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RESEMBLANCE-BASED RESOURCES FOR REDUCTIVE SINGULARISM¹

There is no question, which on account of its importance, as well as difficulty, has caus'd more disputes both among antient and modern philosophers, than this concerning the efficacy of causes, or that quality which makes them be follow'd by their effects.

—David Hume
A Treatise of Human Nature,
Book I, Part III, §XIV

0. Introduction

Hume argued that there is no way, in line with empiricist principles, to justify commonly held beliefs in singular causal efficacy, according to which individual or singular causes *produce* their effects or *make* their effects happen:

All events seem entirely loose and separate. One event follows another; but we never can observe any tie between them. They seem *conjoined*, but never *connected*. (*Enquiry*, §VII, Part II)

At best, he maintained, we can be justified in believing in the holding of certain spatiotemporal regularities between events² of the types at issue—hence was born (or in any case suggested) the regularity theory of causation.³

Hume's discussion has inspired a multitude of accounts on which causation is a matter of more or less sophisticated patterns of events.⁴ This influence reflects common acceptance of two theses, traditionally associated with Hume. First is the broadly empiricist rejection of "the efficacy of causes" as an irreducible feature of natural reality, such that, for example, (manifestations of) intrinsic powers or irreducibly causal dispositions are rejected as being the ground of causal relations; call this *Causal reductionism*. Second is that *Causal reductionism* requires *Causal generalism*, according to which causal relations between events are metaphysically constituted,

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at least in part, by (suitably de-psychologized and appropriately sophisticated) patterns of events. Correspondingly, neo-Humean accounts of causation have typically supposed that, when event e_1 causes event e_2 , this is not metaphysically constituted by goings-on involving just e_1 and e_2 , but rather is, at least in part, a matter of these events' instantiating a causal law constituted by some broader pattern of goings-on, ranging from one involving (as on Hume's account) multiple tokens of e_1 and e_2 's types, to one involving the entire distribution of events at a world (as on Lewis's 1979 "best system" theory of laws).

I aim to argue that the second thesis (that *Causal reductionism* requires *Causal generalism*) is incorrect. Causal reductionists—indeed, Hume himself—have previously unappreciated resources for making sense of *Causal singularism*, the view that causal relations between events are metaphysically constituted only by relatively local goings-on involving those events.⁵

Why try to motivate a reductive singularism? Why not just stick with an appropriately sophisticated regularity account? Perhaps the primary reasons are epistemological: regularity theories have clear difficulties making sense of our knowledge of causal relations. One problem is that we typically do not have access to the global patterns supposed to constitute causation on any regularity account. So, to take a particularly clear case of such failure, we do not presently have access to the future patterns of instantiation that enter into constituting the laws (hence the causes) on Lewis's best system theory. Regularity theorists may maintain that we are at least sometimes in position to gain an appropriate sample of the relevant patterns (and to know that we have done so); but given the (typically) history-wide scope of the regularities at issue, such a claim isn't obviously plausible. Another problem is that regularity theories do not appropriately accommodate our abilities to identify causal relations in the absence of appropriate samples of the requisite regularities⁶—indeed, our abilities to make such identifications even when the causal relation at issue controverts our antecedent beliefs (as in Fair's 1979 case: intuitively, one could recognize a glass's breaking as causal, even if one previously thought glasses of that type were unbreakable). Such abilities additionally support the intuitive view of causal efficacy as being a productive, local matter involving individual events.

Reflecting these and other difficulties with regularity accounts, there have been attempts to reconcile *Causal reductionism* and *Causal singu-*

