

The problem of retention

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A popular version of anti-Humeanism is one that views fundamental properties as being irreducibly dispositional in nature, and it is a view to which I am attracted. Proponents of this view typically object to Humean regularity theories of laws on the basis that they do not explain why our world is regular rather than chaotic from moment to moment. It is thought that, for this reason, Humeanism does not provide firm enough foundations for induction. However, in this paper I argue that it is far from clear how these anti-Humeans can themselves explain this regularity. This is because it is far from clear how they can explain why the entities in our world do not change their dispositional properties arbitrarily over time. This is a neglected problem, which I call the *retention problem*. In an attempt to solve this problem, several naturalistic explanations of retention are explored. Unfortunately, none of these explanations is free of problems, showing that dispositional forms of anti-Humeanism may not have as many advantages as some have assumed where the problem of induction is concerned.

Keywords: laws; regularity; induction; dispositional properties; prediction; explanation.

1 Introduction

One of the central debates between Humeans and anti-Humeans concerns the relationship between the laws of nature and the behavioural regularities we observe. For the Humeans, a law of nature *just is* a regularity of a certain kind.¹ These regularities are viewed as brute contingent facts, and there is no sense in which fundamental laws can *explain* regularities given that they are identical with them. In response, anti-Humeans such as the dispositional realists typically complain that this is deeply

¹ For example, on Lewis's sophisticated Humean theory of laws (1973, pp. 72-6), a law is an axiom or theorem in the 'best' deductive system, one that strikes an optimal balance between simplicity and deductive strength.

unsatisfactory because the behavioural regularities cry out for explanation. For instance, this complaint is forcefully expressed by Strawson:

The objection to [regularity theories] ... is that the theory is utterly implausible in asserting categorically that there is no reason in the nature of things for the regularity of the world ... it is absurd to say – to insist – that there is definitely no reason in the nature of things why regularity rather than chaos ... occurs from moment to moment (1989, pp. 21-22).

I sympathise with this objection, but of course the onus is then on dispositional anti-Humeans to say what it is that explains why ‘regularity rather than chaos occurs from moment to moment’, and thereby provide firm foundations for induction. For as Beebe (2006, p.526) remarks, there seems to be no *a priori* reason for thinking such explanatory urges can be satisfied. Fortunately, in recent decades dispositional anti-Humeans have developed positions which promise to do this explanatory work (e.g. Bird 2006, Cartwright 1989 & 1999, Ellis 2001, Heil 2003, Martin 2008, Molnar 2003, Mumford 2004 and Tugby 2013).² We shall explore this dispositional form of anti-Humeanism further below and see that even if this view is granted, a neglected explanatory problem remains, which I call the *retention problem*. The problem is that the dispositional theory of properties is compatible with the world’s being chaotic from moment to moment. This is because the central tenets of the dispositional theory are compatible with the possibility of objects changing their dispositional properties arbitrarily from moment to moment. To fully explain why our world is regular rather than chaotic from moment to moment, and thereby provide firm foundations for induction, dispositional realists must tell us why our worldly objects do not and will not change their dispositional properties arbitrarily. Surprisingly, this is an issue which has largely been overlooked by those in the Humean

² Cartwright’s position is complicated by the fact that she claims (rightly in my view) that nature does not display as many regularities as many in the laws debate seem to assume. It is arguable that strict behavioural regularities are displayed only in highly controlled experimental environments, if at all. Nonetheless, it still seems fair to say that nature exhibits enough discernible patterns for scientists to be able to formulate predictions—if only inexact ones—and it is these patterns (whatever they are) that anti-Humeans will want to explain. For convenience, I shall continue to speak of these patterns as regularities (in a loose sense).

camp, and one that has been addressed (unsatisfactorily, as I will show later) by only a small number of dispositional anti-Humeans. To be fair, it has been noted by some that dispositionalism is unlikely to have any epistemological advantages over rival views (see e.g. Hawthorne 2001 and Tugby 2014). But these authors have not used the retention problem as a way of drawing these conclusions. Hawthorne (2001, pp. 366-7), for example, focuses on scepticism about our knowledge of properties rather than induction. He argues that dispositionalism does not solve the sceptical problem, because on the dispositional view two property instances could have all the same observable causal effects and yet still differ causally in ways that are inaccessible to us. Beebe (2011), on the other hand, is someone who has focused specifically on induction, and has questioned the claim that anti-Humean views fare better than Humeanism where the problem of induction is concerned. Beebe raises many important points, some of which are relevant for section 4.6 below, but overall the problem of retention is not the main focus of her paper.

Why, then, have philosophers had a tendency to ignore the issue of retention? I suspect the reason is that even dispositional anti-Humeans have thought that some features of the world are so basic that they are not susceptible to explanation. And perhaps they have assumed that the transtemporal stability of things is one such case. A driving assumption here might be that continued, stable existence is such a natural state for things to be in that only departures from such a state are in need of explanation (see Williams 2005, p. 315, who calls this the ‘default setting’ view). Two points should be emphasized in response, however. The first is that many realist metaphysicians accept a version of the truthmaker principle, which says (roughly) that truths about the world should be grounded by some aspect of the world (see Armstrong 2004, Ch. 2). But if one accepts such a principle, and it is true that things must persist in a relatively stable manner (as people like Strawson assume), then surely it is not unreasonable to enquire about the truthmaker for that truth. And secondly, if dispositional anti-Humeans have any hopes of providing firm foundations for induction, then such an enquiry seems obligatory, because one must then provide reasons for the stable existence of things. This, indeed, is one of the main points to be urged in this paper. But unfortunately, as we shall see,

this explanatory need is not easy to meet.³ What this suggests is that those who, like myself, favour the dispositional view should not place too much (if any) weight on arguments concerning induction.

The structure of this paper is as follows. After outlining the retention problem in more detail in the two sections to follow, in section four I consider the main responses that the dispositionalists might offer, including appeals to a principle of change, kind essentialism, the notion of retention dispositions, and world-level essentialism. All of the solutions considered are naturalistic strategies, given that dispositionalism is intended to be a naturalistic theory.⁴ As indicated above, I will show that, unfortunately, it is far from clear that any of them is free of problems.

2 Contemporary anti-Humeanism: the dispositional theory of properties

As mentioned above, the dispositional theory of properties is currently a popular and much-discussed anti-Humean position, partly as a result of the perceived deficiencies of the nomological realism advocated by Dretske, Tooley and Armstrong (see e.g. Bird 2007, Ch. 4 and Mumford 2004, Ch. 6 for critical discussion). But for our purposes we need not scrutinise the details of the debate between dispositionalism and the Dretske-Tooley-Armstrong theory. The important point for current purposes

³ It should be noted that this explanatory problem is only likely to apply to the dispositionalist version of anti-Humeanism. For instance, the retention problem may not arise for the anti-Humean views held by philosophers like Carroll (1994) and Maudlin (2007), because they take laws to be primitive and so are not in the business of providing ‘deep’ explanations for law-like regularities. Anti-Humeans like Armstrong (1983), Dretske (1977) and Tooley (1977) do offer a deeper analysis of laws in terms of relations of nomic necessitation between categorical (i.e., non-dispositional) universals. But as a referee has pointed out, the retention problem may not arise for this view as long as there are appropriate laws (i.e. relations of nomic necessitation) which generate the retention facts, such as conservation laws. For reasons given in section 4.8, it is less clear that the dispositionalists can straightforwardly appeal to conservation laws in this way.

