ‘experimental philosophy’ studies testing this proposal. In Section 5, we argue that

our results explain the intuitive appeal of many of the existing analyses of the concept. They simultaneously explain why all such analyses are subject to compelling counterexamples. In Section 6, we conclude with some reflections on what philosophers can and should be trying to achieve when analysing the concept of innateness. In particular, we argue against using philosophical analysis to defend the concept of innateness against the standard biological critique we have just described.

2. Innateness and Folk Biology

The vernacular concept of innateness finds its home in a broader folk biology. It is closely related to other concepts such as instinct and human nature. These are all part of pre-scientific efforts to describe and reason about the living world, efforts that are often described as making up a folk theory. ‘Folk theory’ is a fancy name for the views that non-scientists hold, either explicitly or implicitly, on topics that are also topics of scientific inquiry. For example, there is a folk physics of heat, according to which heat is a physical quantity more or less directly measurable by the intensity of subjective sensations of heat. In this conception of heat, the wooden handle of a snow-shovel is warmer than the metal shovel itself, and the marble slab in a fishmonger's shop is cooler than the wooden stand on which it rests. These beliefs give rise to the (correct) advice to hold the shovel by the handle and the (incorrect) advice that food will stay fresh longer if kept on the marble slab. The folk physics of heat served people fairly well until they developed technologies that required distinctions between temperature, quantity of heat and conductivity, and the folk theory persists today alongside the scientific theory. To use another example, folk dynamics is the body of beliefs which people unreflectively hold about the movement of three-dimensional, medium-sized objects. People tend to explain the movement of an object that has been

thrown by ascribing to it some kind of impetus (Clement, 1983; McCloskey, 1983). Needless to say, impetus-like forces have no place in either Newtonian or post-Newtonian physics.

Just as there are commonsense ideas about heat and dynamics, there are commonsense ideas about biology. Prominent amongst these is the idea that some traits are expressions of the inner nature of animals and plants, whilst other traits result from the influence of the environment. For example, dogs are bred for their coat and for their temperament, both of which are presumed to be part of their nature and thus inherited, but they are not bred for their attachment to a particular family, which is presumed to be the result of experience. The idea that living things have inner natures that make them the kind of organism that they are is intimately linked to the very idea of heredity. The hereditary traits of an animal are those that are passed on as part of its nature. Natures also explain the stability of some traits within a single lifetime – we do not expect a black sheep to grow white wool after shearing, because the colour of its wool is part of its nature.[1] Like the folk theory of heat, folk-biological ideas work reasonably well for hunting, farming, and traditional stockbreeding. They are not adequate, however, for the purposes of scientific biology. The ecological and evolutionary trajectories of populations cannot be understood with a folk theory of heredity, and it is not possible to understand development using the folk theory of inner natures.

For over 20 years, psychologists and anthropologists have investigated the structure and development of folk biological concepts across a range of different

[1] It may be that an organisms' nature can, ultimately, be altered by the environment in which it finds itself. Lamarckian theories of heredity which make this assumption seem to be highly intuitive. But this is a special, deep kind of alternation different in kind from the usual ways in which organisms are affected by the environment. Certain deeply ingrained habits become 'second nature' to people. In a typical Lamarckian theory, like that of Darwin (1872), it is only behaviors which are deeply ingrained for several generations that eventually become part of an organism's hereditary nature.

cultures.[2] Although many key issues remain unresolved, a consensus has emerged that a core set of biological beliefs are commonly held by non-scientists in a wide range of cultures. We briefly outline the aspects of folk biology that, we suggest, are the likely source of people's vernacular concept of innateness.

One widely documented feature of folk biological categories is that they are hierarchically structured (Berlin, Breedlove, and Raven, 1973; Atran, 1990; Berlin, 1992). People everywhere identify (at least) three general levels of biological classification: a 'generic species' category (e.g., dogs and cedars), a super-ordinate category of biological domains (e.g., animals and plants), and a subordinate category of species varieties (e.g., particular breeds or strains). From a cognitive point of view, not all levels of this taxonomy are equally significant. The generic species rank is of particular importance. Membership in a generic species is associated with what psychologists call 'psychological essentialism' (Medin and Atran, 2004). People are psychological essentialists when they believe that membership in a biological kind is associated with a particular *causal essence* or *inner nature* – that is, some property or set of properties that define membership in a kind and cause members of the kind to possess kind-typical properties (Medin and Ortony, 1989; Atran, 1990; Gelman, 2003). The hypothesis that people are unreflectively essentialist is associated with at least two closely related beliefs that have been identified across a wide range of cultures.[3] First, adults believe that membership in a species is a permanent property of an organism that is inherited by descent and that is not affected by changes to its appearance. For example, when asked to imagine a raccoon that has been surgically

[2] (See, particularly, Carey, 1985; Keil, 1989; Atran, 1990; Medin and Atran, 1999, 2004; Astuti, Solomon, and Carey, 2004; Inagaki and Hatano, 2006)

[3] Some have challenged the claim that postulating a belief in causal essences was necessary to explain these phenomena (Strevens, 2000; Rips, 2001; Ahn et al., 2001). Be it as it may, the psychological phenomena themselves—a belief in a persistent species membership and a belief in inherited properties whose development is impervious to external influences —are not controversial.

modified to look and smell like a skunk, adults maintain that the animal is still a raccoon (Keil, 1989; see also Rips, 1989; Atran et al., 2001 with Yukatek adults; Sousa, Atran, and Medin, 2002 with Brazilian adults). Second, and most important for our purposes, people believe that the development of species-typical traits does not depend on environmental influences. For example, when asked to imagine a cow that has been raised by a family of pigs, adults assume that the cow will display the normal bovine traits (e.g. mooing instead of oinking) (Atran et al., 2001; Sousa, Atran, and Medin, 2002). In addition to psychological essentialism, Scott Atran (1995) has also proposed that folk biology has another core feature: the tendency to explain traits teleologically. That is, people tend to explain the traits possessed by animals and plants by asserting that these traits have a purpose.