larism. There are two main approaches. On the first, causation is a relation between relatively local change events; more specifically (see Ducasse 1926) a cause is the entire change event immediately prior and proximate to the effect event. On the second, causation is a matter of transference of various physical quantities (Aronson 1971b and 1971a), energy (Fair 1979), or any conserved quantity (Dowe 1992 and Salmon 1994 and 1997).⁷ These accounts face difficulties of their own, however (upon which I'll later expand). Change-based and transference accounts each fail to provide an appropriately fine-grained metaphysical basis for the individuation of causes. The baseball strikes the window, and shatters it; but if light from a distant star simultaneously strikes the window, and hence is part of the change event prior and proximate to the effect, a change-based account will fail to distinguish the baseball's from the photon's impact as the cause of the shattering. Similarly for transference accounts, for (e.g.) the photon's energy is transferred to the window as well as the baseball's. Transference accounts additionally fail to make sense of ordinary attributions of macro-causation, for such attributions do not cite and seem not to presuppose transfers of the physical quantities at issue. Such difficulties have led some (e.g., Tooley 2004) to claim that any viable singularist account must be non-reductive. Singularists endorsing *Causal reductionism* thus have good reason to consider whether any previously unappreciated resources are available for making sense of their view.

Indeed reductive singularists do have such resources, thanks to a relation that has been curiously underexploited in the causation debates: resemblance. The core idea I will be exploring, on behalf of reductive singularists in particular, is that causation may be metaphysically and epistemologically indicated by *the coming-to-be of a resemblance*.⁸

I'll start (§1) by identifying comings-to-be of resemblances as experientially available even on Hume's empiricist framework, and arguing that such experiences suffice to justify (at least some) singular causal beliefs. Hence Hume was wrong to maintain that there is no way, in line with empiricist principles, to justify commonly held beliefs in singular causal efficacy. Why go back to Hume for purposes of motivating attention to resemblance as relevant to (in particular, singularist) causation? Three reasons. First, Hume's empiricist framework is strict and straightforward; if we can make sense of reductive singularism here, we can likely do so anywhere. Second, certain key elements in this framework—resemblance

and spatiotemporal priority and proximity—are just those sufficient to justify (albeit fallibly) belief in the presence of a singular causal relation. Third, given how influential Hume’s discussion has been in motivating *Causal generalism*, there is contemporary as well as historical interest in seeing just where Hume’s argumentation for generalism goes off the rails.⁹ (That said, one may cut to the contemporary chase in §2 without too much loss of continuity.)

I’ll then (§2) kick away the epistemological and experiential ladders (just as contemporary regularity theorists do), and consider whether and how comings-to-be of resemblances might enter into a metaphysical account of singularist causation, via a thesis I call *Resemblance-based causation*. As we’ll see, the conditions in this thesis are ubiquitously satisfied; however, mere comings-to-be of resemblances are unlikely to serve, by themselves, as either necessary or sufficient for causal relations.

Nonetheless, I’ll argue (§3), comings-to-be of resemblances provide valuable resources for the reductive singularist. The main objections to existing singularist accounts, mentioned above, indicate that change-based and transference accounts also fail to provide sufficient reductive bases for causal relations. However, when either changes or transfers are combined with comings-to-be of resemblances, these objections can be avoided, and sufficiency appears to be gained.

This result gets the reductive singularist partway towards their goal, in establishing that at least *some* causal relations satisfy both *Causal singularism* and *Causal reductionism*. I’ll finish up (§4) by suggesting how this result may be bootstrapped into general warrant for reductive singularism.

1. Hume’s Resemblance-based Resources for Singularism

1.1 The elements of Hume’s empiricism

Hume’s empiricist framework is familiar, but it bears recalling what he (hence we, in this section) have to work with. In Hume’s idea-istic terms: every idea is either a simple idea, originating in either sensory or introspective experience, or a complex idea ultimately composed of such simple ideas, where the modes of composition involve certain “associative principles” (which may operate in tandem): resemblance, contiguity in place or time, and cause and effect. Though the imagination has free rein to combine

simpler ideas in accord with these principles, beliefs—in particular, *justified* beliefs—involving either simple or complex ideas must ultimately be traceable to experience involving these combinatorial elements (roughly: involving observable objects or events standing in relations corresponding to the aforementioned associative principles). The bulk of Hume’s investigations, then, are directed at investigating whether experiences conforming to these elements are up to the task of justifying various of our beliefs—in space and time, material substance, the self, and so on.

