Genericity and Inductive Inference

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Abstract

We can be justified in acting on the basis of evidence confirming a generalization. I argue that such evidence supports belief in non-quantificational – or *generic* – generalizations, rather than universally quantified generalizations. I show how this account supports, rather than undermines, a Bayesian account of confirmation. Induction from confirming instances of a generalization to belief in the corresponding generic is part of a reasoning instinct that is typically (but not always) correct, and allows us to approximate the predictions that formal epistemology would make.

1 Introduction

If members of a kind F are observed to have some property G, this may confirm a general pattern. If sufficiently many confirming instances of this pattern are observed, this may be reflected in the actions and attitudes taken towards Fs. Observing that m-many robins are red or eating n-many poisonous holly berries may (given certain thresholds are met for m and n) influence the way an observer acts towards robins and holly berries in general.

In short: evidence concerning specific members of some group can shape the decisions that observers make with respect to that group as a whole: Stella looks for trails of red feathers when searching for robin eggs; Landon decides to pack lunch for his hiking trip, rather than snack on foraged berries. These patterns of action and expectation appear to be underwritten by *generalizations* about kinds.

Further, the decisions being made on the basis of such observations are often *rationally justified*. Let us consider these claims in connection with the following plausible principle about the relationship between an agent's evidence and the justification they have for acting:

> Justification-Action Link: If a belief-forming method provides rational support for some action, then that method of

> belief-formation provides doxastic justification for a belief that underwrites it.[1]

This principle represents a central methodological commitment: that we may reason *backwards* from claims about justification for action to claims about justification for belief.[2] If an agent is rationally justified in *acting* on the basis of some observation – if that observation figures essentially in an explanation of their rational behavior – then that observation provides rational support for a belief that underwrites their behavior. The goal of this paper is to determine the output of a certain pattern of inference by considering the actions that are rationally justified by such inferences.

Combine this principle with the earlier claim that observing sufficiently-many Fs that are G can be justification for a pattern of action that appears to be explained by a *generalization* linking Fs to G.[3] Call the belief forming pattern whereby observations of specific instances of a pattern are used to support generalizations a *generalizing inductive inference*.[4]

When someone makes a generalizing inductive inference, they form a general belief about Fs on the basis of observing a limited number of Fs. The standard question about such inferences – often called *the problem of induction* – is how they can be justified, given that there is no necessary connection between observed and unobserved instances of an event. How is it rational to suppose that the next observed F will be G, given only that previous instances have been? And how can such a rational transition reflect a *prima facie* epistemic connection between a generalization and its confirming instances (Hume 1748/1993)?[5]

This paper addresses a different question: what cognitive states do these inferences rationalize? This way of putting the question might seem confused: to describe a particular inference pattern just is to describe a

1 This is a weakened version of a principle linking *knowledge* and action, endorsed in accounts where knowledge "figures essentially in explanations of behavior" (Kipper 2018: 2221). See Hawthorne & Stanley 2008, Fantl & McGrath 2002, 2009, Weisberg 2013, Williamson 2000.

2 Thanks to an editor for the suggestion to make this explicit.

3 I assume, following Davidson (1967), that we can quantify over events like they are members of kinds, such that it makes sense to say that e is a buttering, and that e takes place in the kitchen, and thus that some butterings take place in the kitchen. In general I will restrict discussion to quantification over ordinary objects.

4 I use 'generalizing inductive inference' and 'inductive generalization' interchangeably.

5 See Lange 2008 for comprehensive summary. Take a simple view on which an inference from A to B is justified if and only if someone who is justified in believing A would also be justified in believing B, believes B on the basis of A, and is not presented with any defeaters for their belief (cf: van Cleve 1984). The question is one of "showing that inductive inferences are justified" (ibid: 555).

particular maneuver from a certain set of propositions, E, to another set of propositions H. So debates about what sorts of beliefs an inference licenses are really debates about different kinds of inference pattern. But there is another – I think productive – way of thinking about (and individuating) inference: as maneuvers from a certain evidential position to a certain rational position.

The thesis of this paper is that inductive inferences support *generic generalizations*. More thoroughly: when inductive inferences justify (a change in) patterns of action that generalize with respect to some kind F, this is by way of providing *doxastic* justification for a belief in a generic generalization.[6] Inductive inference is a reasoning tool that allows us to produce non-quantificational thoughts about kinds – to characterize and organize our thoughts about those kinds. Call this the *Generic View*.

Traditionally, inductive inferences are taken to support universal generalizations.[7] The problem of induction is often treated as the problem of figuring out "how the discovery that a great number of Fs are Gs can make it rational to be confident that *all* Fs are Gs" (Bacon 2020: 354, emphasis mine). After setting up the Generic View in Section 2, in Section 3 I argue against the traditional view. In Section 4 I attempt to incorporate the Generic View into Bayesian approaches to induction. On a Bayesian approach, decisions we make on the basis of generalizing inductive inferences are justified by probability judgments. I argue that the Generic View supports probabalistic approaches to inductive confirmation.[8]

6 We could also state this in terms of the results of a generalization: inductive inferences are moves from evidence about confirming instances to a general belief about Fs, and the thesis of this paper is that the confirming instances provide support for a generic belief. Or: inductive inferences are moves from confirming instances of Fs that are Gs to an expectation of regularity among Fs, where this expectation is underwritten by a generic. I find these ways of putting things confusing, in part because they obscure the distinction between a cognitive and epistemic question about induction. The main thesis of this paper might also be stated as the thesis that inductive generalizations are generic in character, but this needs to be taken as an epistemic claim, rather than a cognitive one (see Nelson 1962 for a defense of the cognitive version).