The suggestion that humans share a core set of folk biological beliefs raises a host of controversial issues. There is some debate over the exact point in development at which these beliefs emerge, for example, and the extent of their cross-cultural similarity remains a matter of ongoing investigation.[4] There is also a lingering question about the nature of the underlying psychological mechanism. Some argue that psychological essentialism and the tendency to explain traits teleologically are generated by a domain-specific module (Atran, 1995), whilst others attribute the formation of psychological essentialism to a more general-purpose reasoning ability (Gelman and Hirschfeld, 1999), and yet others attribute the formation of the tendency to explain traits teleologically to our disposition to provide intentional explanations (Kelemen, 1999, 2004). Importantly, none of these more controversial issues bear on the hypothesis being investigated here. What is important for our purposes is that early on and across cultures, people believe that organisms possess inherited 'inner

[4] On developmental and cultural issues, see (Keil, 1989; Gelman and Wellman, 1991; Atran et al., 2001; Sousa, Atran, and Medin, 2002; Astuti, Solomon, and Carey, 2004).

natures' that [1] cause them to possess species-typical properties, [2] whose development is resistant to environmental influences, and [3] that are functional (they have a purpose). Following Griffiths (2002), we hypothesize that the vernacular concept of innateness has its origin in these folk biological beliefs. That is, when the folk believe a trait is innate, what they believe is that it is an expression of an organism's inner nature, and hence that the trait will possess all or some combination of the three features of species-typicality, developmental fixity, and purposive function (hereafter: 'Typicality', 'Fixity,' and 'Teleology').

3. The Three-Feature Theory of Innateness

According to Griffiths (2002, p. 71), it is part of folk biology that three features are particularly associated with traits that are expressions of the inner nature that organisms inherit from their parents. These features are:

1. Fixity – the trait is hard to change; its development is insensitive to environmental inputs in development; its development appears goal-directed, or resistant to perturbation.
2. Typicality – the trait is part of what it is to be an organism *of that kind;* every individual has it, or every individual that is not malformed, or every individual of a certain age, sex or other natural subcategory.
3. Teleology – this is how the organism is *meant* to develop; to lack the innate trait is to be malformed; environments that disrupt the development of this trait are themselves abnormal.

Griffiths described these three features in such broad terms in order to capture shared themes in the very different ideas about the inner natures of living things that are

found in different human societies.[5] Consider, for example, the feature which we have called ‘Teleology’. Darwinists will understand this as evolutionary design, whereas creationists will understand it as God's intention. Each seeks to make sense in their own terms of an intuitive sense that an organism is *meant* to be a certain way whether or not it actually turns out that way. In the seventeenth century, the anatomist William Harvey dealt with the same fundamental intuition within an Aristotelian framework by supposing that the “idea or form” of the organism provided by the male parent is sometimes misinterpreted by the “formative faculty” of the female parent's womb (Harvey, 1989, p. 578). It is the underlying intuition shared by all three theorists that we regard as an expression of folk biology, and in particular of the folk-biological conception of inner natures.

We cannot sufficiently stress that we are *not* proposing to define innateness with a set of necessary and sufficient conditions called Typicality, Fixity and Teleology. The three-feature theory has a similar status to accounts of other concepts developed by psychologists and cognitive anthropologists. It treats the vernacular concept of innateness as a cognitive structure (or a mental representation) that has its origin in folk biology. If the three-feature theory is correct, then the cognitive structure that underpins the use of the term 'innate' is an implicit theory that views organisms as having inner natures which are expressed in traits that are likely to be Typical, Fixed and Teleological.

The aim of the present study is to test the three-feature theory by examining how people actually apply the concept of innateness. The three-feature theory makes claims about folk biology, not about the ideas that people derive from scientific

[5] In his 2002 paper Griffiths referred to the three features as 'developmental fixity,' 'species nature,' and 'intended outcome'. In this paper we use the handier terms 'Fixity,' 'Typicality,' and 'Teleology,' and we reserve the term 'nature' for the broader idea that organisms have an underlying nature of which innate traits are an expression.

biology. Thus, the study asks specifically whether *non-scientists* use the innateness concept in the manner predicted by the three-feature theory. If innateness judgments are indeed influenced by these three features in the way we have suggested, then two predictions should follow:

1. The association of each of the three features with a trait increases the likelihood that participants will identify that trait as innate.
2. All three features will contribute *independently* to participants' judgments about whether a trait is innate.

Note that prediction two is stronger and more risky than prediction one. It is a direct consequence of our hypothesis that the three features in question (Typicality, Fixity, and Teleology) contribute *additively* to judgments about whether some trait is innate. Suppose that we are wrong, and that people only take one feature – Fixity, for example – to be characteristic of traits which express inner natures. But, suppose also that people use the other two features as suggestive cues for whether the defining feature is present (perhaps because they believe that the corresponding properties tend to co-occur). This alternative to the three-feature theory predicts an interaction among the three features. Direct evidence that the trait is not Fixed will reduce the influence of evidence that the trait is Typical or Teleological on the final judgment about its innateness. An analogy may make this point clearer: seeing a Prada logo on a handbag strongly influences the judgment that it is a Prada handbag. But independent evidence that it is *not* a Prada bag – for example, the fact that it is being sold in a street market in Jakarta for the equivalent of one U.S. dollar – reduces the influence of the logo on judgments about the brand. Prediction two says that evidence about the three features of innate traits will not interact in this way.

We should also stress that we are not proposing that only three, simple cues affect judgments of innateness. It seems clear, for example, that being present at birth and not being learnt are cues which people use to identify traits as innate. But we suggest that these and many other specific cues can be understood in terms of the three broad intuitive aspects of innateness which we have identified. The significance of presence at birth and not being learnt, for example, is that they provide evidence that the trait is insensitive to the environment and is developing as if guided by some internal goal—that is, evidence that the trait has the folk-biological feature that we have labeled 'Fixity.'

4. Testing the Three-feature Theory of Innateness

4.1. Study 1: Materials

To test the prediction that Fixity, Typicality and Teleology are additive factors positively affecting judgments of innateness, we studied whether people judge eight examples of birdsong to be innate behaviors. We chose birdsong because it offers the opportunity to find real, or at least realistic, examples of the eight possible combinations of the three factors under consideration (Table 1). There are over nine thousand species of birds and song learning has been the focus of intense investigation since the groundbreaking work of William Thorpe and Peter Marler in the1950s (for an accessible introduction, see Marler and Slabbekorn, 2004). Although the participants in our experiment had no expertise in biology or in any behavioral science, we hope to use these materials in later studies with scientists and feedback from scientists involved in other 'experimental philosophy' studies suggests that they are unwilling to devote time and effort to thinking about unrealistic cases (Griffiths and Karola Stotz, personal communication).

In four cases, we used a bird which is known to acquire its song in a manner corresponding exactly to one of the boxes in Table 1. We failed to find a bird for the remaining four cases. For these remaining cases we used a speciose genus where some species are known to acquire their song in a manner very close to what we required. We invented a new species of that genus which fitted our requirements, and made up plausible common and scientific names for that species. One of our species is the Pale-headed Thornbird *(Phacellodomus pallida).* Unless you are a keen birder with expertise in the relevant region, we doubt that you can tell whether this is one of the real species.