In setting out his framework in the *Treatise*, Hume acknowledges that he has more to do in elucidating the associative principle of cause and effect. Hence, after arguing (Part II) that our beliefs in space and time can be justified by appropriately complex experience of objects or ideas combined via the uniting principle of spatial or temporal contiguity, he goes on (Part III) to conduct this deeper examination:

To begin regularly, we must consider the idea of *causation*, and see from what origin it is deriv’d. . . . Let us therefore cast our eye on any two objects [events], which we call cause and effect, and turn them on all sides, in order to find that impression, which produces an idea of such prodigious consequence. (§II)

Hume then proceeds to argue that no relatively local or singular experience of this sort is sufficient to provide content to the idea of causation—nor consequently (and more to the ultimate point) to justify causal beliefs.¹⁰

1.2 Hume’s argument against singular causation

Hume’s argument against our having justified singular causal beliefs (that is, causal beliefs based only in relatively local, or singular experiences) is an argument by cases which is fine so far as it goes, but which ignores a crucial case. It is worth briefly rehearsing Hume’s argument, both to make the gap explicit, and to register certain common empiricist concerns, which will not attach to the case filling the gap.

Hume first considers whether causal beliefs are justified by experience of some monadic property of a causal relatum (e.g., a causal “glow”) distinguishing it as such; no, he says, for there is no such property common to all causes, or to all effects. Hume’s reasoning here is flawed, since the status of an event as causal may be flagged in more than one way

(say, by either a causal glow or a causal spark). But no matter: even allowing for multiple monadic “flags,” Hume is right that we do not experience any such flags.

Nor, Hume continues, can singular causal belief be grounded in experience of “some *relation* among objects [or events].” Spatial contiguity and temporal priority are typically in place when one event causes another, but since “[a]n object may be contiguous and prior to another, without being consider’d as its cause,” something more is required for causation.¹¹ Unfortunately, Hume goes on, there is nothing else in experience of “any single instance of cause and effect” that might distinguish the relata as such:

Motion in one body is regarded upon impulse as the cause of motion in another. When we consider these objects with the utmost attention, we find only that the one body approaches the other; and that the motion of it precedes that of the other, but without any sensible interval. ’Tis in vain to rack ourselves with *farther* thought and reflexion upon this subject. We can go no *farther* in considering this particular instance. (§II)

He concludes that causal belief is not justified by experience either of “the *known qualities* of objects [or] their *relations*.” This is incorrect, as the neglected case will witness. However, interpreted as the claim that our causal beliefs are not justified by experience of any characteristically causal properties and relations—not only of any causal “glow,” but of any causal “glue”—Hume’s conclusion seems correct.

Hume next considers whether singular causal beliefs might be justified by one or other kind of inference. First, he argues, such beliefs cannot be grounded in demonstrative (more generally, *a priori*) inference, from the existence of the cause (in particular) to the existence of the effect: if such beliefs were so grounded, we would be unable to conceive of their negations; but we can, so they aren’t. One might have qualms about Hume’s reasoning to this conclusion (which assumes, among other now-controversial theses, that conceivability is a sure guide to possibility); but it is after all very plausible that we cannot, by *a priori* consideration of objects “in themselves,” determine what effects these objects will have when placed in various circumstances.

Second, he argues, such beliefs cannot be justified by means of an inference to the best explanation. Any such inference goes beyond the allowed experiential elements and their combinations; on his strict em-

piricism “reason alone can never give rise to any original idea.” This restriction rules out any and all accounts on which singular causal beliefs are somehow grounded in “the secret force and energy of causes,” as located in unexperienced powers, substantial forms, virtues, faculties, God’s efficacy, or some external correlate of our introspective experience of will: all of these “are not in reality any of the known properties of bodies, but are perfectly unintelligible and inexplicable.” To be sure, contemporary empiricists typically do not follow Hume in rejecting inference to the best explanation; but as per *Causal reductionism* they will agree with him in not countenancing any such inferences to the existence of irreducibly modal features.

Considering other options to be equally unsuccessful variations on these themes, Hume concludes that there are no justified singular causal beliefs; then compensates with his deflationary positive proposal, on which beliefs in causation result from “accustomed union”—that is, in *repeated* experience of entities of the relevant types standing in the aforementioned spatiotemporal relations. Such repeated experience cannot resurrect justified belief in singular causal relations, though it does provide a basis (via feelings of expectation engendered by psychological “imprinting”) for explaining why we, in Hume’s view, mistakenly thought causation involved such relations.