7 There have been some notable holdouts; for instance, Popper (1959) argued that scientific inquiry needs to do away with induction to universal generalizations (see also Claveau & Girard 2019). And see Llewelyn 1962, Nelson 1962, for an earlier debate about the claim that direct kind predication is what inductive inferences justify.

8 An important point about terminology: the term 'generalization' is used ambiguously, to refer to belief-forming methods ('inductive generalization') and to refer to propositions that are general in character ('generic generalization'). I try to reserve the term 'generalization' for the latter. Instead of 'inductive generalization' I will use 'inductive inference' or 'generalizing inductive inference'.

2 The Generic View

I will start by saying some things about what generic generalizations are. The rest of the section will elaborate the connection between inductive inferences and generic generalizations.

2.1 What are generic generalizations?

Generics express non-quantificational generalizations. Generics "express general claims about kinds", but cannot "be used to answer the question how much or how many" (Leslie 2012: 355). Generic sentences include 'Dogs have four legs', 'Ravens are black', 'Ducks lay eggs', and 'Mosquitoes carry West Nile'.[9] In a generic, a predicate denoting a property G is attributed to a (bare plural designator of a) kind F, without apparent quantification over individual members.[10]

Generics are present in every known language, but in no language are generic sentences 'marked' with an explicit generic operator. Generics are studied (by philosophers, linguists, and developmental psychologists) because of their abstruse formal properties and the important role they play in cognitive development.[11]

What sorts of beliefs do generics express? According to Sorensen (2012), "generics cannot be elliptical for universal generalizations or statistical generalizations" (445). This is a substantive assumption, but not difficult to motivate. As Leslie (2007a, 2017) notes, when we consider generic sentences to which we would assent, we do not think of what we're doing in terms of a quantificational paraphrase. Young children are able to adopt and use generic generalizations years before they are competent with explicit quantification, further weakening the prospects for holding generic generalizations to be quantificational. As Sterken (2017) says, generics do not "convey any stable or easily specifiable information about how many members of the given kind or group have the given property" (1).

9 These generics are closely related to what Michael Thompson calls 'natural historical judgments' (Thompson 2008); statements like 'The lemur gives birth to two offspring'. I do not have the space for a detailed comparison, but it might be that the claims of this paper could be helpfully recast in Thompson's terms.

10 The term 'kind' here may be taken to mean anything that we can think of under a concept. 'Dogs bark' is a generic but so are 'Tables have legs' and 'Stabbings occur at night'. I will sometimes use the term 'kind' where a term like 'group' or 'type' might be natural.

11 See Johnston & Leslie 2012, Leslie 2007a, 2008, Leslie & Gelman 2012, Rhodes et al. 2018 and many chapters in Rhodes 2020.

A comprehensive survey of theories of generics would be too much to attempt, but I will consider two views of the beliefs that generic generalizations express.[12]

2.1.1 Cognitive Defaults

Most take the meaning of a generic sentence to involve a two-place operator, 'Gen'. The logical form of a generic sentence ⌜Fs are Gs⌝ is:

(1) Gen x $[F(x)][G(x)]$

According to an influential view, the 'Gen' operator is a *cognitive default generalization* (Leslie 2007a, 2008): humans possess a primitive cognitive mechanism for forming general thoughts about kinds on the basis of experiences involving instances of those kinds. Generics express the cognitive state this mechanism produces.

Such defaults reflect a natural cognitive capacity for individuating kinds, often by linking them to apparently 'essential' features (Leslie 2017).[13] Notably, we individuate kinds not only by the properties that adhere with the highest frequency among members, but also properties that are striking, or adhere with *more* frequency in one group than another. The truth-conditions for generics – now relativized to these cognitive defaults – track dimensions along which we sort the world that have historically benefitted us.[14] The grounds for accepting a generic blurs the line between epistemic and practical reason; generic beliefs will reflect our capacity to organize the world in a way that benefits us, rather than merely a capacity to represent things as they are.

2.1.2 Direct Kind Predication

Liebesman (2011) defends the view that generics express direct predications of properties to kinds (see Leslie 2015 for a critical response).[15] Liebesman's

12 See Sterken 2017 for a survey of work on the semantics of generics. The main *semantic* controversy in the literature on generics is about whether generics have a tripartite structure involving a binary quantifier, 'Gen'. But as we will see, the main import of this controversy for the present paper is likely to be *metasemantic* in nature.

13 See Sterken 2015a for criticism.

14 Other operator views are defended by Nickel (2016), who holds that the generic operator functions to pick out the most normal worlds, and Sterken (2015b), who holds that it is an indexical that picks out different thresholds for quantification depending on the context. I will briefly return to Sterken's view in section 4.2.

15 Some evidence for the simple view comes from the fact that no known language includes a generic operator, and that we can quantify over kinds in such a way that the truth of the

'simple' theory of generics shifts questions about the truth conditions of generics to questions concerning the metaphysics of kinds (Liebesman 2011; see Carlson 1982).[16] Generic statements report facts about the world, and the logical form of a generic like

(2) Tables have legs.

is $L(t)$, where L denotes the property of leggedness, and t names the kind *table*. The truth of (2) is thus fixed in the same way as that of a simple subject-predicate sentence like

(3) Josh runs.[17]

Both (2) and (3) are true just in case the subject of the statement instantiates the property.[18] To say that Josh runs is just to say that Josh is among the running things in our semantic model. And what settles the question of whether it is appropriate to include Josh among the running things in our model is a matter for metaphysics.

Generic sentences are used to express thoughts about a kind, rather than its members. 'Cats meow' is about an individual cat in the way that 'This chair is made of wood' is about the chair's leg. Generics are helpfully thought of as singular thoughts about general *objects*.