⁴ One could provide a non-naturalistic explanation for property retention by maintaining that God sustains the universe at every moment. This would, however, leave us with a divine governance view of laws, which would mark a significant shift away from the dispositionalist naturalistic project.

is that even if dispositionalism about properties succeeds in overcoming problems that other versions of anti-Humeanism face (as I believe it does), an important and neglected explanatory problem remains, namely, the *retention problem*. Before outlining the problem, it will be useful to explain dispositionalism in more detail, for this will provide the framework within which the retention problem can be expressed.

According to dispositionalism, natural properties are by their very nature causally potent. Some develop this idea by saying that properties have a dispositional essence (e.g. Bird, 2007 and Ellis 2001), while others such as Mumford (2004, p. 171) play down the notion of essence and instead simply identify properties with clusters of causal powers. Either way, the upshot is that properties must dispose their bearers to play the same causal roles wherever they are instantiated. On this view, if an electron is negatively charged, then it must, given the nature of negative charge, be disposed to accelerate in a certain way in an electro-static field. To be negatively charged *just* is, in part, to be disposed in this way. This does not mean that negatively charged things will *always* accelerate in a certain way in an electro-static field. Dispositionalists do not deny that disposition manifestations can be prevented by interfering factors.⁵ However, if the surrounding conditions are optimal, then on this view we can safely predict that the disposition will manifest. Thus, Ellis claims that if dispositionalism is true, it follows that ‘... for all x, necessarily, if x has P, and x is in circumstances of the kind C, then x will display an effect of the kind E’ (2001, p. 286).

At this point, we can see how an explanation for worldly regularity might *seem* to fall out of dispositionalism. If we are told that it is necessary that, if a thing has a certain property, it will be disposed to display effect E in circumstances C, then it no longer seems surprising that things behave in the regular ways they do. Such a view therefore seems to provide firm foundations for our predictive practices. If properties necessarily dispose their possessors towards certain effects, then future patterns of behaviour can be predicted, as long as we know which properties things have. As

⁵ This again relates to Cartwright’s (1999) point that strict regularities are rarely, if ever, exhibited in uncontrolled environments.

we shall see in the next section, however, as things stand the dispositional view does not by itself rule out arbitrary behavioural chaos, which is what Strawson's challenge requires us to do.

Before outlining this problem in the next section, a brief word is in order regarding the relationship between dispositional properties and laws of nature. One might worry that, considered as a rival to the Humean regularity theory, dispositionalism is a non-starter. More precisely, one might suspect that understanding dispositional concepts requires a prior grip on the notion of laws, in which case dispositionalism will be unable to provide an illuminating, non-circular account of laws. One obvious way of answering this worry is to adopt the structure of Bird's dispositional analysis. On his view, counterfactuals are generated by facts about the dispositions of things, and it is from these counterfactuals (plus certain assumptions) that the laws of nature are derived (see Bird 2007, p. 46 for details). But as a referee has pointed out, it is not clear that this avoids all circularity, because it is not clear whether there is an analysis of counterfactuals which is both adequate and which does not itself appeal to laws of nature in a circular way. For instance the dominant 'possible worlds' analyses of counterfactuals are known to face a variety of problems (see e.g. Tooley 2003), not to mention the fact that on most possible world accounts, getting a grip on the notion of the 'closeness' of worlds requires prior knowledge of the laws at those worlds. I agree that this is an important issue and unfortunately it is probably one that many dispositionalists have not considered often enough. However, one route for a dispositionalist to take is to adopt a non-worlds-based account of counterfactuals of the sort proposed by Jacobs (2010, p. 242-46). Jacobs offers a dispositions-based (or 'powers'-based) analysis of counterfactuals, which does not invoke the concept of laws. This is essential, because Jacobs' aim is to provide 'a semantics for counterfactuals that appeals only to properties and their powerful natures' (2010, p. 241), and he is clear that 'the source of powers is not the laws of nature' (2010, p. 236). In short, then, if Bird is right that laws can be derived from counterfactuals, while the counterfactuals themselves can be understood independently of nomic concepts, this may provide the dispositionalists with a non-circular analysis of laws. But what if it could be shown that the Jacobs-type analysis implicitly invokes laws, or if it is problematic for some other reason? In that case, perhaps it would have to be conceded that the concepts of dispositions and

laws are mutually dependent, with neither being reducible to the other. It is far from clear that this would be fatal for the dispositionalist project, however. Here, the dispositionalists could point to Mumford and Anjum's view (2011) on causation. Although Mumford and Anjum concede that causal concepts cannot be reduced to dispositional concepts, because the latter are themselves inextricably bound up with causal concepts, they argue that the metaphysics of dispositions or 'powers' can still shed light on the nature of causation (2011, pp. 7-8).

Given that my concerns lie elsewhere in this paper, I will not say any more here about the precise relationship between dispositions and laws, though I welcome further work on this issue. All we need to note before proceeding is that according to the dispositional view, the properties of the world are irreducibly dispositional, and that if two things have the same properties, they will necessarily be disposed to behave in the same way in the same sorts of circumstances. With this central point in place, let us now proceed to our discussion of the retention problem.

3. The retention problem

The problem facing dispositionalism is relatively easy to state. Let us grant that all natural properties are dispositional in nature. If such a view is correct, then Bird, Ellis and others are surely right in saying that this helps to explain why, *if an object has a certain property*, it must be disposed towards certain behavioural manifestations in appropriate circumstances. But does this automatically explain, in Strawson's words, why 'regularity rather than chaos ... occurs from moment to moment (1989, pp. 21-2)? I do not think so. To explain *that*, a further element is needed which addresses the question of why entities in our world tend to retain their dispositional properties over time in a stable way.

The problem with the dispositional view, as it stands, is that it is compatible with a world that is radically chaotic and in which scientific predictions cannot be made. To be precise, the problem is that even if each property is essentially such as to dispose its possessors to behave in a certain way, it will only so dispose them *for as long as that property is instantiated*. And importantly, it is far from obvious that the dispositional essences of properties can explain why objects do not constantly change their dispositional properties in an arbitrary and chaotic way. Even if we concede that, for the duration

of a property's instantiation, its possessor must be disposed to behave in a certain way, this alone does not ensure that dispositional properties are generally retained for long enough for any discernible patterns of behavioural regularity to emerge. If such chaotic worlds are possible even if dispositionalism is granted, then what explains why our world is one of the regular ones in which predictions can be made reliably? Without answering this question, the dispositionalists have not fully explained worldly stability and have not yet provided firm foundations for our predictive practices.