	Typical		Atypical	
	Functional	Non-functional	Functional	Non-functional
Fixed	Grey-throated Antwren	Eastern Phoebe	Alder Flycatcher	Pale-headed Thornbird
Plastic	Black-Capped Chickadee	Archer's Grasshopper Warbler	Chaffinch	Sarkar’s Sparrow

Table 1: The Eight Possible Combinations of Fixity, Typicality, and Teleology

The eight probes describing the examples of birdsong have the same structure. The probe begins with a standard paragraph about research on birdsong, designed to convince participants that there is a wealth of well-established scientific knowledge about birdsong. The next paragraph begins with one or two sentences naming a specific bird and providing some neutral information about it. This is designed to convince participants that this is a real animal. The remainder of this paragraph states

whether the song of the male of this species is Fixed, Typical, Teleological or their opposites, using one of each of these pairs of statements:

Fixed/Plastic

0. Studies on _____ show that the song an adult male produces depends on which songs they hear when they are young.

1. Studies on _____ show that the song an adult male produces does not depend on which songs they hear when they are young.

Typical/~Typical

0. Studies also show that different males in this species sing different songs.

1. Studies also show that all males of this species sing the same song.

Teleology/~Teleology

0. Close observations of these birds reveal that the males' song is not used to attract mates nor to defend territories. Scientists therefore agree that this feature of the bird has no real function, like the appendix in humans.

1. Close observations of these birds reveal that the males' song attracts mates and helps to defend their territory. Scientists therefore agree that this feature of the bird has a real function, like the heart in humans.

To control for order effects, we presented the information about Typicality, Fixity, and Teleology in three different orders—Typicality-Fixity-Teleology (order 1), Teleology-Typicality-Fixity (order 2), Fixity-Teleology-Typicality (order 3)—resulting in 24 different probes.[6]

To illustrate, the probe describing a species of bird in which birdsong is not-Typical, is Fixed, and has a Function, with the items presented in order 1, read as follows:

[6] Probes and full datasets are available at http://philsci-archive.pitt.edu (not posted until article is accepted)

Birdsong is one of the most intensively studied aspects of animal behaviour. Since the 1950s scientists have used recordings and sound spectograms to uncover the structure and function of birdsong. Neuroscientists have investigated in great detail the areas of the brain that allow birds to develop and produce their songs. Other scientists have done ecological fieldwork to study what role song plays in the lives of different birds.

The Alder Flycatcher (*Empidonax alnorum)* is a migratory neo-tropical bird which breeds in southern Canada and the northern USA. Studies on the Alder Flycatcher show that the song an adult male produces does not depend on which songs they hear when they are young. Studies also show that different males in this species sing different songs. Furthermore, close observations of these birds reveal that the males' song attracts mates and helps to defend their territory. Scientists therefore agree that the bird's song has a real function, like the heart in humans.

On a 7-point scale, 1 meaning strongly disagree and 7 meaning strongly agree, how would you respond to the following statement?

'The song of the male Alder Flycatcher is innate.'

It should be noted that a substantial amount of interpretation is involved in reducing the three hypothesized features associated with innateness to these three information items. Our interpretation of Fixity reflects the general tenor of the birdsong literature, in which the songs of sub-oscine passerine birds are traditionally described as 'innate' because, unlike the oscine passerines, their development does not depend on exposure to correct song. Our interpretation of Typicality ignores the idea

that a variable song might be an evolved polymorphism like eye colour. Our interpretation of Teleology as having a 'real function' was driven by the need to remain neutral between evolutionary and creationist conceptions of teleology. The examples of organs that have and do not have a 'real function' (respectively, heart and appendix) were included to ensure that participants interpreted 'real function' in the sense we intended. It seems plausible that typical North American participants will be familiar with these two examples.

4.2 Study 1: Participants and Procedure

255 individuals taking classes at the University of Pittsburgh took part in the experiment. 10 participants were not native speakers of English and 1 subject did not specify whether she was a native speaker of English. These 11 participants were removed from the data set, resulting in a sample of 244 participants (mean age: 20.9; range: 18-40; 50.8% males).

In classroom settings, participants were randomly assigned to one of the 24 probes. They were asked to answer the innateness question by circling a numeral on a 7-point scale, anchored at 1 with ‘totally disagree’ and at 7 with ‘totally agree’. Participants were also asked to fill a short demographic questionnaire. This asked for their education level in biology and in psychology as well as for their general propensity to favour ‘biological’ over ‘environmental’ explanations of human behavior. We found no meaningful relation between either our participants’ education level in biology and in psychology or their propensity to favour biological over environmental explanations and their answer to the innateness question.

4.3 Study 1: Results

To exclude outliers, we eliminated seven data points whose values deviated from the mean of the relevant probes by at least two standard deviations. Table 2 summarizes our results.

	Typical		Atypical	
	Functional	Non-functional	Functional	Non-functional
Fixed	5.86 (.86)	5.57 (1.16)	5.39 (1.17)	4.52 (2.03)
Plastic	4.40 (1.77)	4.03 (1.87)	3.64 (1.41)	3.75 (1.67)

Table 2: Mean Answers (and Standard Deviations) for the 8 Combinations of Factors

To test the three-feature theory of innateness, we used an ANOVA with Fixity, Typicality, and Teleology as between-participants factors. As expected, we found a main effect of Fixity (Fixed > Plastic, $F(1, 229) = 47.39$, $p < .001$, partial $\eta^2 = .17$) and Typicality (Typical > Atypical, $F(1, 229) = 10.24$, $p = .002$, partial $\eta^2 = 04$), and a marginal effect of Function (Functional > Non-functional, $F(1, 229) = 3.16$, $p = .08$, partial $\eta^2 = .01$). Importantly for our purposes, there was no significant interaction (see Figure 1).