2.2 Pragmatic Features of Generics

How can any claim be made about justification for a belief if what it takes for that belief to be true is not known?[19] Aren't we owed a story about what

quantificational statement depends on the truth of a generic. The sentence 'Most mammals give birth to live young' is (on one reading) made true by the fact that the majority of mammal *species* have this property.

16 See Liebesman & Sterken 2021 for discussion of the relationship between generics and the metaphysics of kinds.

17 As Sterken (2015b) notes, "the intuitive truth-conditions of generics seem to vary quite radically from generic to generic" (1). It seems natural to think that there is a connection between the intuitive truth of 'Tigers have stripes' and the fact that many tigers have stripes, but – to use a standard contrast case – most books are paperbacks, and yet 'Books are paperbacks' is intuitively false.

18 Carlson (1982) defends the view that generics contain a monadic predicate operator, taking individuals to kinds. (3) is represented in the semantics by $G(\lambda x(Lx))(t)$. But the conditions that make this operator appropriate to apply cannot be read off from the semantics. The transference of properties from instances to kinds is nothing over and above the transference of properties from parts to objects (Liebesman 2011: 419; see Teichman 2016 as well).

19 Thanks to an anonymous referee for this question.

it is for tables to have legs, for cats to meow? A semantic theory tells us how things have to be to make a sentence true, but only in the set-theoretic terms of a formal model – the semantic theory gives us a representation of the world, but not an explanation of what worldly features make that representation accurate.

Relatedly, a theory of epistemic justification may give us the conditions under which the sorts of thoughts that are expressed by S are appropriate to have, but it can avoid questions about how the world has to be organized in order for S to be true. A theory of perceptual justification might provide an explanation for how the visual experience of a red apple is *prima facie* warrant for believing the apple is red, but the epistemologist does not owe us a story about what it is for an apple to be red. Likewise, we can claim that observing sufficiently-many black ravens justifies the belief that ravens are black without offering a story about what it is for ravens to be black.[20]

As noted at the outset, the central methodological assumption of this paper is that we can reason *backwards* from an agent's rational decisions to the belief contents that explain their decision. Rather than the truth-conditions of generics, we might consider their inferential and action-guiding properties. What role do generics play in practical reason, and what are the properties generics have, such that they play that role?

2.2.1 Generality

Both a universal generalization ⌜Every F is G⌝ and a generic generalization ⌜Fs are Gs⌝ can be said to express something about Fs in general. But these constructions put expression to different sorts of thought.

What is it to ascribe 'generality' to a thought in the first place? This can be explained in terms of the inferences and actions such thoughts dispose us to make. Namely, to have a general belief about a class is to be able to reason, in a certain way, about *arbitrary members* of that class.[21] When you believe that every raven is black, this disposes you to act in a certain way towards any potential future raven you encounter. If you believe that every raven is black but you fail to act as though the next raven you encounter will be black, then you are not rational.

As Sorensen (2012) notes, "[belief] in a generic disposes one to believe that an arbitrary member of a kind will have the relevant [property]" (444)

20 Simple theories like Liebesman's provide an attractive way of packaging the thesis of this paper: that observing – for instance – sufficiently many winged ravens just is an observation of the apparent wingedness of ravens (we will return to this line of thought in section 4.2).

21 Thanks to an anonymous reviewer for comments here.

– generic propositions dispose us in at least one of the same ways that universals do.[22] To think about *F*s in general is to reason to conclusions about arbitrary members of *F*. The exact route from a generic to our treatment of arbitrary members of a kind may depend on – among other things – the semantic theory we accept. For instance, we might insist on a normative understanding, such that a generic is about *F*s in general because it tells us something about what any *F* ought to be like (Nickel 2016),[23] or a dispositional understanding where a generic is about *F*'s in general because belief in that generic disposes us to treat arbitrary members of *F* in a particular way.

2.2.2 Flexibility

Generic sentences express "general propositions without being committed to full generality" (Liebesman 2011: 409). A generic of the form ⌜*F*s are *G*s⌝ expresses something about *F*s in general without making a commitment to the presence of *G* in every instance of *F*. Generic sentences like 'Ravens are black' and 'Dogs have four legs' can be felicitously uttered even though there are albino ravens and three-legged dogs. In other words, the existence of non-*G* members of *F* does not undermine an assertion of the generic ⌜*F*s are *G*s⌝.

You would like to get a pet, and your only criteria is that it be able to fly. I can felicitously utter, as a reminder, 'Birds fly' and not have said something misleading (even though we may both be able to think of many flightless birds). Birds fly, but cats don't – cats are clean, but dogs aren't. Such statements are understandable, and play an action guiding role. What I have done is I have prompted you to consider, in your search for the ideal pet, the kind *bird*. Some mammals fly but 'Mammals fly' does not – to us – seem as appropriate a thing to utter.[24] Some mammals fly, but many more do not; it is not appropriate to think of the kind mammals (in this context, at least) as among the flying things in our ontology.[25] This flexibility means

22 Note that this is not the familiar notion of generality that is typically contrasted with 'singular' contents in debates about intensional contexts.

23 This may help us understand the relationship between induction and knowledge of what the next in an arbitrary sequence of members of some kind might be like. That ravens are black tells me that the next raven *ought* to be black, at least in some sense; that mosquitoes carry West Nile tells me that the next mosquito is something I should avoid.

24 Insofar as it is appropriate, I think it is natural to read such claims as elliptical for 'Some mammals fly'.

25 It is sometimes claimed that some generic generalizations forbid exceptions (Sorensen 2012). For instance, a generic like 'Whales are mammals'. But there is not much *semantically*

that you can take actions that generalize over kinds, without committing you to generality in full.