It is not difficult to illustrate why arbitrary property changes could lead to chaos. Suppose a body has a certain mass at t_1 , which disposes it to exhibit the gravitational behaviour we would expect of a massive object in our world. However, suppose that at t_2 the body's mass arbitrarily disappears and is swapped with a new property, call it mass*. In virtue of being a different property, mass* will (according to dispositionalism) bestow different dispositions. Let us suppose, for example, that bodies with mass* repel other bodies rather than attract them. Let us then suppose that at t_3 the body's mass* arbitrarily disappears and is swapped with a new property, mass**, and so on. And let us suppose that, in this way, all the objects in this imagined world undergo continual arbitrary changes in their dispositions.⁶

Clearly, a world like the one just described could be radically non-regular and chaotic. It could, for instance, be a world in which it is impossible to formulate scientific predictions, because we could have no idea how things would be disposed to behave from one moment to the next. And yet, such a world is one that is consistent with the core tenets of dispositionalism. Of course, our world is not like the world described above. Although things do change their properties, this only occurs as the result of causal influences, or, in probabilistic cases, as a result of the propensities of things. Things in our

⁶ Another way of conceiving of this 'disposition swapping' scenario would be to say that the body has an arbitrary 'gruesome' dispositional property. So, in the case above we could describe the body as having the complex dispositional property to attract other masses before an arbitrary time t and to repel masses after t , and so on. The result would be the same, which is that it would be very difficult to predict behaviour in such cases. An anonymous referee has informed me that the possibility of complex dispositions like these has been raised previously by Barry Loewer and Tim Maudlin.

world do not seem to change their dispositional properties arbitrarily, but the question we may rightly press is: why? Dispositional anti-Humeans might respond by resisting the idea that conceivability entails possibility where arbitrary property change is concerned, and therefore question the example provided above. But what reasons are there for thinking that arbitrary change is metaphysically impossible? Until reasons have been provided, then the complaint that Strawson raises against Humean views—that they do not explain why the world is regular rather than chaotic from moment to moment—is one that applies equally to dispositionalism.

As mentioned earlier, not many Humeans or dispositional anti-Humeans appear to have noticed this problem. As far as I know, only a couple of anti-Humeans have made a serious attempt to address it, and one of these is Strawson himself. The other is Williams, who will be discussed in section 4.5 below. Here is what Strawson (1987) has to say on the matter:

...what (as it were) holds matter together, as something with a (constant) nature, from instant to instant? What maintains it as something that remains qualitatively similar from instant to instant? The answer cannot be ‘Nothing as all’. For then the transtemporal qualitative similarity or stability is after all entirely coincidental, and matter cannot after all be said to possess a (more or less stable) persisting intrinsic *nature*. So, the answer must be ‘Something’. And the present suggestion is that the phrase ‘objective forces’ is as good a name as any for whatever that something is (1987, pp. 260-1).

Strawson’s suggestion, then, is that the transtemporal stability of things is best explained by the work of underlying objective forces. That is, such forces provide the stability needed for material things to remain qualitatively similar from moment to moment. What Strawson also emphasizes is that these forces are not externally imposed upon material things, but rather ‘such forces are part of the nature of things’ (1987, p. 254). So, does this appeal to forces automatically solve the retention problem? Unfortunately, it is far from clear that it does. I accept that Strawson’s appeal to forces is something that the dispositionalists may find attractive, for his characterisation of forces fits the dispositional framework well, and although he does not like using terms like ‘causal powers’ (1987, p. 255), his view is easily interpreted as a version of dispositionalism. For Strawson, the forces exerted

flow from the intrinsic natures of things, and this is naturally expressed in dispositional terms as the idea that forces flow as the essential manifestations of certain intrinsic properties of things.

The problem with Strawson's proposal, however, is that even if we conceive of forces in an objective anti-Humean way, we may still ask what it is that explains why those unifying forces *continue* to exist over time. Strawson's answer appears to be that the forces cannot fail to exist given the natures of the material things involved. But this just delays the question at hand, for what is it that explains why material things do not change their natures arbitrarily? If such changes are possible, then the forces manifested might be very different from moment to moment, leading to the arbitrary chaos described earlier.

There is, I concede, a reading of Strawson's view that *might* provide a more substantial explanation. When Strawson says that 'such forces are part of the nature of things' (1987, p. 254), perhaps he could be interpreted as advocating a form of essentialism about substantial kinds: by 'nature', we might suppose, he means essence. According to at least one version of essentialism about kinds, it would be a mistake to say that the forces manifested by those kinds could change. This is because at least some of the intrinsic dispositional properties responsible for those forces may be essential to those things being the kinds of entities that they are (see e.g. Ellis 2001 as an example of someone who pairs dispositional realism with essentialism about kinds).

In what follows, we will examine potential solutions to the retention problem including the essentialist reading of Strawson just outlined (see section 4.3 below). In section 4.5, we will then explore Williams' solution, which appeals to the idea of retention dispositions (or what he calls 'static' dispositions). In section 4.7 we will examine a more ambitious essentialist strategy which appeals to world-level retention dispositions. Unfortunately, however, we will see that even if these views are modified in various ways, it is far from clear that any of them is free of problems.

4. Potential solutions and replies

4.1 The principle of change strategy

Let us begin by ruling out what is perhaps the most obvious way of tackling the retention problem, one which employs a broadly rationalist strategy. This discussion will lead to a further reason for pursuing the essentialist strategy mentioned above, and so will lead us naturally to the Sect. 4.3.

Taking inspiration from a rationalist world view, the dispositional anti-Humean might try to establish a Principle of Change (PC), which says the following in its most basic form:

PC: For every change C that occurs, there is a reason why C occurs rather than not.⁷

Clearly, such a principle would preclude things from changing their dispositional properties arbitrarily. According to the principle, if a thing were to undergo a change in its properties this would have to be explained in some way. Such an explanation would involve, say, pointing to some external or internal causal influence (probabilistic or otherwise). But without such causal influence, the principle entails that a thing must go on retaining the dispositional properties that it has. An analogy with Newton's First Law may help to illustrate the point. PC predicts that the only way a moving body can change its velocity is if something provides a reason for it to change, for example the exertion of some external interfering force. Hence, in the absence of such a force, a moving body must forever continue with the same velocity if PC is true, and this is precisely what Newton's First Law suggests. Analogously, PC entails that if left uninterfered with, an object's dispositional properties must remain constant, which is to say they must be retained. So, if PC were true, it would guarantee that things do not change their dispositional properties arbitrarily.

4.2 Response to the PC strategy

So far, so good. But opponents will want to know why it is that PC holds. PC must either hold contingently or necessarily. But if it holds contingently, it is difficult to see how it can do any explanatory work. PC takes the form of a universal quantification and says that all changes happen for

⁷ Note that this principle does not imply determinism. This is because dispositionalists are able to provide reasons for chancy occurrences in terms of the manifestations of the objective propensities of things. It is therefore important not to confuse chancy occurrences with arbitrary occurrences, which are inexplicable.

a reason. But if this is a contingent generalisation, then it is something that even a Humean could accept. And so, such a statement would merely express the retention facts rather than explain them.

Perhaps, then, the principle is necessary in some sense, in which case it may explain itself. But what could ground such necessity? The Humeans will point out that it does not seem to be a conceptual or metaphysical truth that PC holds, for it seems perfectly coherent to entertain a world in which objects change their properties arbitrarily. If conceivability is not a good guide to possibility in such cases, then the Humeans will want to know why.