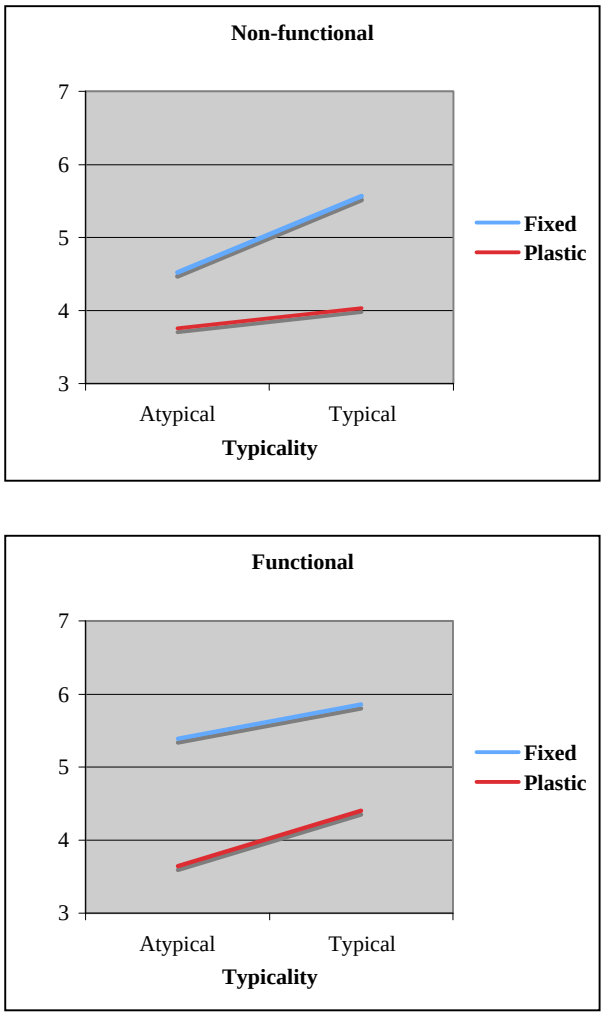


Figure 1: Participants' Mean Answer to the Innateness Question as a Function of Typicality, Fixity, and Teleology (Function).

Together, our three predictors explain around 22% of the total variance (see Figure 2).

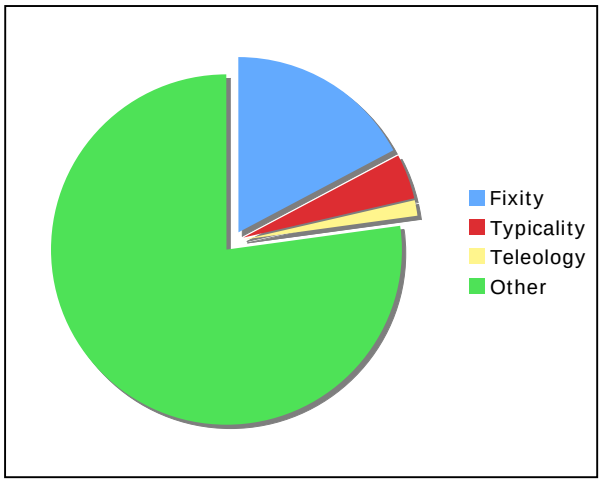


Figure 2: Proportion of the Variance Independently Predicted by Fixity, Typicality, and Teleology

4.4 Study 1: Discussion

The three-feature theory of innateness is supported by the results of Study 1. As we expected, people are more likely to agree that a trait is innate when it is fixed than when it is plastic, when it is typical than when it is atypical, and when it is functional rather than when it is non-functional. Together, Typicality, Fixity, and Teleology explained more than 20 % of the variance in participants' answers to the innateness question. Finally, as we also expected, the influence of each of these three factors on people's judgments about innateness does not depend on the other factors.

Fixity turned out to be a more important factor than Typicality. Typicality alone explained only 4% of the variance in participants' answers to the innateness question, while Fixity explained 17% of the variance. Thus, when people decide whether a trait is innate, the Fixity of a trait matters more than its Typicality. Teleology significantly influenced participants's answers to the innateness question, but its influence was limited, since it explained only 1% of the variance.

Study 1 is limited in two main respects. First, the effect of Teleology on participants' answer to the innateness question was only marginally significant and Teleology explained only a very small portion of total variance. Thus, though relevant, the functional significance of a trait does not seem to be clearly an important factor when people decide whether this trait is innate. We see three mutually exclusive explanations of this result. First, we may simply be wrong in assuming that the function of a trait is one of the cues that people use to decide whether this trait is innate. In support of this first explanation, one might follow some psychologists

(Kelemen, 1999, 2004) in arguing that in contrast to the folk tendency to categorize a trait as innate if it is either canalized or species typical, the folk tendency to explain teleologically biological traits does not originate in folk biology. If folk biology is the source of the vernacular concept of innateness, function might then not be relevant when the folk decide whether a trait is innate.

A second, alternative explanation is that, while it is part of folk-biology that innate traits are how organisms are 'meant to be' (Teleology), this is not adequately expressed by the claim that innate traits have a function. Griffiths's original (2002) proposal was inspired by the widespread assumption that an organism which fully expresses its inner nature is somehow better than one which does not, and that only ill-effects can come from interfering with the expression of an organism's true nature. The original meaning of 'monster' (*terata*) is, after all, an organism in which the form of the species has failed to impress itself on recalcitrant matter. These ideas may simply not be adequately represented by the information we provided about whether a trait has a function.

There is a third, simpler explanation that is also consistent with the three-feature theory of innateness. In our probes, when we gave information about the functional significance of birdsong, we compared birdsong to a biological organ *both* when birdsong was functional (the heart) *and* when it was not (the appendix). Now, if participants believed that the heart and the appendix are both innate traits of humans, our probes inadvertently suggested that function was not important for deciding whether a trait was innate. This explanation can be tested, by eliminating the comparisons from our current probes. We intend to do this test in a follow-up study.

The second limitation of our study is that our three predictors taken together explain 22% of the variance in participants' answer to the innateness question,

corresponding to a medium effect size (Cohen, 1992). One might wonder why they do not explain a larger part of the variance if the three-feature theory of innateness is true.

We hypothesized that the limited proportion of variance captured by each factor (Fixity, Typicality, Teleology) is mostly due to the noise introduced by the between-subject design. Because individual participants likely differ in their background beliefs about whether birdsong, or animal behavior generally, is innate, it is unlikely that each subject made the same use of the 7-point scale, resulting in a substantial amount of variance not explained by our three factors. We thus predict that the proportion of variance explained by each factor would substantially increase in a within-subject design. Study 2 was designed to test this prediction.

4.5 Study 2: Replication

The goal of Study 2 was to extend the findings of Study 1, by circumventing some of its limitations. Specifically, we attempted to better evaluate the influence of our three factors on intuitive judgments about innateness by reducing the noise produced by between-subject differences. To achieve this we used a within-subject design: each subject was presented with all of the probes.[7]

38 individuals at the University of Guelph (Canada) took part in the experiment in exchange for a small monetary compensation. One subject was not a native speaker of English and was removed from the data set, resulting in a sample of 37 participants (mean age: 22; range: 18-50; 43.2% males).