2.2.3 Non-Quantifiability

Generics express something general about a kind, but the fact that G is true of *many* or *most* members of a kind F is neither a necessary nor sufficient condition for a generic ⌜Fs are G⌝ to be felicitous to state. Against necessity: we can note the apparent felicity of statements like 'Ducks lay eggs' (egg-laying is a property that is instantiated by many, but certainly not most ducks) and 'Mosquitoes carry West Nile' (not true of many mosquitoes).[26] Against sufficiency: we can note the apparent *infelicity* of statements like 'Books are paperbacks' (true of most books) and 'Humans are right handed' (true of most humans).[27]

Sally Haslanger notes that generics let us sort kinds by their 'striking features'; perhaps by the features that strike us as most important (Haslanger 2011: 185). The fact that many individual dogs are four-legged might strike us as an important feature for distinguishing dogs from other sorts of things (like: humans, birds, insects).[28] Likewise, the fact that mosquitoes have the capacity to transmit viruses like West Nile might strike us as an important feature for distinguishing mosquitoes from 'less dangerous' insects. This is in spite of the fact that very few mosquitoes are West Nile carriers.

interesting about this. It is a feature of the property of being a mammal that if one member of a kind (where that kind is individuated in a particular way) has it, they all must.

26 The latter of these might be disputed as actually being some kind of capacity claim – like, 'Mosquitoes *have the capacity to* carry West Nile' or 'Mosquities *are (the) carries of* West Nile', or even 'Any mosquito *could be* a West Nile carrier'. To me, however, the most natural paraphrase is one that classes the kind *mosquito* as among the West Nile carriers.

27 Perhaps this is due to the properties in question being ones we use to sort and discriminate between members of these kinds: most physical books are paperbacks, but learning that something is a paperback is (in most contexts) sufficient for learning that it is a book.

28 Relatedly, generics appear to require little evidence in order for us to accept them as true (Cimpian et al. 2010). The question of whether our cognitive system's being set up this way is something that allows us to approximate more demanding kinds of rationality is related to the discussion in section 4.1. This paper is focused on the claim that inductive belief forming methods generate epistemic support for generics, and not the any claims about what it takes to believe a generic to begin with. So we can set this issue aside, for now.

2.2.4 Role in Inference

It has been observed that generics often license the following sorts of (non-monotonic) inferences:[29] (P1) Birds fly, (P2) Tweety is a bird, therefore (C) Tweety should fly. That Tweety *should* fly does not entail that Tweety *does* fly. And though learning that Tweety is a bird may license actions taken on the basis of the belief that Tweety flies, this is a defeasible belief. That tweety flies is a proposition we can accept for the purpose of deliberation and action, but it remains to be seen whether it is true.

The connection between such epistemic 'ought'-claims and rational deliberation and action is not well understood. But what ought to happen – epistemically – presumably has some impact on how one is justified to act. For instance, if you justifiably believe – or know – that it *should* rain tomorrow, then you seem to be justified in (among other things) acting as though it will rain tomorrow (for instance by packing your umbrella, or cancelling your outdoor plans).

2.3 Generics and generalizing inferences

Imagine a rational agent who observer a large group of robins for the first time. All of the robins they observe are red. What are they in a position to conclude, about robins in general, on the basis of this observation? My claim is that they are in a position to conclude that robins are red.

In a generalizing inductive inference, one moves from an observation of some Fs to a conclusion about Fs in general. The evidence collected leaves open the possibility that there are unobserved Fs, but the conclusion drawn is, in part, *about* those unobserved members of the group. A standard way of understanding inductive inferences is as a reasoning mechanism that allows us to draw conclusions about the unobserved in virtue of what we have in fact observed.

We can identify two characteristic properties of generalizing inferences:

a. The evidence used in a generalizing inference is *compatible* with the feature observed in a group of Fs not holding for every F. Observing n-many Fs as having the property G is always compatible with some individual $n+x$th F not having the property G (and the action taken with respect to the inference is taken in full view of this compatibility).

b. The belief justified by a generalizing inference is *general*: the belief that an agent comes to hold on the basis of her observation of a group

29 See Thakral 2018 for an illuminating recent discussion.

> of n-many Fs is a belief about Fs in general, not just a belief about n-many Fs.

Generic generalizations express something general about arbitrary members of a kind. We can take it for granted that the generality consideration in (b) is met by the Generic View, and does not need to be elaborated.[30] Below I elaborate on the claim that inductive generalizations are compatible with disconfirming evidence, and how we might treat this as an explanatory desiderata for a theory of inductive inference. I also explain how it is that such disconfirming evidence, despite potentially overwhelming the confirming evidence, is not itself to be taken as evidence for a different generic claim.

2.3.1 Compatibility with 'defeaters'

One way of putting the problem of induction made famous by Hume (1748/1993) is as a problem of reconciling the compatibility of an inductive base (an observation) with some proposition p, with the fact that p is *not* compatible with the conclusion of the inductive inference, which was made only on the basis of the observation. In an inference from A to B, A is compatible with p and B is not. But the problem of induction is a problem of uncertainty. It is the problem of explaining how evidence can justify an expectation of regularity without the possibility of deductive certainty. What Hume pointed out is that we cannot be deductively *certain* of the regularity that we come to expect, and those who have since defended the rationality of induction have sought to defend the claim that our confidence in this regularity is nevertheless warranted.