In response to such worries, perhaps the dispositional anti-Humeans' best option is to maintain that PC must hold *in worlds like ours*. That is, they could deny that conceivability is a good guide to possibility where worlds *like ours* are concerned. And such a claim would be consistent with the plausible thought that PC does not hold in all metaphysically possible worlds, for it would amount only to attaching a conditional necessity to PC. How, then, could one motivate such a claim? One strategy is suggested by Pruss (2007, p. 298), who has argued in a different context that a promising way of establishing what he calls the Causal Principle (which is relevantly similar to PC⁸) is to argue that it is a consequence of the laws of nature in our world. On the dispositionalist view, however, laws are grounded in dispositional properties, and so Pruss's suggestion would have to be understood as the idea that things have certain dispositions which ensure those things retain their other dispositions (in the absence of interfering factors). We will discuss this strategy in section 4.5, when we will address Williams' 'static' dispositions view (2005).

A second way of establishing the claim that PC holds *in worlds like ours* would be to develop the proposal within a kind essentialist framework, just as Strawson's view can be (see section 3 above). Such a response is not available to dispositionalists like Mumford (2005) and Bird (2007, pp. 208-210), who do not accept kind essentialism. But it is available to someone like Ellis who advocates both kind essentialism as well as dispositionalism. With such a view in play, perhaps it could be argued that by their very essence, the things in our world have to retain their properties through time. Let us now examine this proposal in more detail.

⁸ Pruss's Causal Principle says that every contingent event has a cause (2007, p. 292).

4.3 The kind essentialist strategy

Suppose we agree with dispositionalists like Ellis (2001) who hold that we need a distinct ontological category of natural kinds, and suppose that each member of a natural kind has certain essential intrinsic properties, in virtue of which it is a member of that kind. Might such a view provide the resources for ruling out arbitrary changes in dispositional properties?

An initial point the essentialist might emphasize is that if, for example, an electron is essentially negatively charged, then in order for that electron to persist, its property of negative charge cannot be swapped with another property. Hence, in this way perhaps the essentialist could block the idea that a thing's properties can be swapped arbitrarily, at least in the case of essential properties.

Of course, one might respond that many intrinsic properties are accidental, even if some are had essentially by the individuals in question. And at least with respect to those accidental properties, it will still be unclear what rules out arbitrary property swapping. Such swapping, if possible, could give rise to radically new dispositions and make for a chaotic world, even if the essential properties of a thing must remain in place throughout its existence.

In short, for the essentialist strategy to deliver a comprehensive solution, it would have to be that *all* natural properties are essential. It would be a large undertaking to establish such a strong form of essentialism, but perhaps such a view could be aided by the fact that when we look at the fundamental level of, say, quarks, leptons, and mediators, it is less clear that any intrinsic properties really are accidental. Such particles have relatively few properties, and an essentialist may be inclined to argue that *all* of them are essential. In any case, I do not wish to pursue this question further here. For even if this strong form of essentialism is justifiable, it is still far from clear that it would rule out arbitrary chaos from moment to moment. Let us now see why.

4.4 Response to the kind essentialist strategy

The problem with the strong kind essentialist picture just outlined is that it still does not ensure that the world is non-chaotic. Even if it solves the retention problem, a new problem awaits which we may call the *invader problem*. The kind essentialist response just outlined rules out the possibility of

arbitrary changes in the dispositions of things *given the continued existence of those things*. However, as it stands, such a view is perfectly compatible with objects being arbitrarily annihilated and replaced with different kinds of entities—entities with different essential properties. Such a world could be radically chaotic from moment to moment, because things could constantly be swapped arbitrarily with things that have different essential dispositions.

In calling this the ‘invader’ problem, I borrow terminology from Handfield, who in a different context observed that dispositional essentialism is compatible with the metaphysical possibility of ‘space-invaders’ popping into existence (2001, p. 489). Invasion cases, Handfield suggests, should be classed by the dispositional essentialists as law-abiding miracles.⁹ In any case, what is important for current purposes is that for the essentialist strategy to succeed in ruling out arbitrary chaos, not only must all entities be such that they have their dispositions essentially, they must also essentially be such that they cannot be arbitrarily annihilated and replaced by other kinds of entities.

If we were prepared to accept such strong essentialist claims, there may be hope for providing a complete explanation for the non-chaotic nature of our world. An initial problem is, however, that sceptics will see no independent reasons to suppose that the things in our world are essentially such that they cannot be annihilated and replaced. One problem here is that anti-annihilation properties are not observable in the way that standard kind essences are. Many agree with the essentialist intuitions of Putnam (1975) and Kripke (1980), and accept that, for example, a substance which is superficially similar to gold, but which does not have an atomic number of 79, does not deserve to be called ‘gold’. Whatever we think about this intuition, we can at least be sure that the property of having atomic number 79 exists, due to the positive evidence we find in chemistry. In contrast, from a scientific perspective it seems we can have only negative justification for thinking things have anti-annihilation properties. It is hard to see what evidence there could be for positing such properties, aside from the fact that generally things have not been arbitrarily annihilated until now. In short, anti-annihilation

⁹ The possibility of space invaders is also used in support of Beebee’s arguments (2011) against Ellis’s natural kind essentialism. Below we will consider ways in which an essentialist like Ellis might try to resist the possibility of arbitrary replacement.

properties can only be inferred rather than observed, and one might therefore think that belief in such properties is less secure than belief in the properties that kind essentialists normally appeal to.¹⁰

Another worry with the anti-annihilation essence strategy is that even if we are happy to posit anti-annihilation properties, it is far from clear that the Putnam-type Twin Earth experiment delivers a clear essentialist verdict where the issue of arbitrary annihilation is concerned. The following sort of thought experiment provides the test. Let us consider a world containing a particle which, from a physicist's perspective, has all of the intrinsic properties that would lead us to classify it as an electron. That is, it has unit negative charge, rest mass $0.511\text{MeV}/c^2$, and so on. Now, suppose that this entity is spontaneously annihilated and replaced by some other kind of entity. Is it intuitively plausible to accept that, because the entity was annihilated, it was not really an electron after all? Although our intuitions are not always clear in unusual circumstances like this, it does not seem absurd to insist that the particle in question really is an electron, but an electron that was unlucky enough to have been randomly annihilated.

Now, I am happy to accept that the objections above are by themselves inconclusive. First, one might think that even if anti-annihilation essences cannot be observed in the way that other kind essences can, there are still good reasons for inferring their existence. And in terms of the Twin Earth experiment just outlined, one might simply disagree with my intuitions. However, we come now to what is perhaps a more serious problem for the anti-annihilation kind essence strategy. The problem is

¹⁰ This is not to say that anti-annihilation properties could not perform the sorts of explanatory roles that essences like 'atomic number 79' play. One justification for elevating the latter's status to that of an essential property is that it plays important explanatory roles, such as explaining the other 'manifest properties and behaviour of the substances in question' (Ellis 2005, p. 467). But as a referee has pointed out, it may be that anti-annihilation essences could help to explain the other manifest properties of an entity. For example, there is a sense in which water's ability to dissolve salt rests in part on the fact that water generally does not arbitrarily disappear when in contact with salt. And one reason for this general fact could be that water has an anti-annihilation property.

that *even if* independent reasons could be found for positing anti-annihilation essences, this would still only offer a partial solution to the problem of ruling out arbitrary behavioural chaos. Let us see why.

