Theory and History in the Human and Social Sciences

Series Editor

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Chapter 4
Culture or Biology? If This Sounds Interesting, You Might Be Confused

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Introduction

Which differences between us are *biological* and which are caused by differences in learning, socialization, economics, upbringing, or, as it is sometimes generally called, *culture*? What is due to nature and what is due to nurture? These questions can seem important. They seem to matter for our self-conception – for who we are and can hope to be. They seem to matter for resource distribution – for which kind of research should be funded. And they seem to matter for policy-making – for which kinds of interventions are feasible or promising.

Questions about the role of biology tend to divide those studying or researching the social sciences. On the one hand, there is *biology attraction*. People in this group feel the appeal of a novel, naturalistic paradigm that promises to transform and rejuvenate the social sciences. Biology attraction may be fueled by the hope for a unified framework for understanding the human condition. On the other hand, there is *biology repulsion*. To the biology repelled, the rise to prominence of the life sciences at the university and in societal discourse feels like a hostile takeover that is at once naïve with regard to social science research and aggressive in its aspirations.

Public discourse a bout the relative contributions of biology and culture has a tendency to get politically charged. The biology attracted tend to view the biology repelled as avoiding reality in favor of well-willing ideology, as idealistic, and as driven by political rather than scientific motives.[1] The biology repelled, by contrast,

[1] Cf. Baron-Cohen (2004, pp. 29–34).

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J. Valsiner (ed.), *Social Philosophy of Science for the Social Sciences*,
Theory and History in the Human and Social Sciences,
https://doi.org/10.1007/978-3-030-33099-6_4

tend to think of the biology attracted as reactionary, as favoring conservative policies, and at worst as playing into the hands of racists and sexists.[2]

What then *is* due to biology and what is due to culture? What is due to nature and what is due to nurture? If you are enthralled by such questions about our biological differences, then you are probably confused – or so I will argue. My goal is to diagnose the confusion.[3] In debates about the role of biology in the social world, it is easy to ask the wrong questions, and it is easy to misinterpret the scientific research. My diagnosis will help to explain why emotions in these matters often run high and why the debate tends to get political.

In the first part of this chapter (section "Psychological Essentialism and How It Thinks of "Biological Differences""), I will draw on evidence that suggests that in the public understanding, reference to "biological," "natural," or "genetic" differences tends to be associated with an essentialist picture of human kinds. The evidence suggests that because of a deeply rooted human psychological tendency called *psychological essentialism*, this picture has an easy grip on us. In public discussions of biology and culture or nature and nurture, it is the essentialist picture that dominates the debate, incites our emotions, and fuels the conflict between the biology attracted and the biology repelled.

The essentialist picture is a serious distortion of what biological research really contributes to our understanding of human social behavior, as I will review in the second part of the chapter (section "Psychological Essentialism Deeply Distorts Biology"): the notion of an essential difference between some human populations (and populations of other organisms) is foreign to biological thinking; traits and behavior that are heritable need not therefore be genetically caused; and if a difference between two groups is genetically caused, this does not mean that the difference is not caused by social structures and that it cannot be changed by learning or social intervention; social mechanisms may be so deeply intertwined with other biological mechanism that it makes no sense to ask about their relative contributions.

What Are "Biological Differences"?

Men on Steroids: An Example

Let us start with an example of how the biology/culture (and the nature/nurture) distinction is sometimes used. The example illustrates how a network of concepts and terms regarding "biology," "nature ", "genes ", "brain ", " hard wiring", "neurosci-

[2] Some of the debate between the biology attracted and the biology repelled has, for example, played out in the public discussion in Norway following the release of the 2010 documentary "Hjernevask" (Brainwash) co-produced by Harald Eia and Ole-Martin Ihle.

[3] My discussion draws heavily on, summarizes, and connects the excellent work in Fausto-Sterling (2012), Keller (2010), Fine (2005, 2012, 2017), Gelman (2003), Leslie (2013), Richardson (2013), and others.

ence", "innate ", or "essential" tend to operate together in the popularization of biological explanations of social differences.[4]

The example concerns the biology of sex and gender. In a series of papers and popular books, neuroscientist and psychologist Simon Baron-Cohen distinguishes between a female and a male brain type. These types, it is argued, can be traced back to the different levels of testosterone produced by the male and the female fetus. Those fetal testosterone levels influence their brain development.[5] The alleged result is a differentiation between the female brain, which is an empathizing brain "predominantly hardwired for empathy" (Baron-Cohen, 2004, p. 1), and the male brain, which is a systemizing brain "predominantly hardwired for understanding and building systems" (ibid.). Sex-linked genes (e.g., on the sex chromosomes, XX and XY), according to Baron-Cohen, may also be "a major determinant of the male and female brain types" (ibid., p. 198) possibly acting through testosterone secretion. We can thus "be confident that genes controlling empathizing and systemizing will be identified" (ibid., p. 199). Of course, "[g]enetically and/or hormonally based neural systems underlying empathizing and systemizing still require the right environmental input (sensitive parenting, for example, in the case of empathizing) in order to develop normally. But identifying such genes or hormones will help us understand why, despite all the relevant environmental factors, some children are worse at empathizing, or better at systemizing, than others" (ibid.).

The claim that males and females have biologically different brains is argued to be an important part of the explanation of large-scale societal structures: female-brained people "make wonderful counselors, primary-school teachers, nurses, cares, mediators, group facilitators or personnel staff" (ibid., p. 185), while male-brained people "make the most wonderful scientists, engineers, mechanics, technicians, musicians, architects, electricians, plumbers, taxonomists, …., programmers, or even lawyers" (ibid.). This (as Baron-Cohen also points out) fits the contemporary gender distribution in many modern societies: in 2011, in Norway, for example, 89% of nurses and 83% of personal care workers were women, while 97% of machinery mechanics and 99% of building finishers were men.[6] Biological brain differentiation, according to Baron-Cohen, is an important part of the explanation of why men and women end up with different types of jobs. Baron-Cohen (2004) also

[4] I have deliberately chosen a *popular science* account that traces "social" structures and observations, as they are typically studied in economics, anthropology, sociology, and psychology, to their "biological" roots. The reason for this choice is that it is this kind of popular writing that is most likely directly encountered by most social scientists and humanities researchers, the one that is most directly in the public eye when it comes to debates regarding nature vs nurture, and the one where the problems I am interested in are often most pronounced.

[5] Baron-Cohen, Knickmeyer, and Belmonte (2005) and Baron-Cohen (2002, 2004). For an in-depth review of research on the role of testosterone for various types of social phenomena, see Fine (2017).