Induction is fallible because the *expectations* it produces are fallible. A belief with a generic character produces expectations that can be defeated by evidence, but this evidence does not defeat the belief. On the Generic View, the object of your full belief is a generic. Generics are compatible with there being disconfirming instances of the generic (i.e., a generic Fs are G is compatible with an F that is not G). Consider generic sentences like 'Dogs have four legs', or 'Ravens are black'; these can be asserted and believed despite known counterexamples (three-legged dogs, albino ravens). The generic generalization is not one of which you are going to be deductively

30 It has been pointed out to me by Sinan Dogramaci that none of this is decisive against treating inductive generalizations as justifying beliefs in other kinds of quantified statements (for example: an existential generalization or some other generalized quantifier). I think there are a few responses that can be given to this, but the most obvious issue is that this does not preserve the intuition of generality.

certain (it is possible to be deductively certain of a generic, but the source of the inference should not change how you are licensed to deploy it).[31]

2.3.2 Justified generic beliefs

The view that induction has a generic character is supported by plausible claims about when beliefs in generics are justified to form. When do we say that a belief in a generic is reasonable or justified? Do generalizing inferences provide this justification? (If so, under what circumstances?) To answer this first question, we can consider what it takes for an assertion of a generic to be warranted, and to warrant action.[32]

Mel and Vic are searching for a piece of jewelry, which has been lost somewhere on the street. They both know that the object is bronze, but nothing else. Mel has no idea what bronze looks like, and so she asks Vic what to look out for. Vic has never seen the ring, but knows what bronze looks like. Vic tries to think about what kind of thing she could tell Mel that would help; Vic reflects on bronze objects she's seen, and forms a belief that she reports to Mel:

(4) Bronze shines.

Vic's assertion is justified; it even seems as though it is plausibly confirmed by what she knows about instances of bronze jewelry. Even if she knows that tarnished or oxidized bronze loses its luster, she is justified in making this assertion. Mel is then justified in acting on Vic's assertion, by way of looking out for something that shines. The basis for Vic's assertion (and Mel's action) is an inductive inference.

This is not just practical justification, either. If Mel and Vic were looking for their friend's ancient bronze armlet, which Vic knows to be oxidized, then it could be *helpful* for her to say 'Bronze is dull and greenish' as this belief would play a practically-appropriate action-guiding role for Mel. Yet this assertion does not seem justified: in fact Vic seems to retain justification for

31 We can see that this is so without even establishing the role that generic statements play in deduction. There is some reason to think that generics cannot be deductively established as anything other than atomic propositions (Liebesman 2011).

32 To claim that someone is justified in asserting something is not to claim that their assertion is 'correct' in the sense of being norm-compliant. For instance, if you hold that there is a knowledge norm for assertion, then warrant for assertion comes from knowledge of the content of the assertion. Nevertheless, you might respect the importance of an internalistic criteria of justification for asserting something, such that my assertion seems to be justified given my evidence (or given what I take my evidence to be). It is this sort of case that I am interested in here.

uttering ‘Bronze shines’ (perhaps with an addendum like ‘...but this armlet does not’ or ‘...this armlet is probably green’). ‘Bronze shines’ is assertable because it corresponds to Vic’s judgments about what bronze objects are usually or typically like; ‘Bronze is dull and greenish’ is not assertable, because it does not match Vic’s inductive base.

At least in some scenarios, then, we say that an assertion of a generic – and a corresponding belief – is justified on the basis of observations confirming a general pattern. It will be reasonable in such scenarios to say that generalizing inductive inferences can provide us with justification in asserting a generic.

This raises some questions about the scope of the Generic View. First: if an inductive base of *n*-many *F*s that are *G* allow for counter-instances (*F*s that are not *G*) then why shouldn’t those counter-instances form an inductive base of their own, especially given that they may outnumber the *F*s that are *G* (as is the case for generics like ‘Ducks lay eggs’)? And second: are we really meant to believe that *any* inductive base serves to justify a generic generalization? If the inductive base included only instances of oxidized bronze, would we be justified in asserting ‘Bronze is green’? What if the inductive base included only paperback books?

A lot of our judgments will depend on what information is *already* part of our evidence. In the case of green bronze, we *theorists* are in a position to know that this is an unusual feature with what Leslie calls a positive counterinstance (i.e., a counterinstance which is a “concrete alternative property” adequate for characterizing the kind [Leslie 2007b: 66]). But if we weren’t aware of this, and if all the bronze in our inductive base was oxidized, then – I claim – there would indeed be *prima facie* warrant for generic generalizations that match what we’ve observed.[33] Likewise, if your inductive base included only paperback books and you did not have a great grasp of the concept of a book, you would – I take it – be justified in beliefs that books are soft, bendable, made entirely from paper: all the properties of paperbacks.

A similar claim can be made for cases where the confirming instances of a generalization are outnumbered by its defeaters. The majority of ducks do not lay eggs, nor do most have egg laying capacities (there is actually a sex ratio imbalance favoring males). And yet we can be confident in stating that ducks lay eggs. But the property of being an egg-laying kind of thing – and what gives such a generalization its explanatory value – is one that requires little adherence among its members. The majority of instances of Josh are such that he is not running, but we cannot infer – on these grounds alone – that Josh does not run *ever*, and this is because such instances are compatible

33 In such a situation you could also be justified in concluding that *oxidized* bronze is dull and greenish.

with the most plausible ways for it to be the case that Josh is a runner, *and we are aware of this*. Likewise, the observation that many ducks do not lay eggs does not serve *for us* as the inductive base for a generic, since we are in a position to know that the observations we are making adhere with the same regularity in worlds where ducks do and do not lay eggs.

Observing an egg-laying duck and observing a non-egg-laying duck do both give us confirmation of (contradictory) generics. However, what it takes for these generics to be true is quite different. This is because what it is for a kind to have a property *F* or *G* is different from what it is for a kind to have the negation of that property. So the conditions under which it is true that ducks lay eggs and the conditions under which it is true that they do not are not parallel. But this means that we should not expect the conditions under which we are justified in believing each of these things to be parallel either, given an abundance of background knowledge.