The problem is that unless it is a metaphysically necessary truth that all possible kinds have anti-annihilation essences, then the possibly remains of future instantiations of kinds which do not have anti-annihilation essences. And it is hard to imagine how such a strong necessity claim could be justified. It is one thing to claim that all of the entities observed so far have anti-annihilation essences, and quite another to say that all *possible* future entities have anti-annihilation essences. As observed earlier, sceptics will emphasize that we can conceive of entities being arbitrarily annihilated, and if we are to deny that conceivability is a good guide to possibility in this case, then we must be told why.

Are there any alternative essentialist strategies that one might appeal to in order to rule out arbitrary behavioural chaos? One strategy that has been suggested to me is that we could move away from essence facts concerning specific kind categories and turn instead to essential facts about the material world as a whole.¹¹ The most obvious way of developing this proposal would be to say that it is of the essence of our kind of material world (considered in its entirety) that it contains just the fundamental entities that it does. If one then asks why it is that, say, particular electrons do not arbitrarily go out of existence, the answer is simply that those electrons have to exist for our material world to be the kind of world it is, and therefore that the arbitrary annihilation of such entities would not occur, given the continued existence of the world.

This simple world-essence solution is elegant, but unfortunately it faces two worries. The first problem is along the lines of that raised against the kind-essentialist strategy above. What independent reasons are there for thinking that the world essentially contains just the entities that it does? This is a very strong essentialist view, and it seems contrary to intuition to suppose that minute changes in the inventory of particles at the fundamental level would put us in an altogether different kind of world. Without independent reasons to the contrary, the world essence view seems an ad hoc metaphysical

¹¹ I am grateful to an anonymous referee for this suggestion. Note that this general strategy is the one used by Bigelow et al. when considering the question of why events in our world obey conservation laws (1992, p. 384). We will return to this issue later on when we discuss the world-level retention strategy in section 4.7.

commitment, and a major one at that. However, there is also a further worry that arises, which suggests that, again, the world-essence strategy only delays the problem that it is supposed to solve.

Recall that the discussion of annihilation arose from the need to address the invasion problem, which concerns the possibility of arbitrary changes in the kinds of material entities that exist. Now, although this was not explicitly acknowledged, the invasion problem raised earlier is what we might call a *local* problem. It was the problem of ruling out the possibility of *specific* entities in the material world being arbitrarily annihilated and replaced by space invaders (entities which come with different essential dispositional properties, thereby leading to behavioural chaos). Clearly, the simple world-essence view just outlined solves the local problem, because arbitrary local changes in the material world would be impossible, given the continued existence of that world. But as I say, the worry is that this only delays the problem because it seems a more global version of the annihilation problem can be developed. Even if arbitrary *local* annihilation is ruled out by the current proposal, how can we rule out the possibility of the material world *as a whole* from being arbitrarily annihilated? If global annihilation is possible at any moment, then our confidence in predictions about the future is severely affected. And perhaps we could even take the response one step further, and suppose that after being annihilated, the material world could be *replaced* by a new kind of world, one which differs by consisting of a different inventory of material entities. Given certain (albeit controversial) assumptions, perhaps there might even be ways of maintaining that observers like us could survive such changes, in which case our experience of the environment would be thrown into chaos. In order to resist all of these possibilities, it seems an anti-annihilation essence is needed once again to block them, one which this time applies *to the material world as a whole*. But as we saw above, appeals to anti-annihilation essences seem ad hoc and unduly strong.

Now, in response, the opponent might question the coherence of the idea of global replacement. It may not be difficult to conceive of one material world being annihilated and a different one coming into existence, but if time is world-bound, as seems plausible, then it seems less easy to get a grip on the idea of one material world being a *replacement* for another. There are a couple of things to be said in response, however. First, even if the possibility of global replacement cannot be sustained, it is still

problematic enough if the material world as a whole could be arbitrarily annihilated. As mentioned above, this possibility alone would severely affect the stability of induction. Given that our predictions require the stable existence of the world around us, our confidence in such predictions would be shaken considerably if the material world as a whole could be arbitrarily annihilated at any moment. Secondly, perhaps there are certain ways of making sense of one material world being *replaced* by another. As a referee has pointed out, if we adopt a Newtonian substantivalist conception of space and time, perhaps sense can be made of the totality of material things being arbitrarily replaced. On such a view, space and time is seen as an inert backdrop against which the material world exists. This backdrop exists independently of matter and hence could persist through a wholesale change in the matter that exists. Hence, if by ‘material world’, we mean the totality of material contents, then perhaps sense can be made of one material world replacing another. And as mentioned earlier, perhaps sense could even be made of the observers involved surviving such wholesale changes, as long as one assumed a non-materialist view of persons. Of course, all of these assumptions, such as substantivalism and non-materialism about persons, are controversial. But as highlighted above, even if these further metaphysical assumptions are problematic, the possibility of global annihilation is by itself sufficient to shake our confidence in predication about the future.

This concludes our initial discussion of the essentialist retention strategies. Recall, however, that there is an alternative suggestion from Pruss (2007, p. 298) on how to ground the Principle of Change discussed earlier. This involves viewing the principle as a consequence of the laws of nature. By appealing to laws of nature, perhaps we will be left with a more plausible and transparent explanation for property retention. In the subsections to follow we shall see that the retention laws strategy is itself likely to involve essentialist commitments of a certain sort. But before addressing that point and identifying criticisms, let us examine the laws strategy in broad outline.

4.5 Retention laws strategy

Suppose that in addition to the dispositional properties that are usually discussed (such as charge, spin and mass), physical things also have retention dispositions. These are dispositions that things have to

retain their other dispositional properties over time. Given these dispositions, we might say it is a law that, in the absence of interfering influences, such things retain their intrinsic properties through time.