[6] These data come from the official statistics of *Statistik Sentralbyrå* Norway (Statistics Norway). See www.ssb.no/en/regsys (StatBank table 11411, www.ssb.no/en/table/11411) or the brochure "Men and Women in Norway 2018" available at https://www.ssb.no/en/befolkning/artikler-og-publikasjoner/women-and-men-in-norway-2018.

hypothesizes that the male/female brain differentiation partially explains the persistence of gender differences in math and physics education.[7]

This example illustrates an explanatory scheme. We start with something that seems clearly biological and independent of cultural or societal factors: here these are differences in genes and fetal hormone levels. These biological facts seem objectively measurable and clearly independent of any cultural or social factors (after all, the genetic makeup of an organism is determined at fertilization, and the hormone level differentiation occurs in the fetus already before most mothers, or anyone else, even know the gender or sex of their future child). In a second step, this biological factor is then argued to cause a similarly biological difference in brain development. In this case, there is stronger cross-hemispheric connectivity and activation in female brains and stronger intra-hemispheric connectivity and activation in male brains. The fetal hormonal difference brings about a "hard-wired" difference in the very structure of the brain. Third, these differences in brain anatomy and activation patterns lead to functional differences, i.e., differences in psychological traits and strategies. Here these are strengths in either empathy or systemizing. Fourth, the difference in psychological capacities in turn is supposed to scale up: individual psychological differences have societal consequences. If men and women have different psychological capacities, and use different psychological strategies, this, it is argued, must be part of the explanation for why they, for example, tend to be found in different occupations. Finally, we are offered a deeper evolutionary explanation for why the genetic differentiation with its social and behavioral consequences exists (see Fn. 7). The populations have different genes because they responded to different evolutionary selection pressures. The explanatory scheme thus moves from evolutionary history, over anatomy and physiology, to psychological differentiation and to social patterns.

[7] Baron-Cohen also offers some evolutionary speculation as to why do people have such different brain types (of the systemizing or the empathizing kind): Baron-Cohen suggests that such brains "have been selected [by evolution] as specializations for entirely different goals and niches" (Baron-Cohen, 2004, p. 225). The male, systemizing, brain type was good for "using and making tools," especially weapons, that could, for example, "have been a major advantage in male–male competition" (ibid., p. 203); it was good for hunting, and trading, gaining higher social status (which makes males attractive for females); to acquire and exercise social dominance, is linked to aggression, makes men tolerate solitude, specialized experts, and successful leaders. All these are aspects of the evolutionary niche of the human male. The female empathizing brain type, by contrast, Baron-Cohen suggests, was good for mothering (females, who Baron-Cohen thinks were the principal caregivers, may thus have evolved an empathizing brain); it is also good for making and keeping friends – the kind reciprocal relationships important to females who need community stability given the resources they invest in children and parenting; relatedly, an empathizing brain makes you good at participating in gossip which stabilizes dependable alliances, integrate into novel social groups (like the family of a male partner); it helps a female understand and be compassionate toward her partner and thus provide her with "a better chance of keeping her relationship stable during her offspring's vulnerable years, thus promoting their survival and the spread of her genes" (ibid., p. 223). The empathizing brain is thus hypothesized to be perfect for the female evolutionary niche. Baron-Cohen offers comparatively little scientific support for these speculations. For a powerful critique of such "evolutionary psychology" speculations, see Richardson (2010). Richardson shows how such speculations fall dramatically short of accepted standards in biology. See also Laland and Brown (2011).

This explanatory scheme no doubt, at least to the biologically attracted, appears powerful. Are we supposed to simply reject the evidence that male and female fetuses are exposed to different levels of testosterone? Are we simply supposed to ignore the genetic differences between men and women? Are we supposed to think that psychology has nothing to do with brain activation? Or are we supposed to think the psychological tendencies of individuals play no role in the explanation of which occupations certain groups of people tend to choose? Each step of the argumentative scheme can seem irresistible. In light of the availability of explanatory schemes exemplified here by Baron-Cohen's research, it can seem that one indeed would have to be "brain-washed" to reject that "biological sex-differences must play an important role in explaining why [for example] Norwegian women and men to such a large degree choose "traditional" educations, professions, and career strategies" (my translation) as the biology-attracted sociologist Gunnar Aakvaag (2015) suggests in a recent newspaper article.

What Is a "Biological Difference"?

What are the "biological sex differences" Aakvaag and others are talking about? While public debate about the relative contribution of biology and culture, or of nature and nurture, can be heated, what is at issue is often discussed very little; it is taken as implicitly understood. Glancing reference to the type of writing exemplified by Baron-Cohen, if even that, tends to be all that is felt needed to get the discussion going. But let us step back and ask:

When is a difference between groups of people a "biological" difference?

One way of understanding something to be "biological" is that it is the kind of thing that is studied in biology or in the biological sciences.

It seems unlikely that this is how the participants in the relevant public debates understand the issue. Biology is a multifaceted field with boundaries that aren't clearly delineated. In nonhuman organisms, *any* sex differentiation in (social) behavior, population structures, ontogenetic development, cellular and molecular mechanisms, neuronal processes, evolution, and more would be studied in the biological sciences. Researchers in biology may, when useful, use methods that originated in the social sciences (like game theory, first employed in economics). Further, most lay participants in the relevant public debates will not know where disciplinary boundaries are drawn in the academy and what methods are used where; and most academic participants will be cognizant of the fluency of methodologies and academic disciplines. When "how much is due to biology?" sounds deep and interesting and incites public debate, it is unlikely that it means "how much can be studied in the biological sciences? " It must mean something else.

Another approach is to focus not on what biological differences *are* but on the pragmatic effects of appealing to the "biological."[8] In this regard one might

[8] With regard to human "nature," Maria Kronfeldner (2018) makes this argument in detail.

emphasize, correctly I believe, that the concepts at issue are "essentially contested" (Gallie, 1956), because they mark domains of epistemic authority. The fact that their descriptive meaning is hard to pin down contributes to their contested nature. People are ready to fight vigorously over what about us is nature or what is biological because the use of these terms delineates who counts as an expert in the domain, who gets resources for its study and for changes or "treatment" in the domain, and therefore who gets power with respect to shaping societal discourse, setting agendas, and in the end also in policy-making.

I believe that their pragmatic function to delineate domains of epistemic authority is indeed an important aspect of why disputes about "nature" or "biology" have a tendency to become heated. But it doesn't yet explain what kind of epistemic authority "biology" indicates. Why does it sound more interesting (and more controversial) to ask which of our differences are "biological" than to ask which are "psychological" (and hence make specialists in psychology experts), "physical" (thus falling to the expertise of physicists), or "economical" (thus being the domain of economists)? In other words, why does appeal to the "biological" signal a special epistemic authority, especially when it comes to human differences?

Psychological Essentialism and How It Thinks of "Biological Differences"

Psychological Essentialism

In order to better understand both the attraction and the controversial nature of appeals to the "biological," I will argue in this section that we need to understand how it is integrated into an important aspect of our psychology. I will argue that the idea of "biological differences" and contributions of "nature" fits well and gets quickly incorporated into a highly intuitive (albeit false, I should already now say) tendency for thinking about human kinds. "Biological differences" are intuitively understood as differences in the internal, unchanging, and immutable *essence* of different kinds of people. Much of the public controversy, in my diagnosis, is fueled by the fact that its participants argue or are perceived as arguing about the viability and the reach of essences – often in vague and inarticulate ways. It is the essentialist picture that generates the strong emotions on both poles of biology attraction and biology repulsion.

In this section, I will review some of what is known about this intuitive essentialist way of thinking. In the next section, I will then show how and why "biology" gets co-opted by that way of thinking.