Further, while claims about absences of properties may be hard to justify, things that entail those absences for particular individuals are not: 'Ducks have penises', 'Josh naps', 'Ravens are affected by albinism'. These are all claims we seem to be perfectly justified in making, on the basis of our evidence.

3 The standard picture, revisited

The standard picture of inductive confirmation is that observing sufficiently-many *F*s that are *G*s, under the right circumstances, makes it rational to believe in a universal generalization: that every *F* is *G*. In this section I will argue that this standard account does worse than the Generic View when it comes to explaining how an agent's behavioral patterns are justified on the basis of inductive inferences. First, consider the following case from Bacon 2020: "It is a law that emeralds are either blue or green, but the distribution of colors is otherwise determined randomly. By chance it happens that all the emeralds in the actual world are green" (354). According to Bacon, someone who observes 100 emeralds in a row, under these conditions, is "not in a position to infer that the next emerald will be green" (354).[34]

34 "[E]pistemic possibilities are identified with assignments of colours to emeralds, and an epistemic possibility w is consistent with my knowledge if at most n different emeralds in that possibility have colours that differ from their actual colours... After observing the first 100 emeralds to be green, and ruling out sequences that don't begin with 100 green emeralds, there are still worlds that are open where some of the remaining emeralds – up to n of them – are blue. This sort of model correctly predicts that I am not in a position to know that all emeralds are green after learning that the first 100 are green" (Bacon 2020).

Absent knowledge of the law governing the distribution of colors, I think they nevertheless *are* in a position to treat emeralds as green objects.[35] They are justified in *acting as though* the next emerald will be green: i.e., looking out for green things if their goal is to find more emeralds; avoiding emeralds if they have some deep aversion to green objects. This justification does not come from a belief about any particular emerald with which they might be confronted, that it *is* green, but instead from the fact that it *ought* to be – based on what's been observed – and is thus rationally treated as such. Believing that every arbitrary F is G is irrational, but treating arbitrary Fs as G may not be.

Of course, in some cases a very inductive-looking leap from one's evidence to a universal generalization is rationally possible. If I observe 35 South China tigers and I see that they are all striped, I may be justified in believing that all South China tigers are striped if I also have justified belief that there are *roughly* 35-40 South China tigers living in the wild.

This kind of likelihood is generated by the antecedent knowledge that there are roughly n many such tigers in the wild. This seems to provide an expected regularity for my observation which gives certain hypotheses a statistical advantage. The same thing can be found in a case where I observe 100 ravens and have a background belief that ravens do not vary in color (I would in fact be wrong to hold this conditionalizing belief, as there are albino ravens). I have an expectation that future instances of gravity's pull that I observe will behave in roughly the same way as all the instances of it I have observed. I have only observed a small fraction of all the instances of gravity's pull there will ever be, but I have a strong and justified expectation of regularity.

Bacon's example sheds some insight on when a universal generalization might be justified to believe. Surely there is always *some* expectation of regularity which constrains our observation. Even if the very moderate skepticism I am advocating is correct, there will always be a universal generalization which can be rationally believed on the basis of confirming evidence. If I make an observation of some Fs, and those Fs are all G, there will always be a universal generalization of the following form which we can justifiably believe:

(5) $\forall x((Fx \wedge \Delta x) \rightarrow Gx)$

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35 Knowledge of the law seems to get them knowledge of a different generic: that emeralds are green or blue.

where Δ is the set of properties provided by the regularity. For example, if I observe several koalas in a zoo, and they all have sharp teeth, I would plausibly be justified in believing that all koalas I have seen *in the zoo* have sharp teeth. The restricting property of having been seen by me in the zoo is provided by the expectation that perceptual deliverances are an adequate guide to reality.[36]

These Δ-*restricted generalizations*, as I will call them, satisfy the compatibility feature discussed in section 2.2.1.[37] If we take F to be the group that the belief is about, then a generalization of the form in (5) is compatible with there being members of the group F not having property G. The existence of koala without sharp teeth is compatible with the fact that every koala in the zoo has sharp teeth. But this comes at the cost of giving up generality with respect to all members of the group F.

There are also certain cases in which the generic offers an explanation of your action and an action-governing universal generalization does not.

Ginger and Mel B. are camping in a national park. They learn something interesting from two other groups of park patrons: that on two separate occasions, in two different parts of the park, these groups had their campsites ransacked by foxes who only took one thing, cold chicken sandwiches. Ginger and Mel B. are reasonably sure that it is not very likely that every fox in the park has a taste for cold chicken sandwiches. And the park is vast enough that they can also be reasonably sure they will not run into the particular foxes that stole from these other park patrons.

The only universal generalization that Ginger and Mel B. are justified in making on the basis of the information they have is one that takes scope over a small portion of the park's foxes. The domain over which they generalize does not plausibly include the next fox they will encounter. Thus, while they are capable of making some sort of restricted generalization, they are not justified in forming any belief about the next fox they will encounter on the basis of that restricted generalization.

But Ginger and Mel B. see this as evidence of a trend among the park's foxes: and intuitively they are justified in a decision not to pack cold chicken sandwiches, on the basis of the information they got from the other park

36 It is worth noting that one view of generics takes them to be restricted quantifiers of exactly this sort. Such views are, for reasons outlined in Leslie 2007a, not particularly plausible, but this connection is worth noting. Thanks to an anonymous reviewer for pointing this out to me.