Now, it may seem odd to suppose that there are dispositions whose manifestations are that of ensuring that the other properties of its possessor are retained from one moment to the next. But it becomes less odd when one acknowledges that, on almost any account of causation, there are causal processes at work within objects which help to explain their stability and persistence. For it takes causal work to maintain a physical structure just as it does for that structure to be disrupted. Moreover, even if there are simple physical entities which lack internal structure, there are still ways of conceiving of their persistence as the manifestation of causal dispositions. One could, for instance, appeal to something like Armstrong's notion of immanent causation in explaining the nature of such processes. Armstrong characterizes immanent causation as a 'remaining within' causality, which occurs within an object when one of its temporal parts leads to the next (1997, pp. 73-4). A feature of an 'immanent' disposition would be that it manifests continually and unconditionally. But this feature would not be especially problematic, because other dispositions appear to be like this. Indeed, rest mass appears to be one such example according to General Relativity (see e.g. Molnar 2003, p. 86-7)

Such dispositions, if they exist, would be akin to what Williams (2005) calls 'static' dispositions. Indeed, Williams' theory of static dispositions could be considered as a retention laws view. On Williams' view, the notion of a static disposition is introduced by way of contrast with 'dynamic' dispositions. The manifestations of dynamic dispositions are those that bring about active changes in the world. The manifestations of static dispositions, in contrast, are much more subtle and go unnoticed, because their manifestations consist merely in things continuing to be in the states they were previously, such as when a bowling ball keeps its spherical shape from one moment to the next (Williams 2005, p. 312). Indeed, one could even hold that retention dispositions are built into ordinary properties themselves, which would mean that, for instance, sphericity confers not only the disposition to roll, but also the disposition to keep that rolling disposition unless other causal factors

intervene. If Williams' proposal were developed in this way, then ordinary properties would be viewed as complexes of dynamic and static dispositions.¹²

Does this mean that we can simply appeal to the Williams-type view as a way of overcoming the retention problem? Unfortunately, matters are not quite so simple. Although static dispositions perform the kinds of explanatory functions that Williams is looking for, by themselves they do not rule out arbitrary behavioural chaos, which is our current concern. We shall see why shortly. What this shows is that Williams' explanatory aims are less ambitious than those being considered here, which aim at providing firm foundations for our predictive practices.

4.6 Response to the retention laws proposal

An initial question that we should ask about retention dispositions is this: do the entities in our world instantiate retention dispositions contingently or necessarily? This is not among the questions that Williams considers, and neither answer is without problems. The problem is that if retention dispositions are instantiated contingently, then the proposal faces much the same difficulty as Strawson's. Strawson proposed that objective forces are responsible for worldly stability, but this just delayed the question at hand, for then we asked why it is that those worldly forces continue to hold over time. In fact, it is not at all clear that the proposals of Williams and Strawson are significantly different, because one way of cashing out what it is that retention dispositions do is to say that they exert certain static forces, which keep the properties of things in place (in the absence of interfering factors). In any case, the problem here is that if objects instantiate their retention dispositions contingently, what ensures that those retention dispositions *themselves* continue to be retained?

In response, one might try insisting that retention dispositions are instantiated necessarily in all things. But what could ground this necessity? The opponents will, once again, point out that we can apparently conceive of things changing their properties arbitrarily. Hence, if we are to accept that what is conceivable is not really possible in this case, then we ought to be told why. Insisting that it is a brute necessity that all things instantiate retention dispositions would leave us with a rather opaque

¹² In private communication, Nancy Cartwright identified a proposal along these lines.

form of necessity. Moreover, if we are to accept brute necessities, why not bypass retention dispositions and simply maintain that the Principle of Change holds as a matter of brute necessity?

It is worth considering, therefore, whether a more transparent explanation can be found for the continued existence of static dispositions. As a first attempt, a fairly obvious move to make is to say that things have a disposition to retain their retention dispositions. But unfortunately, this is clearly a regress in the making. For then we can ask why this further retention disposition does not cease to exist arbitrarily. If a third-order retention disposition is then posited, we can ask the same question again and thus the regress is under way. So, at this point, it seems that if retention dispositions are instantiated contingently, we will be forced to say that it is just a brute fact that things in our world regularly instantiate such dispositions. But that, of course, would be to accept what the dispositional anti-Humeans traditionally want to avoid, which is the idea that the regular behaviour of things rests at least in part on a brute, contingent regularity.

Perhaps, however, there is a more satisfying way of overcoming the regress problem. In his discussion of static dispositions, Williams (2005, p. 322, fn. 10) mentions Unger (2006, Ch. 5) as someone who posits such dispositions. More precisely, Unger holds that the internal stability of an object is best explained by a 'Propensity for (its) continued existence' (2006, p. 286). Although Unger does not address the regress worry, he does offer a view about these propensities which could bypass the regress problem. Regarding an entity that continues to exist in a stable way, Unger writes that it

... will be *Propensitized to retain all its propensities*, each of them just as it is (and just as it's been), including this very propensity itself, of course, which we may call its *Comprehensively Propensitized Propensity* (2006, p. 287).

For our purposes, the important point comes midway through the sentence, when the propensity is said to retain *itself*. If such dispositions are partially dispositions to retain themselves, then no further

disposition is needed to keep them in place. In other words, the explanatory buck stops with the ‘comprehensively propensitized propensity’ itself given that it explains its own continued existence.¹³

So, are Unger’s comprehensively propensitized propensities acceptable metaphysical posits? For ease of exposition, I will call such propensities ‘universal retention dispositions’, given that Unger’s choice of terminology is somewhat ungainly. One notable feature of universal retention dispositions is that they are *multi-track* as opposed to *single-track* dispositions. What this means is that they are dispositions for more than one manifestation. As well as manifesting by keeping themselves in place, they also manifest by keeping in place the object’s other dispositions, which may include a diverse range. Such dispositions are therefore complex in character, and some may find this objectionable. For instance, Bird (2007, pp. 21-4) argues that if a disposition is fundamental (as a retention disposition presumably would be), then it ought to be for a single manifestation only.

I will not pursue this issue further here, because I want to grant the advocate of the current proposal as much as possible and then see whether universal retention dispositions can meet our explanatory aims. Let us therefore assume that the notion of a universal retention disposition is coherent and consider whether acceptance of such dispositions rules out arbitrary behavioural chaos.

We should start by acknowledging that the universal retention proposal provides a clever way out of the regress problem raised earlier. If each thing has a universal retention disposition, which is partially a disposition to retain itself, then this will guarantee that it remains in place and thereby carry out its work in retaining a thing’s other dispositions (in the absence of interfering factors). Importantly, such a view is an improvement on the essentialist strategies discussed in section 4.3. In Sect. 4.4 we saw how, in trying to rule out arbitrary behavioural chaos, the kind essentialist faced the problem of explaining why a thing could not be arbitrarily annihilated and replaced with some other

¹³ In some ways, Unger’s notion of a comprehensively propensitized propensity resembles Bauer’s conception of a pure disposition. In response to the problem of how dispositions can continue to exist when they are not displaying their characteristic manifestations, Bauer (2012, p. 156) argues that they ground their own existence by manifesting their own ‘minimally sufficient’ occurrence. On Bauer’s theory, then, there is a sense in which dispositions are self-retaining.

kind of thing. The way out was to posit ad hoc and implausible anti-annihilation essences, but with universal retention dispositions now in play, such a move can be avoided. If something has a universal retention disposition, this alone will explain why (in the absence of interfering factors) the thing will go on existing as it is. The reason is that the object's universal retention disposition (which retains itself through time) will be continually working to ensure the stable existence of that object. Note also that this solution is very much congenial to dispositionalism given that it explains property retention by appealing to further dispositions of a certain sort.

So far, so good. But unfortunately, an important issue remains. Once again, it is crucial to note that universal retention dispositions will only provide firm foundations for induction if such dispositions are instantiated by all present *and future* objects. Thus, we are led to the important question of what justifies the thought that all entities must have universal retention dispositions. Unfortunately, this is not a question that Unger considers even though he sees the explanatory importance of self-retaining dispositions. And clearly, we cannot just say that future as-yet-unobserved entities will most probably have universal retention dispositions given that previously observed objects have them, because that would amount to underpinning induction in a circular way.