Instead of counterbalancing the order of the three factors, as we did in Study 1, we used the following order: Fixity, Typicality, Teleology. Participants read the 8

[7] The full dataset is available at http://philsci-archive.pitt.edu (not posted until article is accepted)

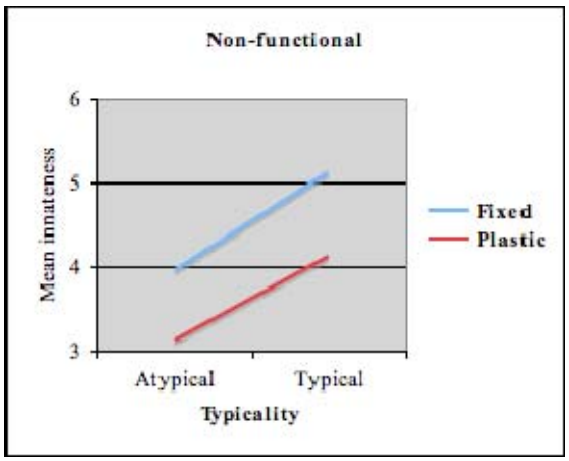
resulting probes and were asked to answer the innateness question on a 7-point scale after each probe. The order of the probes was counterbalanced across participants.

Table 3 summarizes our results.

	Typical		Atypical	
	Functional	Non-functional	Functional	Non-functional
Fixed	5.54 (.30)	5.12 (.30)	4.62 (.35)	3.95 (.32)
Plastic	4.46 (.33)	4.11 (.28)	3.60 (.30)	3.11 (.26)

Table 3: Mean Answers (and Standard Deviations) for the 8 Probes of Study 2

To test the three-feature theory of innateness, we performed a repeated-measure ANOVA with Typicality, Fixity, and Teleology as within-subject factors, resulting in a main effect of Fixity (Fixed > Plastic, $F(1, 36) = 16.48$, $p <. 001$, partial $\eta^2 = .31$), a main effect of Typicality (Typical > Atypical, $F(1, 36) = 15.80$, $p < .001$, partial $\eta^2 = .31$) and a main effect of Teleology (Functional > Non-functional, $F(1, 36) = 3.33$, $p = .07$, partial $\eta^2 = .09$). No interaction was significant, as can be seen on Figure 3.



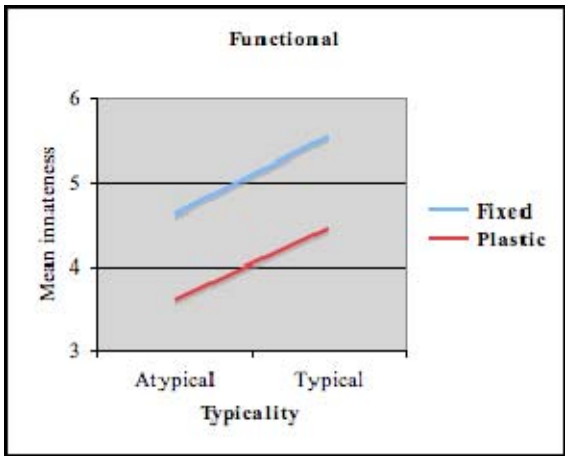


Figure 3: Participants' Mean Answer to the Innateness Question as a Function of Typicality, Fixity, and Teleology

Together, our three factors explained around 70 percent of the variance (Figure 4).

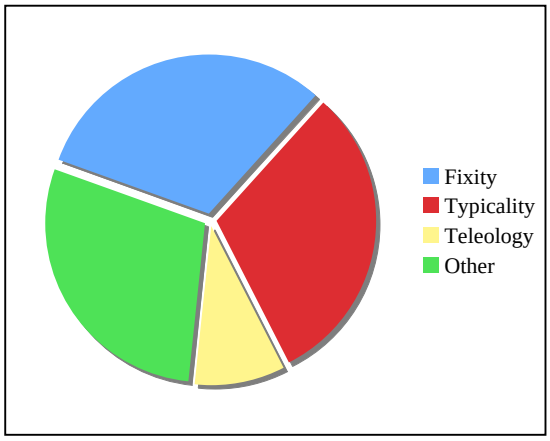


Figure 4: Proportion of the Variance Explained by Fixity, Typicality, and Teleology

4.6 Study 2: Discussion

Study 2 extends the findings of Study 1, providing further support for the three-feature theory of innateness. We found again that people are more likely to agree that

a trait is innate when it is fixed than when it is plastic, when it is typical than when it is atypical, and when it is functional rather than when it is non-functional. Together, Typicality, Fixity, and Teleology explained around 70 % of the variance in participants' answers to the innateness question—a large increase in explained variance in comparison to Study 1. Finally, we found again that the influence of each of these three factors on people's judgments about innateness does not depend on the other factors.

Typicality and Fixity explained a large part of the variance in participants' answers to the innateness question (Fixity slightly more than Typicality). Teleology explains a smaller part of the variance than Typicality and Fixity, but one that is markedly larger than in Study 1. We conclude that controlling for the noise introduced by the diverse use of the scale in Study 1 reveals the strong influence of Fixity and Typicality on people's judgments about innateness as well as the weaker, but real influence of Teleology.

It is noteworthy that Studies 1 and 2 lead us to refine Griffiths' original hypothesis about the vernacular concept of innateness. As we saw, Griffiths proposed that folk judgments about the innateness of a trait depends on whether this trait is typical, on whether it is fixed, and on whether it serves a function. Our findings allow us to specify the relative importance of these three factors. Whether a trait is judged to be innate depend primarily on its fixity and on its typicality and, to a lesser extent, on its functionality. Its fixity seems to matter a little bit more than its typicality.

Finally, this study is a first step toward examining our hypothesis cross-culturally. One might indeed wonder whether innateness is conceptualized similarly across cultures.[8] Although Canada and the USA are culturally similar, Study 2 at least

[8] We are grateful to one of our reviewers for pressing us on this point.

suggests that people think similarly about innateness in these two countries. Further studies should investigate further the cross-cultural generality of our hypothesis.

5. Accounting for the Existing Analyses of Innateness

Philosophers have proposed several intuitively appealing analyses of the concept of innateness, but these analyses are typically subject to intuitively compelling counterexamples, resulting in some kind of stalemate. We now argue that our results explain this aspect of the philosophical literature on innateness. Each analysis fixes on one or two aspects of the vernacular concept of innateness, leaving itself open to counterexamples which appeal to intuitions derived from the other aspects.