Psychological essentialism is a set of tendencies for how non-experts, including children as young as 3–5 years old, tend to group the members of certain kinds of individuals together on the basis of hypothesized, underlying, though unknown, features (cf. Gelman, 2003). This underlying "nature" is thought to make the

individual the kind of individual it is and causes it to normally have its observable properties. Psychological essentialism is thought to be an important aspect of how people tend to think about both natural and social kinds. It describes an important aspect of our intuitive way of thinking about classification; it is what we do unreflectively, quickly, and automatically (and, thus, independently of exposure to real scientific research). Psychological essentialism has been shown to apply to natural substances like water or gold, biological categories like animal and plant types, but also social categories like race and gender (on which more below); it does normally not apply to artifact kinds like types of furniture or tools. Psychological essentialism appears to be a fairly universal aspect of human psychology and has been shown to exist in human communities around the globe (Gelman, 2003 and Heine, Dar-Nimrod, Cheung, & Proulx, 2017 for recent reviews).[9]

The tendencies described by psychological essentialism show up in how people classify individuals, explain, and make predictions. According to psychological essentialism, people implicitly posit an essence for a kind of being; they are said to "essentialize" a kind to the degree to which their intuitive thinking about that kind is governed by roughly the following features (cf. Heine et al., 2017):

> First, essences are held to be substantially and often quite radically *immutable*. Given the immutable essence of the kind, even radical transformations therefore will not change what the individual fundamentally is: a caterpillar that develops into a butterfly remains a member of the same kind, even though its outward appearance has changed radically (Rosengren, Gelman, Kalish, & McCormick, 1991). Importantly, this includes radical changes in the individual's environment, its upbringing, and its social encounters: children believe that a kangaroo will forever retain its kangaroo nature even if it grows up among goats (Gelman & Wellman, 1991).[10]
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> Second, essences are held to be *internal* and *deep within* the organism. Children hold that essences are normally invisible. Changing the inside of an organism, children believe, is more likely to affect its essence than changes to its outward appearances (Gelman & Wellman, 1991).
>
> Third, essences – while invisible to the naked eye – are accessible to *experts*. As a result, "[c]hildren [, for example,] readily accept experimenter-provided labels, even when such labels are surprising and counterintuitive" (Gelman, 2003). Children hold that an expert like the experimenter knows best how to classify individuals. They defer to the expert's knowledge of essence in their classificatory practices.
>
> Fourth, essences tend to be all or nothing. Essentializing a kind therefore leads to *boundary intensification*. While children readily accept that a penguin is an atypical bird, it is still "definitely" a bird (Gelman, 2003). While for non-essentialized kinds, such as artifacts, people tend to hold that something can be a member of a kind to some degree but not fully (it's sort of a chair, but sort of a sofa too; sort of like a car and sort of like a motorbike); people tend to make fairly extreme category membership judgments about essentialized kinds even when they accept that an individual is an atypical member (Gelman, 2003).

[9] As shown in these reviews, the extent of these essentialist tendencies does vary with a number of other factors, e.g., socioeconomic status, and is more widespread in some populations than in others, e.g., Europeans vs East Asians.

[10] Note though that the essentialist beliefs about possible transformations for an individual are interestingly constrained: already 3-year-olds hold that a smaller animal cannot be a grown-up stage of a bigger animal (Gelman, 2003, p. 65).

> Children may think that penguins are atypical birds, but they do not think that they are sort of a bird and sort of something else.
>
> Fifth, essences *can be transferred* from one individual to another. This is so especially through biological parenthood: Gelman and Wellman (1991) as well as Heyman and Gelman (2000), for example, show that already young children believe that infants (human and animal) inherit some aspects of their essence from their biological parents even when they are adopted and grow up in a different environment.

All of these tendencies for essentializing kinds are present in children long before they learn anything about the biological sciences, are present also in communities that have not been exposed to those sciences, and govern also adult *intuitive* classificatory judgments.

Essentializing occurs especially for kinds we think and talk about a lot. Highly essentialized kinds tend to correspond to our subjectively preferred taxonomy, to what Eleanor Rosch has called the "basic level" of categorization (Rosch, 1978; cf. Leslie 2017 for discussion): the kinds for which names, for example, are learned first or for which we can list the highest number of distinguishing or salient features. Our preferred way of carving up the world appears to be in terms of these basic level highly essentialized kinds.

Why do we essentialize kinds? Psychological essentialism with respect to biological kinds, while deeply mistaken with regard to real biological thinking (as I will argue below), serves useful functions: it allows us to efficiently and quickly draw inferences regarding which appearances, forms of behavior, and other important properties will tend to come together. Because they are psychological essentialists, "[p]eople expect the disparate properties of a species to be integrally linked without having to know precise causal relationships" (Atran, 1998). Such a powerful set of inferences would otherwise be unavailable. Inductive inferences about the unobserved can be made on the basis of a few observations and knowledge of kind membership. By simply taking terms to stand for essentialized kinds, children can draw on community knowledge (or bias!) for their own generalizations since in the very use of the term expert (or guru!) knowledge gets encoded.

On evolutionary time scales, psychological essentialism may have become an important feature of human cognition because it was such a practically efficient inductive tool. It may have been evolutionarily available and beneficial for humans because of how sociality (including information sharing, extensive learning, and teaching), intelligence, and language use co-evolved in the human lineage (cf. Pinker, 2010). As Atran (1998) argues, psychological essentialism may have been biologically adaptive in our thinking about the organismic world, because it increased the efficiency of inferential reasoning in the biological domain at fairly low evolutionary costs: the individual differences between the members of an animal or plant kind often matter much less than what is shared between them. Under most circumstances, it is much more important to know that "lions have manes," that "bugs are disgusting," or that "the hemlock is poisonous" in order to avoid death and disease than to know about the many individual differences in appearance and behavior. By encoding psychological essentialism into the most easily acquired linguistic terms, we were able to make quick and powerful generalizations exactly

when it comes to the most striking and – for our community – most important features of the world.

How and when the use of language supports essentializing is not extremely well understood. There is some evidence, though, that suggests that an essentialist understanding is encouraged both by the use of generic sentences and by the use of noun phrases (see Leslie 2017 for a review and further references). Generic sentences are sentences of the form "Fs are G" or "The F is G," e.g., "Lions have manes." They are to be contrasted with explicitly quantified sentences like "Some lions have manes," "Many lions have manes," or "All lions have manes." Evidence suggest that the use of generics contributes to essentializing the kind. Noun phrases are used in sentences like "Simba *is a lion*" and are opposed to the use of verb phrases like "Simba *has fur*." Children will essentialize more if a property is introduced by a noun phrase rather than a verb phrase ("is a carrot eater" vs "eats carrots"). The use of noun phrases and generic language thus can serve as linguistic means for transmitting essentialist attitudes in the community and across generations (Leslie, 2013).

Essentialist tendencies are known to be prevalent also when it comes to kinds of human or social categories.[11] In this case, essences and their consequences are attributed to certain types of people. Among the most essentialized human kinds are gender, race, ethnicity, and disability (cf. Haslam, Rothschild, & Ernst, 2000). On an intuitive level, already young children (but also adults) thus tend to implicitly accept the following ideas about humans:

1. Human individuals come in kinds that differ in their essences (some human kinds have essences).
2. The essence of a kind of human delineates sharp boundaries between groups of individuals (intermediary cases are impossible).
3. The essence of a kind of human consists in an internal feature shared by each individual of that kind (essences are internal).
4. Essences are invisible to the naked eye or casual observation: they are located deep within each individual (essences are invisible).
5. Essences can be known by experts, to whom non-experts will tend to defer when it comes to placing individuals into kinds of human (essences are known to experts).
6. Essences cannot be changed through the life span of an individual: they remain the same through changes in the individual's development or its physical or social environment (essences are immutable).
7. Internal essences causally determine a type-typical outward appearance and behavior. Other (developmental or environmental) causal factors shaping individual appearance and behavior can be separated from the causal role of essences and explain only deviations from the type-typical appearance and behavior (essences are separable causes).