At this point, it may strike the reader that what is needed here is the marriage of the retention dispositions strategy with yet another essentialist proposal. Perhaps we could maintain that the things observed so far are of such a kind that they have universal retention dispositions *essentially*. From this it would follow that all future instances of those kinds must have universal retention dispositions, thereby putting inductive inferences about those kinds on a firm footing. However, the problem again is that this strategy alone does not fully rule out behavioural chaos. Even if good independent reasons can be found for such essentialist claims, these claims would not by themselves rule out possible future instances of different kinds which lack universal retention dispositions—kinds which could be subjected to arbitrary space invasion. Here I borrow a point raised by Beebe (2011, p. 521-22) when criticising certain anti-Humean accounts of induction. Beebe argues that Ellis's natural kind essentialism does little to solve the problem of induction because even if we knew that, say, salt essentially dissolves in water, this still leaves us with the problem of ruling out future occurrences of

substances which are superficially like salt but which do not dissolve. The same sort of problem, I am suggesting, applies in the case of the essentialist retention disposition strategy. In order to rule out future behavioural chaos, we need reasons for thinking there will never be instances of kinds which, say, have all the observable features of current kinds, but which do not have the essential dispositional property of universal retention.

In fact, we encountered similar problems when considering the possibility of anti-annihilation essences in section 4.4. In response, we suggested that dispositionalists could move away from the essences of specific kinds and focus instead on the notion of world-essence. That strategy involved the idea that it is of the essence of our material world that it contains just the amount of fundamental entities that it does (entities which have their dispositional properties essentially). We found this essentialist claim to be implausible, but now that we have the notion of a world-level universal retention disposition in play, perhaps we can provide a modified world essence view. This modified view would posit the existence of a (multi-track) *world-level* universal retention disposition that our world instantiates essentially. Importantly, such a view would ensure that our world will *never* allow things to be arbitrarily changed or annihilated. Let us therefore round off our discussion by considering this modified view and any problems that it faces.

4.7 A final hope: essential world-level universal retention dispositions

First, an immediate complaint that this modified world-essence view might face is that the notion of a world-level essential universal retention disposition looks very much like a desperate metaphysician's invention, and one which is far removed from the kinds of properties posited in science. Such a complaint may be too hasty, however. When introducing the world-essence strategy earlier, we mentioned how Bigelow et al. (1992) were the first to propose a world-essence view of certain laws, and that their view is motivated precisely with specific scientific laws in mind. For instance, they pay significant attention to *conservation* laws, which say that all events and processes in closed, isolated systems must conserve the various quantities that they instantiate. The quantities in question include energy, momentum, angular momentum, charge, baryon number and lepton number. According to

Bigelow et al., it is far from clear that it is of the essence of the category of events that their quantities are conserved (1992, p. 385), and so it is not immediately obvious how such laws are grounded. The dispositionalists cannot, of course, accept that conservation laws represent brute, contingent regularities, for that would signify a retreat to Humeanism. The solution offered by Bigelow et al. is that a conservation law, being global in character, must reflect an essential dispositional feature *of the world as a whole* (1992, p. 385). And what is interesting to note here is that the notion of conservation is very much like the notion of retention. What a conservation law does, considered as an essential feature of the world, is precisely to rule out the arbitrary annihilation (or creation) of a certain quantity within a system, by ensuring the quantity remains the same overall. That quantity can of course be distributed differently at different times, but at no point can a portion of that quantity be annihilated.¹⁴

Overall, then, it seems that the notion of a universal retention disposition could take a legitimate place in a scientifically informed metaphysics. Moreover, this world-essence analysis of conservation laws allows us to view those laws as being metaphysically necessary, which is what the dispositionalists need.¹⁵ However, what is distinctive about the current proposal, as opposed that of Bigelow et al., is that because the retention disposition we are considering is universal, its role includes the *retention of itself*. This is necessary, to recall, so that the regress of retention dispositions is avoided. Putting the idea in terms of conservation, we might say that it has to be of the essence of the world that the conservation laws are themselves conserved. Crucially, this modification helps us to rule out the global annihilation problem discussed in section 4.4. With world-level universal retention

¹⁴ An anonymous referee has suggested that the Schrödinger equation is another example of a global law which does not allow room for the spontaneous annihilation or creation of matter. If this is right, then what the current proposal would say is that the Schrödinger equation is metaphysically grounded by a conjunction of world-level dispositions: a dynamic, probabilistic disposition for motion together with a universal retention disposition.

¹⁵ Note that the mere acceptance of conservation laws in science does not automatically solve the dispositionalists' retention problem because such laws can easily be accommodated by Humeans, who will just treat them as expressing brute, contingent regularities. Therefore, in order to solve the retention problem, something like the world-essence view is needed, so that these laws may be viewed as non-contingent.

dispositions in play, such a possibility is ruled out because it is of the essence of the world that its existence is stable, given that its global retention dispositions are by their nature retained over time.

4.8 Response to the essentialist world-level universal retention dispositions proposal

I am happy to concede that, if there were world-level essential universal retention dispositions, this would ensure that arbitrary chaos will not ensue from moment to moment. The crucial question is therefore whether such world-level essences are ones that we can reasonably accept. Unfortunately, there are some reasons to doubt the plausibility of such essences, as we shall now see.

Let us begin with two worries that others have already expressed in connection with the world-essence strategy of Bigelow, Ellis and Lierse. Livanios among others complains that the explanations delivered by world-essence strategies are either ‘ad hoc’ or ‘poor explanations’ (2010, p. 302; see also French, 2014, p. 251, who voices similar concerns). And even some who advocate dispositionalism agree. For instance, after initially advocating the world-essence account of conservation laws in his 2005, Bird concludes later that the approach of Bigelow et al. is ‘ad hoc’ (2007 p. 213). Mumford (2005) also raises similar concerns about Ellis’s essentialist arguments. His basic worry is that one would not have a reason for elevating the status of a property to that of an essential property unless one *already* assumed a certain view of modality and induction (Mumford 2005, p. 424).