37 There is no deep difference between what I am calling unrestricted universal generalizations and their Δ-restricted counterparts. Both $\forall x(Fx \rightarrow Gx)$ and $\forall x((Fx \wedge \Delta x) \rightarrow Gx)$ are restricted versions of $\forall x(Gx)$. But with respect to beliefs *about members of the group F*, the first of these is unrestricted and the second is not.

patrons; they are justified in acting on the basis of something they learned when they learned that two groups of foxes had developed a taste for cold chicken sandwiches. (Consider that if they had been in a park without any instances of this phenomenon, their concerns would have been different.) Further, this action takes the form of patterns of behavior that seem to generalize with respect to the park's foxes.

When you act on the basis of an inductive generalization, and you are justified in so-acting, what best explains your taking the action you do is a belief with a certain set of properties. If we take this to be a matter of full belief then the only beliefs which have these properties are beliefs in generics. Whatever explains your behavior in this case has a number of relevant features. (A) It is a general belief about foxes in the park: you believe something about foxes in this park as a kind (that they have a taste for chicken sandwiches). It is a belief about the whole group of foxes, but it is not a belief about the sum of individual foxes which make up that whole. (B) It seems immune to 'counterexample': the fact that some foxes are known or presumed not to have developed a taste for cold chicken sandwiches is not a defeater for your belief. Finding a fox that does not have such a taste does not necessarily change your opinion of foxes in the park generally. (C) It seems sensitive to features that seem relevant for distinguishing this group from others: learning that some small number of foxes have developed this taste motivates you in acting, but learning that two of the park's coyotes are male should not lead you take action to prepare for the park's coyotes to be male. (D) It has no associated quantity: though you may have antecedent reason for believing that some number of foxes have a taste for cold chicken sandwiches, that is not what motivates your acting. What motivates your acting is a belief about foxes that you have in spite of this quantity.

4 Bayesian Decision Theory

The discussion so far has been framed in the terms of traditional debates about confirmation: debates about how we justifiably come to believe propositions on the basis of our confirming evidence. Where it is traditionally thought that observing a sufficient number of *F*s that are *G* justifies a commitment to the claim that all *F*s are *G*s, I have argued that such observations are more appropriately taken to justify a commitment to the proposition expressed by a generic sentence ⌜*F*s are *G*⌝.

Bayesian accounts of confirmation eschew talk of 'justification' in favor of rational probabilities for hypotheses given our evidence and prior probabilities. Bayesian accounts treat inductive inference in terms of incremental increases in the probability we are rational to assign some proposition (a hypothesis H) on the basis of our evidence (E) that lend probabilistic support to that proposition, where that support is measured in terms of an agent's prior probabilities relating E and H.

Consider the proposition that all ravens are black (H): observing a black raven (E) raises your degree of confidence in the overall proposition, based on the following rules:

$$P_{new}(H) = P_{old}(H|E)$$

$$P(H|E) = P(H)\frac{P(E|H)}{P(E)}$$

Given that the proposition that all ravens are black entails that any given raven will be black, $P(E|H)$ will necessarily be 1 (by the Kolmogorov axioms of probability theory). Thus, as long as an agent has fixed *prior* probabilities in H and E, we can determine their probability assignment for H given E, and thus what their change in credence ought to be given that they have observed a black raven (namely, that their new credence in H should be their prior conditional credence in H given E).[38]

According to the Bayesian, we start with a background probability assignment linking any given member of some kind to a property. Let's say we assign a prior probability of n (where $0 < n < 1$) to any given F being G. Observing any F that is G raises this probability by a predictable amount – exactly what amount will depend on an agent's priors.

How can the Bayesian strategy be reconciled with my proposal in this paper? I will suggest two such strategies of reconciliation: one strategy ties the justification conditions for generic beliefs more directly to norms of *instrumental rationality*, which is explained by Bayesian methods. Another strategy implicates generics more directly in the Bayesian methodology, as either the objects of credence or the sources of our prior probabilities.

4.1 Compatability

It is possible that Bayesian and traditional full belief models for action have distinct, but complimentary, explanatory aims. Weisberg (2013) argues that

38 An agent who is 50% confident that all ravens are black (perhaps she believes that they are all black or all white and thinks each possibility equally likely) and 50% confident that the next observed raven will be black (given that H entails E, her confidence in E cannot be lower than her confidence in H) should adjust her probabilities as follows: $P_{new}(H) = P_{old}(H|E) = P_{old}(H)\frac{P_{old}(E|H)}{P_{old}(E)} = 0.5\frac{1}{0.5} = 1$.

Bayesians and traditionalists are after different things when talking about rational action. The aim of Bayesian decision theory is to tell us what is ideally rational; the aim of a traditional account of confirmation is to tell us what *assumptions we are justified in relying on* when we act. Presumably, we would like to act in accordance with what is rational. However, we may not always have the tools of Bayesian decision theory at our disposal.

This difference can be highlighted by analogy: Imagine a perfect food pyramid, which says exactly what portions of which foods one ought to eat in order to maximize their health and wellbeing. The food pyramid tells us, more or less definitively, what it is good to eat. Of course, we do not have access to such a food pyramid. So, we have developed (via selective pressures) our own sets of tools for determining healthiness of foods (how they make us feel, their taste, color, etc.). This is how, without having tasted poison, I am able to tell that something tastes wrong. The goodness of our diet can be measured against the health ideal of the food pyramid; however, the tools that we use to pick the foods we eat bear almost no resemblance to the food pyramid.[39]

So, there is some rational condition, elucidated by Bayesian methodology; but that rational condition is hard for us to achieve. Rationality is too demanding when it comes to certain kinds of reasoning, especially statistical reasoning that measures the prevalence of a property in a group. But we can shortcut this with certain sorting techniques. Our set of cognitive tools can provide us with judgments that enable a rough behavioral approximation of the Bayesian ideal, but at the cost of being much less accurate. Such simple heuristical reasoning is what we typically put to use in decision-making. Bayesians tell us what it is rational to do, but the Generic View tells us what sorts of mental representations enable us to justifiably act.