[11] Rothbart and Taylor (1992); see also Prentice and Miller (2007) for a fairly recent overview.

Consider gender (cf. Bohan, 1993; Gelman & Taylor, 2000; Haslam et al., 2000): already young children tend to think that the differences between men and women reflect an underlying difference in internal features that make someone either a man or a woman (Taylor, 1996). Men have one kind of internal essence. Women have another. This essence (what makes someone a man or a woman) is not visible to casual observations. The essentialist child accepts that some men look like women and behave like them. But deeply within a man will always remain a man (and a woman, however much she dresses and behaves like a man, will always remain a woman). While a person's hair color may change through processes like dying and aging or through external factors like exposure to sunlight (since the kind "blond" or "dark-haired" is not strongly essentialized), children tend to think that whether a person is a man or a woman is *not* something that can change through her lifetime (once a woman always a woman). Further, children think that there is a sharp boundary between men and women. While someone can be sort of blond and sort of dark-haired (maybe they have some blond and some dark hairs; maybe their hair color falls in-between in some way), no one can be sort of a man and sort of a woman. Even if they are an atypical man, in many ways behaving and looking much like a woman, they are definitely a man (or they are definitely a woman). The boundary between men and women gets intensified. Finally, already young children believe that the behavior and appearance of a gendered person are partially due to effects of their gendered essence (whether they "really" are a man or a woman) and partially due to effects of how the person grew up and the environment they live in (a man may grow long hair or behave like a woman if he is surrounded by women or socialized in a certain way; but – children think – their nature as a man in the end can be determined by an expert).

This way of thinking about gender – as an essentialized kind – then is something that most of us find intuitive already when we are 5 years old and that we all continue to find intuitive even as adults. It is a reflection of a deeply rooted, evolutionarily old, and adaptive way of thinking about many aspects of the biological and social world.

Interpreting Biology as Concerned with Essences

It is therefore with those essentialist tendencies in them that lay people, but also many academics, hear about (popular representations of) research on our biological differences and approach the question of what is due to nature and what is due to nurture. In this section, I argue that there is good reason to think that they will map the new terminology to that already familiar way of thinking: what is due to biology or nature in a kind of person is understood as what is due to the essence of the relevant kind. By contrast what is due to culture or nurture is what does not spring from this essence.

"Fetal hormone levels," "genes," and "hard-wired" brain structures intuitively are an excellent fit for the role of essences. They are internal, invisible, and known to experts but not lay people; they are biological inherited, are portrayed as unaffected

by environmental factors, and have important and intuitively separable effects on observable appearances and behavior. While not all popular writers are as explicit as Baron-Cohen in their claim to uncover "essential differences," I claim that especially lay participants in the public debate about "biological differences" or "nature" and "nurture" often intuitively understand the debate as being about whether to accept an essentialist picture of the relevant kinds of human. In Baron-Cohen's writings, we see, for example, a heavy emphasis on "types" (of brains and people) that are "determined" or "controlled" by fetal hormones and genes. These "types" can develop "normally" or abnormally, and the "right" environmental input is needed to get out the type-typical appearance or behavior, the one that is "supposed to" be the result – given the relevant essence.

In a number of studies, Dar-Nimrod, Heine, and colleagues (cf. Dar-Nimrod & Heine, 2011; Heine et al., 2017) have argued that people associate genes with essences. They argue that people tend to view genes as the materialization of unknown essences and are ready to transfer their intuitive categorization device to this scientific concept. Genes are internally located, can be transferred from parent to (biological) child, are unchanged through development and transformation of appearance and environment, are discovered by experts, and are supposed to explain many outward properties. "Because of this overlap with people's essentialist intuitions, we submit," so Heine et al. (2017), "that when most people are thinking about genes they are not really thinking about genes – they are thinking about metaphysical essences." It is thus no wonder that people are ready to view the power of genes in an almost mystical fashion (Nelkin & Lindee, 1995) and are very quick to explain all kinds of conditions in terms of those "genes": after all, here the experts are speaking about our deep nature that we were attuned to from early childhood on.

The gene-essence association, Heine et al. (op. cit) argue, leads to a number of (mis)conceptions about genes.

Given that genes qua essences are internal and immutable, we cannot change how they affect appearance and behavior. If a condition or behavior is caused by genes, it is therefore thought to be outside our control. Studies show that when non-experts read about the genetic origins of some condition or tendency, they will tend to form fatalistic attitudes toward that condition or tendency, i.e., they will tend to treat it as relatively unchangeable, and less subject to choice: people who read about research describing "obesity genes," for example, tend to eat more cookies afterward, compared to those who read research about how social networks affect obesity or those who read about non-obesity-related research (Dar-Nimrod, Cheung, Ruby, & Heine, 2014). Given that genes are viewed as essences, their effect is thought to be what is independent of environmental (including social and developmental) conditions.[12]

[12] Dar-Nimrod, Zuckerman, and Duberstein (2013), in a related study, focus on the effects of (apparently) learning that one has an "alcoholism gene." They show that this leads participants to experience negative affect and lack of control over drinking. Similar results are found in more complex domains: people who are led to think that learning styles (how someone learns most efficiently) have genetic causes tend to think that they have no control over their own learning style and that learning is best when learning styles are matched between teacher and student (see Heine et al., 2017).

Relatedly, people also have a tendency to think that if a condition has a genetic cause, it does not have another (e.g., environmental) cause as well. Genetic causes dominate other causes and exclude them. If obesity is genetic, people tend to think, then it does not matter how much you eat; either you become obese or not – independently of your behavior.

If someone believes that gender differences are biological, we would therefore expect that they think that these differences spring from the relevant essence of the gendered kind. And if they spring from those essences, they cannot be changed and have to be accepted as a given that is outside human control (just like for obesity). And this is exactly what has been found. Brescoll and LaFrance (2004) tested how subjects reacted to being presented with a biological rather than a cultural or social explanation of gender differences and found that "exposure to biological explanations significantly increased participants' endorsement of gender stereotypes" (p. 515). Similarly, Coleman and Hong (2008) found that an endorsement of a "biological gender theory [was] … linked to [a] stronger gender self-stereotyping tendency" (p. 34) (as reflected by greater endorsements of negative feminine traits and slower reaction time in denying stereotypic feminine traits). They found further that "this relationship holds even when the participants' sexist attitudes were statistically controlled" (ibid.).

Exposure to biological or cultural explanations of gender differences does not only influence people's explicit attitudes (whether they endorse a stereotype), there is also evidence that it affects people's performance on stereotyped tasks (Dar-Nimrod & Heine, 2006): in their experiment, women did a math test, after reading essays that they were told tested for reading comprehension. If those essays argued for a biological gender theory, then women's math scores were significantly lower than when those essays argued for a cultural, experience-based explanation. Indeed, exposure to the biological theory significantly lowered math scores compared to reading an essay on a neutral topic.

If people intuitively associate "biological" explanations as concerned with internal metaphysical essences, we can explain why the acceptance of such explanations leads to a fatalistic attitude with regard to the status quo.[13] What is biological is what cannot be changed through social means like education, and therefore we simply need to accept those biological differences as an immutable given. If it is a "biological" fact that women are bad at math, then – if you are a woman – it is not even worth trying. If sex differences are "biological," then they are essential to who we are, and therefore we must accept their type-typical results. Exposure to claims about a "hard-wired" or "biological" difference between male and female brains, since those claims are interpreted as concerning essences, therefore "quite independently of their scientific validity, have scope to sustain the very sex differences they seek to explain" (Fine, 2012).