Now, I am not sure that the ad hoc worry is by itself fatal. What Ellis could emphasize is the Strawsonian point that the so-far non-chaotic nature of the world cries out for explanation, and so if world-level essentialism supplies the best explanation, then it could be accepted purely on that basis. This brings us to the second of Livanios’s complaints, however, which is that world essences may not in fact provide good explanations for their corresponding laws. Livanios’s remarks here are brief, but his main worry is that world-level explanations are ‘too coarse grained’ (2010, p. 302). I think this points to two related worries. The first is that world-level explanations are too easy to find and the second connected worry is that they are so general in character that they are not very informative. The basic problem here is that the world-essence strategy provides us with a method for automatically explaining any global patterns whatsoever that we could conceivably come across. But surely

providing good explanations should be more difficult than that. There remains the suspicion that different patterns ought to be explained by different parts or aspects of the world, and that by appealing to world-level essences we are not getting to the heart of the matter. On the other hand, if a more fine-grained explanation could be found for a given regularity, then the word-essence explanation would be redundant (Livanios, 2010, p. 303). Indeed, the fine-grained approach is precisely what Bird has to take after ruling out the world-level explanation of conservation. By rejecting the notion of world kinds, Bird's explanation for conservation has to appeal only to the dispositional essences of the relevant fundamental properties. Unfortunately, though, as with the other proposals we have examined, Bird's view does not offer a solution for those seeking to provide firm foundations for induction. Bird's view faces the same problem as the 'local' universal retention dispositions strategy. For even if each of the properties observed so far have conservative essences, this does not rule out future instantiations of different quantities that lack conservative essences.¹⁶

In short, although the essentialist world-level universal retention disposition strategy is perhaps the best hope for dispositional anti-Humeans seeking firm foundations for induction, there remain worries about the feasibility of the 'explanation' it offers. Moreover, it is worth noting just how strong an ability the world would have if it were to have an essential universal retention disposition. This disposition, to recall, is one that is self-retaining by its very essence. But this means that once the world comes into existence and instantiates such a disposition, it is in a certain sense invincible. As we saw earlier, it is a feature of retention dispositions that they manifest continuously, much like the example of rest mass. And unlike most other dispositions, there do not appear to be any circumstances which could possibly frustrate the manifestation of a world-level universal retention disposition. Clearly, an interfering factor cannot come in 'from the outside' so as to cause the world and its essential properties to go out of existence, because the world *just is* the totality of all concrete things that exist. Hence, if a world exists and has a universal retention disposition essentially, then it seems

¹⁶ I note also that Livanios's alternative account of conservation laws is of no help to the dispositionalists. On Livanios's account (2010), properties are categorical rather than dispositional, and symmetry principles (which entail conservation) are primitive properties of the world or its structure. See also French (2014, Ch. 9).

the world must forever retain its contents in the way that the retention disposition dictates. By ruling out arbitrary chaos, then, the dispositional anti-Humean has arrived at a surprisingly strong conclusion: that the world must continue retaining its contents forever. One could of course avoid this conclusion by allowing that the universal retention disposition is probabilistic and that it may for certain periods cease to manifest. But clearly, that would be of no help to those seeking to provide firm foundations for our predictive practices.

As a way of illustrating just how strong this position is, we may note briefly that it is incompatible with the ‘Big Crunch’ cosmological theory, which was popular until relatively recently. According to this theory, the universe will eventually start to contract, resulting in a destructive big crunch. The contraction would occur on the supposition that the gravity of the galaxies restrains the outward motion of the currently-expanding universe, therefore causing the rate of expansion to decelerate. If such expansion fell to zero, the result would be a reverse big bang. The consequences of a big crunch are unclear, but as Davies explains, it seems possible that all aspects of the world could be reduced to nothing. When describing the Big Crunch model, he writes that

... it might result not only in the obliteration of all familiar physical structures, but in the complete annihilation of the universe, including space and time. The singular termination of the cosmos would then be a symmetric reflection of the singular origin. In such a model the universe only exists for a finite duration (Davies, 1982, p. 34)

As mentioned above, the Big Crunch model is not currently popular. Indeed, current evidence suggests that the rate of the expansion of the universe is increasing rather than decreasing.¹⁷ As such, a proponent of the world-level retention view need not be concerned by the Big Crunch theory, at least for the time being. Nonetheless, it is important to note that, if the world-level retention view is accepted, it is no longer an open empirical question as to whether the world (including spacetime itself) will exist for only a finite duration. Hence, the strength of the world-level retention view should

¹⁷ For further details of the accelerating universe hypothesis, see e.g. Riess et al. 1998.

not be underestimated. If one adopts it, then one also adopts a stance on cosmological theory, and specifically the issue of whether the world could have a finite duration.

There is also another broad lesson to be drawn from this section, which is that the more an anti-Humean wants to explain, the more she will be pushed towards strong necessitarianism about various aspects of the world. Some anti-Humeans may of course be happy with this, and Alexander Bird is one dispositional anti-Humean who seems to have appreciated this point. For instance, in his 2014, Bird tentatively suggests that the world's initial conditions may have been necessary, on the dispositional essentialist assumption that they are dictated by laws which are themselves necessary. If this is right, then this may allow the dispositionalist to go a long way toward providing a complete explanation for the world's course of events. Unfortunately, though, Bird's discussion fails to address the important issue of arbitrary annihilation, and therefore does not address the problem of retention.

In sum, then, we have seen in this section that those who seek firm foundations for induction face a difficult choice. The best hope for dispositionalists seeking an illuminating account of property retention is something like the essential world-level universal retention dispositions strategy. But as we have seen, there are reasons for thinking the explanations offered by this view are ad hoc and too coarse-grained to be very illuminating. Moreover, we have seen how this view has surprising and strong implications for issues in cosmological theory. On the other hand, if it is conceded that the world's stability cannot be explained in a satisfactory way, then the dispositionalists lose a perceived advantage over Humeanism where induction is concerned.

5. Conclusions

Strawson criticises Humeanism on the grounds that it provides no reason why regularity rather than chaos occurs from moment to moment (1989, p. 21-22). Anti-Humeans such as Strawson have assumed that dispositional forces can, in contrast, help to explain the fact that our world is regular in ways that underpin our predictive practices. Unfortunately, though, the retention problem shows that, as things stand, the dispositionalist explanation is not complete.

In this paper, the most obvious naturalistic theories of property retention have been explored, and it has been argued that none of them is without problems. A natural reaction that a dispositional anti-Humean may have to all of this, and one to which I am in some ways sympathetic, is to concede that it is just a brute fact that things tend to retain their dispositions over time. This would mean, however, that dispositionalism does not have as many explanatory advantages as some like Strawson have assumed. And as has been pointed out to me¹⁸, such a concession may have negative consequences for what it is rational to believe. For if the patterns of property retention observed so far are effectively cosmic coincidences, and if we take a non-subjective approach to probability, it is difficult to see how it can be rational to believe in the existence of global regularities.

So, where do we go from here? I suspect that most fellow dispositionalists will want to stand firm and insist that property retention is necessary (in the absence of interfering circumstances). We have seen, however, that such necessity is not easy to explain. If forced to choose a winner from among the options we have considered here, it seems the essentialist world-level universal retention dispositions strategy is the least problematic. But perhaps there are further ways of grounding retention necessities that have not been considered here, and I invite dispositional anti-Humeans to undertake further work on this neglected issue. On the other hand, if an illuminating theory of retention necessities cannot be found, then perhaps the best thing for a dispositional anti-Humean to do is to take a more humble stance, epistemically speaking. Perhaps all we can say is that there must be constraints imposed by reality—being itself—such that its contents persist in a relatively stable way, even if we have little hope of theorising about what grounds those constraints or how they operate. The untenable alternative, it seems, is to accept that absolutely anything goes.¹⁹

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¹⁸ Here I am again indebted to an anonymous referee.

¹⁹ I am grateful to John Heil, who made this last point in private communication.

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