As Weisberg notes, there is a "massive research program in psychology dedicated to determining what methods we use, when we use them, and how effective they are at generating expected-utility-maximizing choices" (Weisberg 2013: 6).[40] One upshot of this research has been the discovery that we seem to favor 'economical' methods, like making decisions on the basis of full beliefs, rather than more 'expensive' Bayesian methods. This way of dividing things up seems to make Bayesian decision theory a theoretical tool

39 Another example of this kind can be found in the truth tables and proof rules for logic. The truth tables determine the semantic facts of the logical constants, but what you actually deploy in reasoning is closer in kind to the proof rules, which are notoriously difficult to support *a priori*.

40 See work by Baron (2007), Gigerenzer et al. (2000), Kahneman & Tversky (1979), and Mercier & Sperber (2018).

for determining rational action, and making full belief a practical tool that we actually use. This is not quite how we should draw the line. It is obviously possible, even if it is not likely, that someone will use a decision theoretic method to make a decision. We might instead think of the division as drawing the line between what people ought to do (ideally) and what people generally do to match the ideal. What you do in reasoning is a low-powered way of matching what decision theory (a high-powered method) says is rational.

So, the Generic View can be situated within the project of discovering a "psychologically plausible notion of rationality" (Gigerenzer et al. 2000). This makes the claims of this paper (and of research on the links between full belief and action in general) conditional: *Given that we use economical methods to reason*, you are justified in believing a generic about *F*s on the basis of a generalizing inference from your evidence base.

I think this reconciliation is promising. We can explain what it is instrumentally rational for an agent to do by appeal to the complex principles of a robust decision theory. What it is instrumentally rational for an agent to do may sometimes involve behaviors that appear to be / depend on generalizations about certain kinds. A natural shortcut for limited agents like ourselves would be to represent those generalizations.

Generics may express what Kahneman and Tversky call 'System 1' judgments (Leslie 2007a); these are the judgments produced quickly and with little deliberative effort.[41] Leslie treats generics as cognitive default generalizations – according to Leslie, generics "give voice to our most primitive, default generalizations, while explicit quantifiers, in contrast, require our conceptual system to actively diverge from this default" (Leslie 2007a: 382). Empirical evidence that this is the case comes from experiments involving young children, who are able to recall quantifiable information generically, but struggle with abstract quantificational characterizations.[42]

4.2 Humean Views

Bayesianism is not immune to Humean skepticism. On the Bayesian story, our probabilities are relativized to prior beliefs and credences, and the chances of reducing all of these to a priori judgments seems slim. For instance, the agent's prior probability concerning the likelihood of *H* given *E* is dependent on the

41 Thanks to an anonymous reviewer for suggestions here.

42 As I have already noted, generic generalizations that lack an explicit generic operator are a human universal. Leslie points out, however, that quantification may not be. She points to Dan Everett's work with the Pirahã language in making this claim. However, Everett's work has been highly controversial, and so I leave it to the reader to investigate.

probability they assign to E (in this case, the probability that a particular raven will be black). But isn't the Humean point exactly that this probability cannot ever be *known*? That is, there is no way of working out from first principles how likely it is that any given raven will be black, unless those first principles are stipulated. Substantive principles matching our prior probabilities to various features of the world have been proposed, but – reasonable as many of them sound – they still fall prey to the Humean skeptical argument.

But the generic view can be incorporated into the Bayesian solution in a different way, too: we might, for instance, hold that the contents of our probability assignments are generic sentences (see Silva 2020 for an interesting suggestion along these lines). Having a credence of 0.6 that all ravens are black means taking it to be 60% likely that any unobserved raven will be black. But the problem of induction is one of showing how exactly this sort of prediction – a prediction about the likelihood of some unobserved thing happening – can be made.[43] We have no more reason – based on what we've already observed – to take this to be 60% likely than we do to take it to be 2% likely, or so the Humean will claim.

But taking it to be 60% likely that ravens are black need not have this implication. If we hold that such beliefs are not nestled in the probabilistic structure of the universe, then we need not posit any relationship here at all. The 'simple' theory of generics discussed earlier holds that generic sentences like 'Ravens are black' express 'bare' facts about the world: the kind *raven* instantiates the property of *being black*. And there is no reason to think that this sort of thing can't be more or less directly observed.

This is not to say that there is no connection between generic sentences and probabilities concerning their instances. As Silva (2020) notes, the observation of instances of a generic should make us more confident in that generic. This picture of reconciliation between Bayesian and generic approaches to induction can be extended to operator views as well. Here the precise relationship between the generic operator and probabilities is important. To give just one example, an operator view that ties the metaphysical truth-conditions for generics to something like normality (Nickel 2016) or contextually fixed probabilities (Sterken 2015b) will "explain quantificational variation as an epiphenomenon" (Sterken 2017: 4).

More generally, if we think of epistemic space as corresponding to a set of probability spaces, then any modal claim will supervene on probability distributions, even if there was no way of reading from the modal to a particular probability distribution (claims of the form ⌜Might p⌝ are true

43 Thanks to an editor for this journal for making this suggestion.

in virtue of some probability space(s) being salient). So generics qua 'Gen' will always correspond to probabilistic learning of one kind or another. A full story of how this is still needs to be worked out. But the point is that having any particular credence in a generic does not commit you to precise probabilities concerning unobserved instances of that generic. Thus, incorporating genericity into our Bayesian explanations allows us to sidestep one of the problems of induction.

5 Conclusion

The role of generics in reasoning has been underexplored. This paper is a programmatic attempt at correcting this, by exploring some of the advantages of the generic view over standard views of induction.

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