[13] Related to boundary intensification, people who view a human kind as largely homogenous, and importantly and fundamentally distinct from other kinds, tend to also view membership in that kind as genetically caused.

Let us then look, returning to our case study, at how someone who is already – and has been from early childhood – a psychological essentialist would encounter Baron-Cohen's writings.

His 2004 book, the most popular exposition of his scientific research, of course is titled *The Essential Difference* (presumably referring to the "male and female brains" of the book's subtitle; but easily understood as holding between men and women as such: the book's Penguin edition cover, after all, showcases not brains but a man and a woman and their "typical" thoughts). Essential differences between the male and female mind (note the generic formulation) are again prominently mentioned at the beginning of the acknowledgments; a contrast is drawn between the claim that some of the observed differences between "the mind of men and women" (note the use of generics again) "reflect … differences in "essence" (p. 157)[14] as opposed to cultural factors. "Biological factors are the only other candidates" (p. 166) other than those cultural factors. Biology, in Baron-Cohen's writings, gets associated directly with the essence of man and woman (and their minds).

It is not only the explicit appeal to "essences" that triggers an essentialist reading of Baron-Cohen's exposition of his research.

Throughout the book, he uses the language of *types* of brains, thus strongly suggesting that population differences in neuroanatomy and neuronal processes can be traced to a difference between two types of brains ("the male brain type" and "the female brain type" or "brain type E" (for empathizing) and "brain type S" (for systemizing).[15] To speak of "types" suggests a deep and fundamental difference "in nature" (or who would speak, unless half-jokingly, of the blond and the dark-haired type of person).

The book is further full of generic language, often speaking of "the male brain" or "the female brain," but also of what women or men generically are like, do, or have evolved to do (in sentences without explicit quantifiers like "some," "all," or "many"). As we have seen, there is evidence to suggest that use of such generics will encourage essentializing the relevant kinds, and that generics are easily accepted on the basis of just a few striking instances, but tend to lead to overgeneralization to a large proportion of the essentialized kind.

Of course, Baron-Cohen also, at various places in the book, emphasizes that he is "only talking about statistical averages" (p. 20; see also p. 27, 185), that not all men have "the male brain type" and that not all women have "the female brain type," and that "your sex does not dictate your brain type." Unlike stereotyping, he stresses, "science recognizes that many people fall outside the average range for their group" (p. 28). But the psychological essentialist easily acknowledges such

[14] Scare quotes around "essence" are in the original. I suspect, though cannot show this, that with the use of the quotation marks, Baron-Cohen here shows some awareness that appeal to "essences" is considered scientifically unacceptable in the biological sciences. But note that he seems to be also happy to quite explicitly take the shortcut to get his readers to understand the distinction he aims to draw.

[15] The latter sounds more scientific than the former, but Baron-Cohen clearly associates them strongly and often combines the terminology, speaking, e.g., of a "male brain type S" (p. 20).

variations: their (implicit) view is an essence plus variations picture. Some members of an essentialized kind might appear and behave quite differently from the kind type, due to unusual circumstances, cover-up, or lack of "the right environment input" (Baron-Cohen, 2004, p. 1999). What all members of the kind share is an internal disposition (the essence) that could but need not manifest itself. To someone disposed to psychological essentialism, talk of "statistical averages" is therefore naturally interpreted as noisy variation around the norm for the "group" which is identified as the separable causal upshot of the type essence. And of course, psychological essentialists are ready to be corrected by experts. They do not, after all, think that essences can be directly predicted based on appearances or outward behavior. What outwardly looks like a man thus might well have inside its skull "the female type."

The psychological essentialist who is exposed to Baron-Cohen's work thus gets ample apparent evidence that the reported scientific research has uncovered the metaphysical essence of males and females (and the male and female mind) and has a ready interpretation for those places where strict boundaries appear to be denied.

Explaining the Controversy

We have seen evidence that psychological essentialism is deeply rooted in human psychology and that humans – including and especially children and lay people – think of differences between some human kinds, such as the difference between men and women, along essentialist lines, long before and independently of whether they have ever been exposed to biological research.

We have also seen evidence that psychological essentialism gets easily co-opted into an interpretation of biological research on differences between human populations. Differences described in terms of "genes," "hormone levels," or those that are "hard-wired" tend to be understood as differences that are due to differences in the essences of the relevant kind. The way we all tend to intuitively understand "biological differences" thus is as differences of essence, while those differences that are not biological (especially social or cultural differences) are the ones that are not due to a difference in the essence between the relevant kinds and in this sense merely accidental. What is biological thus cannot be changed through education or social arrangements, while other differences can be changed through such means.

This explains why appeal to our "biology" carries special epistemic authority. While we may not know exactly what is biological and what is not, it matters deeply what is part of biology and what is "merely" social: what is biological is what carves human kinds along their essential joints. Experts in the "biology" of sex and gender thus are intuitively understood as experts in what makes gendered people the kind of people they are. Since the difference between what is essential and what is not essential is so important and yet hidden from the observation of behavior and appearances, it is going to be highly contested what falls on which side. We can thus explain the contested character of the concept of a "biological difference." The difference

between nature (or biology) and nurture (or culture) seems deep and important exactly because it aligns with the difference between essence and accidents that psychological essentialism gives us.

We have also seen that this essentialist thinking has social consequences: since what is essential is immutable, people are not motivated to try to change or counteract what is due to biology (it can after all not be fundamentally changed but only "covered up" in its effect on behavior or appearances). Biological differences are thus seen as differences that form a neutral and objective background against which all policy making or social arrangement must be taking place and not themselves as differences that can be affected or even eradicated by changes in social arrangements.

This way of aligning the essentially unchangeable with what is biological, internal, hidden, and given from parents to offspring, as we have seen, is present already in young children. It is not a scientific discovery that there are "essential differences" between men and women. Children and lay people already believed that there are exactly such differences and stood all too ready to believe that biology unearthed them in its talk of genes, hormones, and brain wirings. Those who defend biological differences between, say, men and women are thus understood as defending an unchanging and unchangeable difference in the essence of the type "man" and the type "woman." If differences in which professions men and women tend to choose are due to "biology," it is thus understood that such differences will not disappear, whatever social arrangements we may come up with (and the same for differences in math performance or empathy).

It is thus no wonder that those with a progressive political view will be opposed to "biology": the more is seen as due to biology, the more about us cannot be changed and thus presumably is not worth trying to change. Those who advocate social change thus won't like "biology." By contrast, those with a conservative political viewpoint will be happy to see the realm of the "biological" increase. After all, it supports their view that certain aspects of how things are should not be subject for attempted changed (after all, they cannot be changed, and so its hubris to *try* to change them).

The essentialist understanding of our "biological differences" thus explains why debates about them get the hearts racing and have a tendency to become political. They are debates about what should be taken as a given background and what is amenable for social change. We have a fairly well-developed psychological explanation for why the nature/nurture or biology/culture debate *seems* deep and important.

Psychological Essentialism Deeply Distorts Biology

Psychological essentialism explains why the question about our "biological differences" psychologically seems to us deep and important. Is the picture of the world of organisms (including humans) provided to us by psychological essentialism even halfway adequate? Do kinds of organisms have essences of roughly the sort

psychological essentialism tells us they do? Is the picture of genes, hormone levels, and brain wiring as corresponding to essences a roughly correct picture of how real biological research thinks of them? The answer, I will argue in this section, is no. Essentialism of the kind we have encountered is a serious misrepresentation of biological research.