5.1 Analyses of Innateness Based on Typicality[9]

In his seminal paper 'The idea of innateness' (1975), Steven Stich examined a number of suggestions about the structure of the concept. One is that a trait is innate if and only if a person will manifest it in the normal course of human development. The intuitive appeal of this analysis is confirmed by the fact that some scientists have used the term 'innate' to refer to any feature which is characteristic of an entire species (Bateson, 1991). Stich himself immediately offered a counterexample to this analysis: universally held beliefs, such as the belief that water quenches thirst, will count as innate on this analysis whereas intuitively they are acquired (Stich, 1975, p. 9). André Ariew has offered another counterexample: it is part of the normal course of human development to develop the typical gut flora that allows us to digest our food, but Ariew finds it counterintuitive to call these bacterial communities an innate feature of human beings (Ariew, 1999, p. 133). Ariew has suggested that Stich's analysis

[9] Recall that the capitalized terms Typicality, Fixed, and Teleological refer to the elements of folk-biological theory discussed in Sections two and three, and are being used here strictly in this, stipulated sense.

derives its plausibility from the unspoken assumption that if a trait is species-typical, then there is some mechanism that ensures its presence (Ariew, 2006, p. 10).

The proposal that a trait is innate just in case it is typical of normal development appeals to the folk biological idea that traits which express an organism's inner nature will typify that species. Our results show clearly that judgments of innateness are influenced by information about Typicality, so it is unsurprising that suitably chosen thought experiments evoke intuitions that favour this analysis. However, our results also show that judgments of innateness are influenced by information about Fixity, so it is equally unsurprising that the thought experiments listed above, both of which make salient the dependence of typical traits on interaction with the environment, evoke intuitions hostile to the analysis.

5.2 Analyses of Innateness Based on Teleology

Another popular analysis of innateness suggests that a trait is innate if its development is guided by 'inherited information' rather than 'environmental information.' This idea was suggested by Stich (1975, 13-16), and has been defended at length by Muhammad Ali Khalidi (2002; 2007). Its most prominent defender, however, was the ethologist Konrad Lorenz (1965).[10] The key question facing an account of this kind is how to measure 'information.' Lorenz identified information in this context with adaptive fit. An adaptive trait fits some environments better than others and hence can be said to contain information about the environment. If a person has calluses on their palms rather than on the backs of their hands, then these calluses contain information about where their skin gets rubbed. [11] If they form calluses on their palms more easily

[10] This account of innateness replaced Lorenz's much criticized 1937 account based on the deprivation experiment. For more on Lorenz's 1965 theory, see (Browne, 2005).

[11] Stich and Khalidi both restrict their account to cognitive traits, presumably because they think it will be easier to measure the information content of cognitive traits. Lorenz's analysis suggests that this

than on the backs of their hands (or if, like the ostrich, they are born with calluses in useful places), and if these traits fit their future environments, then those traits contain information about those future environments. This anticipatory information, Lorenz argues, must have been in the genome, and must have been absorbed from ancestral environments.

Lorenz's analysis can readily be expressed in information-theoretic terms, with the environment as the signal source and the organism as the receiver. Organisms need to reduce their uncertainty about what demands the environment will place on them and to develop in a way that meets those demands. There are two ways to do this. One is gather information during development. The water flea *Daphnia pulex* monitors chemical traces of predators as it develops and grows defensive armour if predators are indicated. The information about the environment inherent in the armour was collected by the individual as it developed. The other way is to inherit information from your ancestors. The sickle cell allele, a costly trait which survives only because it also confers resistance against malaria, carries information about the prevalence of malaria in the ancestral environment and thus, probably, in the environment of the organism which inherits it. The information about the environment inherent in the sickle-cell allele was collected by the individual's ancestors through natural selection. To the extent that the functional adjustment of a trait to its environment is explained by 'inherited information' of this kind, Lorenz argued, the trait is innate.

Stripped of its colourful language, the 'inherited information' analysis amounts to the claim that a trait is innate if its fit to the environment can only be explained by evolutionary adaptation (or by intelligent design, if you swing that way).

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restriction is unnecessary. This avoids the difficult problem of defining 'cognitive.' Khalidi counts birdsong as 'cognitive,' but why is singing more 'cognitive' than walking or biting?

An organism is *innately* suitable for a particular kind of environment, if it is designed in advance to fit that environment. The intuitive appeal of this analysis can readily be explained if it is part of folk biology that traits which reflect an organism's inner nature are design features, representing how the organism is intended to develop. Our data showed a significant effect for Teleology (though weaker than for Typicality and Teleology) in driving judgments of innateness, suggesting that this explanation is correct. Moreover, despite its intuitive appeal the analysis is open to counterexamples based on Typicality and/or Fixity, just as we would predict on the basis of our results. For example, the massively over-grown jaw typical of the inbred Hapsburg royal family was innate—the Hapsburg's were innately hideous—but this was neither an evolutionary adaptation nor an instance of intelligent design.

5.3 Analyses of Innateness Based on Fixity

A third class of analyses identifies innateness with Fixity: innate traits are those like the Hapsburg jaw which are hard to change. This view has been ably defended by Andre Ariew, who argues that traits are innate to the extent that they exhibit environmental canalisation (Ariew, 1996, 1999, 2006; for discussion, see Griffiths and Machery, 2008). The concept of canalisation derives from the mid-20th century embryologist and theoretical biologist Conrad H. Waddington. A trait is genetically canalised to the extent that it will develop despite variations in the organism's genome. It is environmentally canalised to the extent that it will develop despite variation in the organism's environment. It is canalised *simpliciter* to the extent that both of these are true (Griffiths, 2006). Innateness-as-canalisation is a matter of degree. A trait is more innate the more environmental parameters its development is

buffered against and the wider the range of variation in those parameters against which it is buffered.