1.3 The neglected alternative: resemblance-based causation

Hume’s argument by cases fails to consider an alternative source of the justification of singular causal beliefs compatible with his empiricism—and more generally, with *Causal reductionism*.

Recall that on Hume’s framework, beliefs may be justified by complex experiences involving objects or events standing in the resemblance, spatiotemporal contiguity, and/or causation relations. Given *Causal reductionism*, causal relations must be reducible to non-causal properties and/or relations. As above, Hume is right that neither monadic properties nor spatiotemporal relations can (alone) serve as such a reductive base. Curiously, however, Hume does not consider whether *resemblance* might, either alone or in combination with other non-causal properties or relations (e.g., spatiotemporal relations), be capable of doing so.

Hume’s treatment of space and time (Part II) provides a model for the alternative view. Returning to Hume’s idea-istic terms for a moment: par-

ticular ideas of space and time are complex ideas, arising from experience of sequences of impressions involving spatial contiguity and from temporal sequences of impressions or ideas, respectively. Hence it is that:

The ideas of space and time are therefore no separate or distinct ideas, but merely those of the manner or order, in which objects exist.

I'll now argue that singular causal beliefs may also be justified, in accord with Hume's standards, by experience reflecting a certain kind of "manner or order" in which events (or their constituents) exist—where the manner in question primarily involves *resemblance*, rather than spatiotemporal relations (though these will typically also make an appearance in experience of the sort in question).

1.4 Causes that produce resemblances

Consider the following sequence of events ("the cookie cutter sequence"):

1. I roll some cookie dough onto my kitchen counter, then take a star-shaped cookie cutter out of my kitchen drawer. At time t_1 , I observe that cutter and dough are not in spatiotemporal contact (that is, are not in spatial contact at that time) and that cutter and dough fail to resemble in respect of having a star-shaped part.¹²
2. At time t_2 ($> t_1$) I press the star-shaped cookie cutter into the dough, and observe that cutter and dough are in spatial contact.
3. At time t_3 ($> t_2$), I lift away the cutter, and observe that cutter and dough are not in spatial contact, and that cutter and dough resemble in respect of having a star-shaped part.

The individual experiences in each of (1), (2), and (3) are compatible with Hume's framework, and together constitute a complex experience E . I claim that such a complex experience, involving a *spatiotemporally mediated coming-to-be of a resemblance*, suffices to justify belief in the holding of a singular causal relation having the general content that, on the occasion in question, some entity's having a certain feature and coming into spatial contact with some other entity made the latter come to have that feature.¹³

More specifically, I claim that *E* (subject to a proviso concerning background information) justifies a belief with content *C*:

C: On the occasion in question, the (event of the) cutter's having a star-shaped part coming into contact with the dough (that is, the cause event) made happen or produced (the event of) the dough's coming to have a star-shaped part (that is, the effect event).

Why think that experience *E* justifies a belief with content *C*? Hume does not provide a criterion for when experience justifies belief; when he aims to show that a given belief is so justified, he simply describes some or other experiences as plausibly doing the job. However, Hume's discussion (and more generally, attention to the sort of contents that empiricists take experience to justify) suggests the following sufficient condition on an experience's justifying a belief with a given content:

Reasonable judgment: An experience *E* had by a subject *S* at or during a temporal interval *t* justifies a belief with content *C* (as held by *S*) if absent *S*'s having reason to think their experience cannot be taken at face value, *S* would be subsequently reasonable to judge that *C* was the case at or during *t*, and unreasonable to judge that *C* was not the case at or during *t*, or to remain agnostic on this score.