There Are No Internal Biological Essences

While, as we have seen, appeal to "biological differences" in public discussion and in popular books like Baron-Cohen's tends to be closely associated with differences in "essences," it is almost universally accepted within biology that no population of organisms (no kind of organism) has anything like the intrinsic, internal, and immutable essence psychological essentialists intuitively posit. Ernst Mayr, one of most influential biologists of the twentieth century, famously contrasted "typological thinking," which he found in the philosophical tradition of Plato and Aristotle, with the "population thinking" that characterizes modern biology. He writes that, according to biology,

> [a]ll organisms and organic phenomena are composed of unique features and can be described collectively only in statistical terms. Individuals, or any kind of organic entities, form populations of which we can determine the arithmetic mean and statistics of variation. Averages are merely statistical abstractions, only the individuals of which the populations are composed have reality. The ultimate conclusions of the population thinker and of the typologist are precisely the opposite. For the typologist, the type (eidos) is real and the variation an illusion, while for the populationist the type (average) is an abstraction and only the variation is real. No two ways of looking at nature could be more different. (Mayr, 1959, p. 2)

The population thinking that Mayr describes here is diametrically opposed to the essentialist picture. Mayr's view that an evolutionary and biological approach to humans and other organisms is not compatible with essentialism about the relevant kinds is widely shared among biologists and philosophers of biology. With regard to what biology thinks about the idea of "human nature," another influential biologist, Michael Ghiselin, sums the idea up as follows: "What does evolution teach us about human nature? It teaches us that human nature is a superstition" (Ghiselin, 1997, p. 1). The widespread evolutionary consensus against essentialism is not specific to humans; it applies to all biological kinds. With regard to whether biological species – the paradigm of essentialized kinds for those in the grips of psychological essentialism – have internal essences, philosopher of biology Eliot Sober (1994) says "essentialism about species is today a dead issue" (p. 163; cited also in Okasha, 2002, p. 191).

Why is this? As Samir Okasha (2002, p. 196) puts it, "[e]mpirically, it simply is not true that the groups of organisms that working biologists treat as con-specific share a set of common morphological, physiological or genetic traits which set them off from other species." There is a lot of intra-species genetic variation, often more

than between species, and while many members of a species share certain genetic features, there is no set of genes that makes an individual a member of that species. Indeed, such genetic variation within all populations is essential for the operation of processes of natural selection, and therefore such variation "is fundamental to the Darwinian explanation of organic diversity" (Okasha, op. cit., p. 197). The Darwinian view of organismic populations has no room for distinguishing essential aspects of a kind of organism from their accidental features.

Biological species, like *Homo sapiens*, are not defined by any essential features shared by all of their members but rather are individuated by reference to their place in the tree of life (they are the result of speciation events) and certain types of interactions that are possible between the members of the species (typical reproduction). Whether an individual is a human thus, biological, has little to do with its intrinsic characteristics, but rather with its historical connection to a certain constantly changing, evolving, population.

While there are heated controversies within biology and the philosophy of biology about how best to think about species and the species concept, what is almost universally accepted is that biological species are *not* individuated by an internal essence that all of its members share. There are no tiger genes located deep within (the cells of) each tiger that make that individual a tiger. There is also no set or cluster of tiger genes. There is no internal, intrinsic property that makes something a tiger.[16] Psychological essentialism thus delivers a deeply wrong picture of species.

What holds for species also holds for other biological kinds. Specifically, it holds for sex differences. Psychological essentialism is also deeply wrong about the kind "male" or "female." Males and females do not have anything like the essences the psychological essentialist posits.

First, it is important to note that sex differentiation is not uniform across the organismic world. It is highly diverse and far from universal. Most organisms, especially the prokaryotes, do not reproduce sexually at all or have more than two sexes; many – especially plants – use sexual reproduction only occasionally; there are a good number of animal species where sex is determined through the environment (in crocodiles and some turtles, e.g., sex is determined by the temperature in which an egg is incubated), in stark contrast to the internal determination of the male or female kind the psychological essentialist believes in. Further, several animal species can and do change their sex within their life span (in many snails but also in some fish), in contrast to the immutability of essences posited by psychological essentialism. Even in those organisms where sex is stable over the life span and more dependent on internal features, there is a variety of sex-determining mechanisms rather than the uniformity of types suggested by the essentialist picture: in

[16] Note that this does not mean that there is *no* sense in which species have essences. It is compatible with the denial of classical essentialism about species (of the kind psychological essentialism appeals to) that species have, for example, historical and/or relational essences: what makes something a tiger is its relationship to other organism, both at a time (with regard to possible biological reproduction) and over time (as a member of a certain biological lineage). See Okasha (2002) for more discussion.

insects like bees and ants (hymenoptera), for example, unfertilized eggs become males, while fertilized eggs generally became females; and even those that use a chromosome-based system use a number of variations. If we look across the organismic world, there isn't anything like an intrinsic and internal male or female essence of the type our intuitive psychological essentialism posits.

Second, let us consider human sex differences specifically. There are, of course, sex chromosomes in humans, where most males have the XY genotype and most females have the XX genotype (though there are exceptions). These sex chromosomes, for those already inclined toward essentializing sex and gender, may appear like natural candidates for playing the essence role of the relevant kinds. They are, after all, located deep within an organism, are already present in the embryo, and seem to draw a sharp boundary between the male and the female "type." Are the sex chromosomes at least well suited to play the essence role for *human* males and females?

The answer is fairly clearly no. The sex chromosomes contain nothing like a "blueprint" for how males or females are "supposed" to develop under normal conditions even with regard to the primary sexual organs or the sex differentiation in fetal testosterone levels we have encountered in Baron-Cohen's work. Human primary sex differentiation is a complex process that involves many aspects of the genome interacting in complex ways (see Dupré, 1986, Fausto-Sterling, 2012; Keller, 2010). Gonadal sex differentiation, i.e., the development of testes and ovaries (which later end up being involved in the production of estrogen and testosterone), consists in a complex interaction of "two active and opposing signaling pathways" (DiNapoli & Capel, 2008, p. 4; cited also in Fausto-Sterling, 2012, p. 20) involving a variety of genes on several chromosomes blocking and enhancing each other. There is simply nothing like a gene that in some sense "stands for" the production of the female or the male type of primary reproductive organs. Because sex differentiation is such a complex multifaceted process, there are no sharp boundaries between the relevant types. And given the complex pathways leading, for example, to various different levels of estrogen and testosterone production, there is no ground for, say, speaking of something "defective" or "abnormal" in a high level of testosterone in an XX fetus. Biological populations simply do not allow us to speak of something like "normal" types.[17]

To sum up, biological population thinking applied to men and women would precisely *not* speak of "essential" differences, or differences in the nature of men and women. Rather, it would speak of the statistical correlation between certain traits, variations within certain parts of human populations, and the complex interacting developmental pathways leading to the development of those traits.

[17] We can, of course, speak of more or less "fit" organisms of a certain genotype, where such fitness would be related to the overall expected number of offspring. But that fitness will always depend on the specific environment and be relative to the overall population. An organism that has relatively little fitness in one natural or social environment might have a very high fitness in a different environment.