Our data suggest that intuitions about innateness respond more strongly to information about Fixity than to information about Typicality or Teleology. Innateness-as-canalisation should therefore fit people's intuitions about innateness better than other analyses.[12] Despite this, however, analyses which identify innateness with Fixity remain subject to intuitive counterexamples that trade on intuitions derived from those other features. Consider the penile reflexes of the rat. Celia Moore (1992; 1984) has shown that the spinal cord nuclei of male rats differ from those of female rats in ways that allow the male to use his penis during copulation. These neural differences result from differences in gene expression in the developing spinal cord of the rat pup, which in turn result from differences in the amount of licking of the genital area by the mother, which in turn results from greater expression of a chemical that elicits maternal licking in male pups. According to innateness-as-canalisation, these experiments show that the rat's ability to copulate is not innate:

> 'Distinguish between two reasons why the trait appears invariantly in an environmental range: the first, because an environmental condition is developmentally required yet is found everywhere the system develops; the second, because the system develops independently of the environmentally condition. Innateness should be identified with the second sort of invariance, not the first.' (Ariew, 2006, p. 10)

[12] We believe that this reveals something important about the concept of innateness vis-à-vis other concepts that reflect the underlying folk-theory of biological natures, such as the concepts of instinct and of human nature. These concepts may place different weightings on the three aspects of the folk-conception of biological natures which we described above. The readiness with which people speak of diseases as 'innate' already suggests that Teleology is not as heavily weighted in innateness as it is in instinct or human nature. It would seem perverse to express a strongly hereditarian view of autism, for example, by saying that autistic behaviors are 'instinctive.' If this suggestion about alternative weightings is correct it should be possible to demonstrate this in future research by comparing the application of the different concepts to the same set of examples. We intend to study this issue in future research.

We do not think that intuitions about the penile reflex case follow this prescription. Our data support this hunch. One of our examples of birdsong is the Black-Capped Chickadee *(Parus atricapillus)* (Table 2). Despite the wide geographic range of the chickadee, its morning 'fee-bee' song is invariant throughout the species. But males must be exposed to species typical song in order to acquire that song themselves. With this probe we gave participants exactly the evidence Ariew takes to show that a trait is not innate – 'an environmental condition is developmentally required yet is found everywhere the system develops' – but our participants regard the song as innate. The modal answer in Study 1 was 5 on our 7-point scale, while the modal answer in Study 2 was 7 on the same scale.

6. **What, if anything, can conceptual analysis of innateness achieve?**

We showed in Section 4 that people rely on the typicality of a trait, on its universality, and (to a lesser extent) on its teleology (functionality) to decide whether it is innate. In Section 5 we have shown that the main proposed analyses of the concept have focused on one of these three features. As a result, they are left open to counterexamples that elicit intuitions about innateness derived from the other two features. We argue in Section 6.1 that this shows traditional philosophical analysis is not a good tool for studying the vernacular concept. In section 6.2 we argue that philosophical analysis should not be used to sidestep the criticisms advanced by the many scientists involved in the study of behavioural development who regard the concept of innateness as fundamentally confused. Finally, in Section 6.3 we consider the use of philosophical analysis to understand the use of the innateness concept by specific scientific communities.

6.1 Conceptual analysis and the vernacular conception of innateness.

Traditional philosophical analysis is not a good tool for studying the vernacular concept. The thirty-year tradition of philosophical analysis of the innateness concept discussed in this section has yet to produce an analysis that comes close to being successful. In fact, each major analysis picks only *one* of the three features that the ordinary speakers actually use to assess innateness. Some more recent analyses seem to draw on *two* features, which probably increases their intuitive adequacy (e.g. Mallon and Weinberg, 2006). However, a successful analysis of the vernacular concept of innateness—one that would not fall prey to intuitive counterexamples—would have to include (at least) all three features discussed in this article—viz. Fixity, Typicality, and Teleology.

Moreover, if philosophers truly want to characterize the vernacular concept of innateness, they should renounce the methods that were used to develop the existing analyses. An accurate characterization would not just *include* all three features, but would give them appropriate *weights* and specify the pattern in which the features *interact*. Our two empirical studies suggest that, though relevant, Teleology matters less than Fixity and Typicality. Our studies also suggest that they interact additively, when they could equally well have exhibited complex interaction effects, with one taking on more or less significance in the light of the others. It is not plausible that the lower weighting of Teleology, or the fact that the various features interact additively, could have been discovered by comparing putative analyses of the concept of innateness with an unsystematic set of counterexamples, as philosophers traditionally do. At most this traditional, informal approach might suggest hypotheses for testing. Thus, if philosophers really wanted to characterize the vernacular concept of

innateness, they should undertake empirical studies of the kind described in this article.

6.2 Conceptual analysis and the scientific critique of innateness

Many philosophers see themselves as reforming, rather than analysing, the folk notion of innateness in order to make this notion more useful role for science. Ariew is particularly explicit about this in his (2006). He proposes to identify innateness with environmental canalization because such a reformed concept of innateness would be useful in biology and psychology. These reformist 'explications' of innateness are supposed to sidestep criticism of the innateness concept as vague and confused by providing a clear account of what 'innate' *could* be used to mean. In this section we argue that philosophical analysis should not be used in this way to sidestep scientific criticisms of the concept.

The data from our two empirical studies bolsters the standard scientific criticism of the concept, which is that it conflates a number of different ideas and leads to fallacies of ambiguity (e.g. Lehrman, 1953; Hinde, 1968; Tinbergen, 1963; Johnston 1987; West and King 1987; Bateson 1991; Oyama 1990; Ford and Lerner 1992; Michel and Moore 1995; Gottlieb 1997; Meaney 2001, for a good introduction, see Moore 2001). We have shown that Typicality, Fixity, and Teleology have an *independent influence* on folk judgments about innateness. This means that people need not know whether a trait is fixed or has a function to decide whether it is innate on the basis of evidence about typicality (and vice-versa). Thus, if they are told that a trait is species-typical, people may well infer that it is innate. But all three features are involved in vernacular conceptions of the innate. Having judged that it is innate, people are likely to infer that it is fixed—that its development does not depend on its

environment. Or if they are told that a trait has a function, people may infer on that basis alone that it is innate. Having judged that it is innate, they are likely to conclude that it is species-typical (and so on). The problem is that traits that are species-typical are not necessarily fixed; traits that are functional are not necessarily species-typical, and so on.

At this point, some philosophers will object that whilst the inferences just described may technically be fallacious, this is not important because as a matter of fact, when a trait is species-typical, it is usually also canalized and functional (and vice-versa). In our experience, philosophers presented with the standard critique of the concept of innateness from behavioral biology are unimpressed because it seems intuitively obvious to them that the various aspects of innateness, whilst theoretically separable, are always found together in nature. But this intuition is merely an expression of the folk theory of inner natures which philosophers, as much as anyone else, make use of in their everyday lives. In fact, the literature just cited contains many well-researched examples of disassociations between Fixity, Typicality, and Teleology, disassociations that from a folkbiological point of view appear paradoxical. It was these discoveries, rather than a desire for conceptual precision, that led the many students of behavioral developmental listed above to reject the idea of innateness.

There are also sound theoretical reasons for rejecting the presumption that Typicality, Fixity and Teleology will go together, however intuitive this presumption may appear. First, natural selection has no particular bias towards producing traits that are species-typical (monomorphic). Many important traits in humans and other organisms are genetically maintained polymorphisms, either as a result of frequency dependent selection, or as a response to variation in the environment across the

species' range (ecotypes). Natural selection also frequently produces phenotypic plasticity, in which the developmental system responds to the environment with a range of traits, as in the example of the water flea *Daphnia pulex* given above. Second, natural selection does not select for mechanisms which buffer traits against variation in the environment unless variation of that kind has posed a significant problem in the past. In fact, any buffering mechanism which is not actively being used will tend to decay by mutation. The human ascorbic acid synthesis pathway was disabled by mutation during the long period in which our fruit-eating primate ancestors had no chance of developing vitamin C deficiencies (Jukes and King, 1975). As Terence Deacon has nicely put it, in evolution organisms become 'addicted to' innumerable aspects of their environments, from ascorbic acid, to gravity, to social interactions (Deacon, 1997). In less colourful terms, the development of evolved traits assumes the presence of an 'ontogenetic niche' (West and King, 1987) which supports and enables the normal expression of the genome. Thus, on theoretical grounds, we should expect many evolved adaptations to be polymorphic, many to exhibit plasticity, and many, including those which are monomorphic and show no plasticity in natural environments, to nevertheless depend on the details of a 'developmental niche'.

Reformists like Ariew respond to the scientific critique of the innateness concept by stipulating that the term 'innate' be used to express only one, clear idea. He suggests 'innate' be used to express fixity, and he makes the idea of fixity as precise as possible by identifying it with the biological concept of 'environmental canalisation'. This is supposed to provide a useful concept for scientific research. But scientists already have such a concept, namely the concept of canalisation, and they already have a word that expresses that concept, namely 'canalised.' As Bateson

(1991) and Griffiths (2002) each remarked, if your goal is to mean canalised when you say ‘innate,’ why not just say ‘canalised’? Furthermore, our findings show that by ‘innate,’ the folk do not merely mean ‘canalised’. By using the term ‘innate’ instead of ‘canalised,’ biologists who follow Ariew’s reformist suggestion would systematically increase the risk of miscommunication between themselves, other biologists, and the public at large. When Robin Andreasen (1998) and Philip Kitcher (1999) proposed to reform the concept of race so that the word ‘race’ would become synonymous with the word ‘clade’, or with the expression ‘breeding population’, Joshua Glasgow (2003) and others were quick to note that since the term ‘race’ as used by the folk has specific connotations, this proposal would lead to dangerous misunderstandings among the lay consumers of science. A similar argument applies to reformist proposals for ‘innate,’ although the anticipated danger is obviously less immediately catastrophic.

6.3. Analysing the scientific use of the innateness concept

We are more sympathetic to a third proposed aim for philosophical analyses of the innateness concept. A philosophical analysis can aim to make clear how innateness is conceptualsied by some specific group of scientists. For example, Samuels (2002) describes his project as an attempt to analyze the concept of innateness used by cognitive scientists, particularly in the controversies spurred by Chomsky’s poverty of stimulus argument. Work of this kind could make a valuable contribution to assessing the scientific value of different innateness constructs, as urged by Mameli and Bateson (2006).

But if this is the really the project Samuels and others are engaged in, their methods suffers from serious shortcomings. Philosophers like Samuels (2002) and

Mallon and Weinberg (2006) still use thought experiments that tap into their own or the folk's intuitions. If the goal really is to analyze scientists' concept of innateness, this traditional methodology should be abandoned. Neither philosophers' nor the folk's judgments about innateness provide strong evidence about how, say, generative syntacticians think about the innateness of generative syntax? These philosophers also regularly make use of outlandish thought experiments, such as the spontaneous acquisition of the capacity to read or understand Latin after having ingested the famed Latin pill (Fodor 1975; Samuels 2002; Mallon and Weinberg 2006). It seems highly unlikely that the intuitions (if any) triggered among scientists by these thought-experiments would derive from a specific, technical understanding of innateness that plays a role in their scientific work

When they are not dealing with intuitions elicited by thought-experiments, philosophers assume that their analysis of a scientific concept is supported if it casts light on some scientific debate involving that concept or on some body of scientific literature (e.g., the writings of some prominent scientist). For instance, an analysis of the concept of innateness in cognitive science is supported if it casts some light on the debates spurred by Chomsky's poverty of stimulus argument or on Chomsky's writings. This is the obvious way to determine how a particular scientist or research community think about innateness: find a way of thinking about innateness that makes sense of their scientific practice and of what they say. But it can be usefully supplemented by empirical methods. The method we used in this article to study the folk concept of innateness can be readily extended to study scientists' concept(s) of innateness (for discussion, see Stotz and Griffiths, 2008). Scientists' judgments can be surveyed in the same way that we surveyed folk judgments. Unlike exegetical efforts to cast some light on scientific debates or on specific scientific texts, these methods

can systematically examine the factors than influence those scientists' judgments. We are in the process of designing research that will examine the judgments of psychologists, behavioral biologists, linguists, and others.

7. Conclusion

We have shown experimentally that judgments of innateness are strongly and independently influenced by Fixity and Typicality, with the former weighted somewhat more heavily than the later, and that they are independently influenced to a lesser extent by Teleology. This data provides some support for our hypothesis of a folk-biological, implicit theory of animal 'natures' of which the idea of innateness is one expression. We have argued that existing philosophical analyses of the innateness concept are inadequate because they try to make do with only one of these three features and ignore the weighting issue. We concluded with some reflections on the aims and methods of 'conceptually analysing' innateness. If conceptual analysis aims to capture the concept used by the folk or by some specialist community, empirical methods are more powerful than the traditional method of counterexamples, which is best regarded as a source of hypotheses. Empirical methods are also a powerful supplement to the exegesis of scientific texts, although we accept that this is a valuable approach to understanding scientific concepts. Alternatively, the aim of analysis may be to replace the existing concept of innateness with a more coherent, partly stipulative, explication of that concept for use in one or more areas of scientific research. In that case, the traditional philosophical method of counterexamples has at best a minor role to play and attention should focus on showing that the proposed explication meets a significant scientific need. Moreover, we doubt it is wise to use

the term ‘innate’ to express any such explication, since the vernacular understanding of the term is so deeply entrenched.

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