Heritability Does Not Imply Genetic Causation

Let us move to another aspect of how psychological essentialism leads us astray. The psychological essentialist interpreter of "biology," as we have seen, thinks of the essences that characterize social and biological kinds as heritable: they are internal features that an individual inherits from its biological parents, and which make it the kind of individual it is. The notion of a "heritable" difference between two groups of people, for the biological essentialist, therefore, is naturally understood as a difference that can be traced to a difference in an internal essence. Since differences in essences are understood as independent of environmental factors, someone in the grip of essentialism therefore intuitively interprets heritable differences as those that are independent of the environment, such as – in the case of humans – social or political factors.

Heritability is, indeed, an important biological notion. Yet, the biological notion of the heritability of a trait, like being good at empathizing or systemizing or showing certain characteristic patterns of brain activation, does not entail that the development of this trait is largely independent of environmental factors. The intuitive grip of psychological essentialism makes it easy to confuse the biological notion of the heritability of some trait with the notion that this trait is genetically determined (or rather determined by those mythical essences with which we tend to confuse genes) (see Lewontin, 1974 or Block, 1995. For some recent debate about how much about genetic causation can be determined by heritability analysis, see Sesardic, 2003, Oftedal, 2005).

The biological heritability of some trait is defined as the ratio of the genetic variation and the total variation with respect to that trait. Heritability is therefore only defined with respect to specific populations of organisms that differ in that trait. We can, for example, ask about the heritability of systemizing abilities in, say, the Norwegian population. But it makes no sense to ask whether, say, *my* systemizing abilities are heritable. The psychological essentialist in us wants to associate the biological notion of heritability, which applies to populations, with the notion that the heritable trait is in some form "given" like a legal inheritance "in the genes" (or essences) from a parent to its offspring. But the biological notion of heritability is completely silent on how the relevant trait is transmitted from one generation to the next.

A high degree of heritability for some trait difference therefore does not entail that the trait is in any sense genetically caused or determined (as I will show in the next section, it is highly unclear whether there in fact *is* a biologically acceptable notion of "genetically determined"). Ned Block (1995) illustrates this with an example closely tied to the gender differences we have been discussing. Suppose that in a certain population almost only women wear earrings. Most of these women will have XX chromosomes (I've briefly touched on some of the complexities of sex differentiation in the last section). In this population, the trait "wearing earrings" is highly heritable: the total variation with regard to the trait can almost all be "traced" to a genetic variation (having XX chromosomes as opposed to having XY chromosomes), and so the ratio of genetic variation and total variation will be close to one. Heritability will therefore be very high. This does absolutely not entail, though,

that XX chromosomes in some way, independently of cultural norms or the environment, "determine" that a developing person will wear earrings. Cultural norms may change, and have changed, and as a result, many men may also start wearing earrings. As a result, the heritability of wearing earrings will now drop. In the new population, where it is fashionable for both men and women to wear earrings, the heritability of wearing earrings therefore is very low.

What holds for earrings also holds for systemizing and empathizing abilities. Suppose it were true that in a given population, e.g., today's Norway, most women were much better empathizers than men. Given that most women differ from most men genetically, it would then follow that in this population, empathizing abilities are highly heritable, since most variation in the empathizing trait can be traced to a genetic difference and the ratio of genetic variation to total variation would be close to one. This, though, would do nothing to show that those abilities are in any interesting sense genetically "determined." A change in social structures, such as schooling or parenting, may well eliminate the empathizing differences or lead to their reversal. The biological heritability of the trait in one social setting is compatible with the trait *not* being heritable in a different social setting.

The quick association between heritability and genetic determination suggested to us by our intuitive psychological essentialism is, therefore, deeply mistaken.

Genetic Causation Does Not Preclude Environmental Causation

Psychological essentialism, as we have seen, leads people to treat genes as separable and independent causes of appearances and behavior. When people view obesity as having a genetic cause, for example, they treat obesity as something that would develop independently of any environmental effects on obesity: the essence of obesity is present in all individuals carrying the relevant gene. The environment acts only by either allowing or preventing the "normal" development of the carrier of the obesity gene, or by adding a further layer of statistical variation around the "norm" for that genotype. The essentialist treatment of the gene thus naturally leads to the view of genes as blueprints, in which the finished "types" are already preformed. Lay people therefore easily accept the notion that there are genes "for" a large variety of traits, from blue eyes, and obesity, to empathizing or systemizing abilities.

But this way of thinking about genes is deeply mistaken.

First, it is controversial whether genes play *any special* role in development (cf. Oyama, 1985; Griffith, & Gray, 1994; Oyama, Griffiths, & Gray, 2003). An organism's development is influenced by a large variety of factors; DNA and RNA interact with the various other molecules in the cellular matrix, in ways that are strongly dependent on the environment of each cell, be it temperature, various gradients of growth factors that cross cellular boundaries, to the nutrients in the cell's or fetus' ambient environment. As the fetus grows, the influence of intracellular (e.g., genetic) and extracellular (e.g., environmental) factors becomes even more heavily intertwined. This complex developmental process is fairly reliably replicated from one generation of the organism to the next. Those favoring a so-called developmental

systems approach (Oyama, 1985, Oyama et al., 2003) hold that the various factors in the developmental process are on a par (they accept what has been called the "parity thesis"; Shea, 2011). The causal role of genes in the developmental process, according to this approach, is no different from the role of other intracellular molecular factors or environmental factors. For example, we should treat the reliable replication of an organism's environment that is shaped by the parental generation as in principle on a par with the replication of DNA from one generation to the next: a termite embryo, for example, in the same sense "inherits" the symbiotic bacteria that will help it break down cellulose for nutrition, the stable temperature of the termite mound, and the interactions of worker termites and its DNA. Similarly, a human fetus "inherits" in the same sense social conditions, protective structures like houses, the stable temperature of its mother's womb, and the DNA. If the parity thesis advocated by the developmental systems approach is right, then there is nothing – specially not genes – that can play the role of "biological differences" that can in any interesting sense be distinguished from other factors, specifically social factors. We would therefore reject any notion that genes play anything like the role of internal "essences" that "stand for" certain traits that a normally developing organism is "supposed to" develop.

Second, if even the developmental systems approach rejected, and genes are understood as playing a special role in development, they would still not play anything like the role of "coding" for high-level features such as brain structures or systemizing capacities. Genes operate in complex regulatory networks, and – uncontroversially – code for enzymes that facilitate or suppress biochemical reactions, reactions that also depend on the environment, like which nutrients are available. The psychological essentialist in us likes to draw a distinction between those differences between us that are due to genes (the "biological differences") and those that are due to the environment. But genes, through the production of enzymes that facilitate biochemical reactions, always produce their effects through their action on how one cell interacts with others and the environment: genes, as it were, "tell" the cell how to react to certain environments or changes in those environments. The question whether a difference is due to genes or due to the environment therefore makes little sense, as each effect of genes is mediated by environmental variables. Even if we therefore accept that genes are interestingly different from other causal factors, since they are "read' by development (Shea, 2012) and "code' or "stand for" certain things, what they stand for wouldn't be anything like a trait like obesity, systemizing or empathizing abilities or even blue eyes, they would rather be instructions of something like the form "In conditions C1, do X1!" and "In conditions C2, do X2!" Given how genes actually operate, there therefore is no answer to the general question of whether some difference is genetic or environmental (and there certainly is no answer to the question, whether, say, my empathizing abilities are genetic or environmentally caused).[18]

[18] Lewontin (1974, p. 401) explains this point by reference to an analogy: "If two men lay bricks to build a wall, we may quite fairly measure their contributions by counting the number laid by each; but if one mixes the mortar and the other lays the bricks, it would be absurd to measure their relative quantitative contributions by measuring the volume of bricks and of mortar."

It is important not to misunderstand what I have just argued. It is compatible with the claim that genes are not separable causes and that it may be true that in a given environment or in a given range of environments, the difference between people with trait T1 and those with trait T2 can be well explained by a genetic difference between those people. It may well be true that, say, in the environment of contemporary Norway, a large amount of the variation in empathizing abilities is explained and caused by whether a fetus has XX or XY chromosomes (and other differences in sex-linked genes). This is compatible with a different effect of those sex-linked genes in a different environment. The sex-linked genes might, for example, act through the development of primary sexual organs, how caregivers and others react to babies with those primary sexual organs and how they then treat the baby. In a different environment (where caregivers react differently to babies with certain sexual organs), the very same genes might have a very different effect. We therefore cannot conclude from the fact that a certain difference has a genetic cause that its effects cannot be dramatically altered through changes to the social and cultural setting. The fact that a certain difference has a genetic explanation simply does not speak to whether that difference also has a social and cultural explanation.

Summing up this section: unlike the mythical essences with which psychological essentialism lets us identify genes, the causal effects of real genes cannot be separated from environmental factors. The fact that a difference has a genetic explanation does not preclude that it also has a social or cultural explanation.

Hormone Levels Change and Hard-Wired Brains May Be Flexible

As we have seen, the psychological essentialist treatment of biological and social kinds, of biological heredity, and of the causal role of genes presents a deeply distorted picture of biology.

Similar distortions result when statistically significant differences in testosterone and estrogen hormone levels both in the fetus and later in life are interpreted as hormone levels of the male or the female "type." As Fine (2017) shows in a detailed and accessible review, testosterone levels and their production in the gonads, for example, vary greatly both in males and females and are known to depend – in both adult humans and other animals – also on social factors. Androgen hormone levels do influence social factors, but they are also influenced by social factors in turn (see also Francis, Soma, & Fernald, 1993; Oliveira, Silva, & Canário, 2009). The impact of fetal testosterone levels on brain development and on future behavior is further highly complex and multifaceted, as Fine's review shows in detail. There is simply no sense in which hormone levels either as a fetus or later in life can be well described as falling into a male or female "type." The psychological essentialist treatment of hormones as immutable essences that specify the essence of the male or the female is deeply wrong with regard to how androgens operate in development and in how they are involved in shaping behavior.

Similar problems also arise when the term "hard-wired" is used to describe aspects of the human (or other organisms') brains, neurobiology, and also psychology. The general idea behind this metaphor is that just like some aspects of the possible internal processing of a machine (including, but not exclusive to, computers) are wired into the hardware, and this impossible to change once the machine has been fully assembled, e.g., through software change in a computer, so some aspects of brain processing, or psychological processing, are wired into the very hardware of our brains. But on the reflection, the "hard-wiring" metaphor just points us back to the problematic notions of a genetic blueprint. What is hard-wired into the brain is what cannot be changed once the brain (machine) is fully developed. But when is the brain "fully developed"? Certainly not at biological birth. Some aspects of a specific adult's brain might be unchangeable *then* but clearly are the product of learning and contingent brain development during *youth* (consider the acquisition of our native language).

One way to distinguish those aspects of our psychology that are "hard-wired" is to think of them as *innate*. Yet, while the notion of "innateness" figured heavily in the early ethological research of researchers like Konrad Lorenz (1957 [1937]), who thought that innate characteristics could be revealed by deprivation experiments where an animal is supposed to be stripped of all relevant environmental input, the notion was already heavily critiqued in the 1960s so that, for example, one of the most influential ethologists Niko Tinbergen (who had worked closely with Lorenz in the 1940s) came to think that any such deprivation experiment could only show "which environmental aspect was … not to be influential" (Tinbergen, 1963, p. 424) and that the notion of innateness in the end was probably rather "heuristically harmful" (ibid., p. 425). Today the notion of innateness is sometimes used in psychology (see Griffiths, 2017 for a review). The notion of an innate characteristic may here just mean a characteristic that is universal in humans, one that is best studied by biology rather than psychology, one that is not learned on the basis of experience, or one that has been an evolutionary adaptation. None of these notions would imply that the development of an innate characteristic could not heavily depend on the environment and social structures, in contrast to how psychological essentialism thinks about what is "within us." Indeed, a growing number of biologists and philosophers of biology follow Tinbergen and argue that the notion of innateness is problematic, confused, and of little scientific use (Griffiths, Machery, & Linquist, 2009; Mameli & Bateson, 2006; Moore, 2001): arguably it is a remnant of exactly the misleading essentialism that governs our intuitive way of thinking about the biological world that we have already discussed and has no interesting value in real developmental biology and psychology (cf. Griffiths et al., 2009). Whether or not that is true, any useful scientific notion of innate characteristics will be certain to avoid any link to the idea that those characteristics cannot be affected through social change or is essence determining.

Psychological essentialism thus also misleads us about the role of sex hormones as stable and determining characteristics of certain kinds of people, and it misleads us with regard to the distinction between what is innate and what is acquired.

Conclusion

Culture or biology? The question which of what is due to "biological differences" to many seems deep and important. Those who argue for an important role of "biology" in the explanation of human differences often see "the science" on their side. I have argued that this is false – on the interpretation of "biological differences" that is most intuitive and that makes the question appear to be most interesting. Defenders of "biology" have the science against them. What is often called "biology" is a myth: a myth created by an intuitive tendency that grotesquely distorts real biological research.

I have argued that we are intuitively attracted to psychological essentialism, which let us interpret what is biological in distinguishing human kinds as what can be traced to the "essences" of the relevant kinds. On this interpretation, it would be deep and important to know what about, say, the differences between genders is biological: it would correspond to what is essential to being a man or being a woman and be opposed to what is a mere accidental feature that some women or some men have. Yet, I have also argued, the psychological essentialist understanding of "biological differences" is also deeply mistaken about biology. It has the wrong conception of biological kinds, of biological heritability, and of how genes and hormones work.

Does this mean that everything about us can be affected through social changes? Of course not. But instead of confusing the public debate by asking what is due to biology or nature, we should rather directly discuss the complex causal explanation of, for example, how the genders end up in different types of occupation (at a particular time, in a particular culture) and which types of interventions are effective. The answers will probably be complex. We will need a good deal of biological understanding to discuss them productively. And we will need a good deal of social science. But the idea that we can sidestep the complexities by instead asking about nature vs nurture rests on a mistaken conception of the biological world. Responsible research and public debate about biology would avoid any talk of biological difference, of nature vs nurture, of types of brains or people, and probably also of whether there are genes for this, that, or the other.

The unconscious appeal of the essentialist picture contributes an explanation to why we fall so easily for the "mirage of a space between nature and nurture," as Evelyn Fox Keller (2010) has put it. When we start to debate the relative contributions of "nature" and "nurture" or the importance of "biological differences" in the explanation of some social patterns, we most likely have already fallen into the trap that our essentialist inclinations have set up for us. Those on the biology repulsion side of the debate are right that "biology" is associated with an outmoded, false, and socially explosive way of thinking about humans, namely, the essentialist picture. But the only way to move beyond that is biological literacy: we should follow the biological attracted in their appeal for better education in real biological mechanisms and the real science of human evolution. More biology, there is reason to hope, will let us move beyond the misguided debate over our "biological differences."

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