(The condition is expressed so as to allow that *S* might not end up judging one way or another. Of course various conditions need to be in place in order to appropriately apply *Reasonable judgment*: *S* must have access to *C*, understand its constitutive concepts, be able to competently judge, and so on.) This criterion brings to bear the standard of what it is *prima facie* reasonable to judge (hence believe) as a result of having certain experiences; while somewhat vague around the edges, it is considerably more precise than a criterion appealing simply to brute intuition as regards what beliefs experience may justify.¹⁴

Reasonable judgment makes sense of the usual empiricist claims regarding what contents (in particular, observational) experience may justify. For example, consider an experience involving observation of a red apple on a table at time *t*. Absent reason to think their experience cannot be

taken at face value (e.g., because hallucinating or seeing a hologram, etc.), it would be reasonable for the observer to subsequently judge that there was a red apple on the table at t , and unreasonable for them to judge that there was no red apple on the table at t , or to remain agnostic on this score. Hence *Reasonable judgment* confirms the empiricist supposition that experience of a red apple on a table at t justifies the belief that there is a red apple on the table at t . Moreover, the application of *Reasonable judgment* to this case does not condone contents that would be unacceptable to an empiricist; for example, the observer would not be unreasonable to subsequently judge that the apple had no secret causal powers at t , or to remain agnostic on this score. For another example, consider an experience involving observation of two apples, one red and one green, on a table at time t . Absent background information of relevantly the same sort as above, it would be reasonable for the observer to subsequently judge that the apples did not resemble in respect of color at t , and unreasonable for them to judge that they did so resemble, or to remain agnostic on this score. (And *vice versa*, as regards resemblance in respect of shape.) Again, these configurations of what it would be reasonable and unreasonable to judge confirm the typical empiricist supposition that experiences of the sort in question justify beliefs of the sort in question. And again, such applications of *Reasonable judgment* do not condone empirically unacceptable contents. The same promises to be true for experiences and corresponding beliefs that entities are spatially or temporally extended, are touching, and so on. *Reasonable judgment* thus appears to provide a systematic means of identifying what beliefs are justified by a given experience, in conformity with the usual empiricist take on such justification.

Now suppose that a person observes the cookie cutter sequence E . Then, it seems clear, *Reasonable judgment* supports taking C (defined as above) to be justified by E . For absent reason to think their experience cannot be taken at face value, it is clear that, given E , it would be reasonable for the observer to judge that, on the occasion in question, the cutter's having a star-shaped part coming into spatial contact with the dough made the dough come to have a star-shaped part, and unreasonable for them to judge that, on the occasion in question, the cutter's having a star-shaped part coming into spatial contact with the dough did not make the dough come to have a star-shaped part, or to remain agnostic on this score.¹⁵ In particular: absent relevant background information, it would intuitively

not be reasonable for the observer to maintain that (or remain agnostic concerning whether) the cutter's having a star-shaped part coming into spatial contact with the dough *had nothing to do with* the dough's coming to have a star-shaped part, or that the latter sequence of events was *only a coincidence*.

So there is principled empiricist support for taking *E* to justify *C*. Moreover, there isn't any reason for an empiricist to deny that *E* justifies *C*, for *C* is entirely unproblematic, even by Hume's strict lights. In particular, *C* doesn't incorporate or entail any of the features that empiricists, old and new, reject:

- It is no part of *C* that the causation at issue involves unobservable causal elements: causal glow, causal glue, unobservable influxes or energies, species, substantial forms, and other sorts of entities that Hume didn't think exist, are no part of this content; nor are intermediary forces, necessitating universals, essential dispositions, and other sorts of entities that neo-Humeans don't think exist.
- It is no part of *C* that, either before or after experience of the cookie cutter sequence, one could establish *a priori* that, upon contact with the dough, the cutter would produce the effect it did.
- It is no part of *C* that, in other cases where a star-shaped cookie cutter comes into contact with dough, it *must*, as a matter of (nomological, metaphysical, or other) necessity, cause the dough to have a star-shaped part. *C* expresses only that one event made happen or produced another event *on the occasion in question*, hence is silent on any further, distinctively *modal* claims.¹⁶
- Since, as per the previous observations, no modal connection is part of *C*, no *irreducible* modal connection is part of *C*. Hence *Causal reductionism* is served.

It is worth expanding on the last observations. Of course, the content of *C* trivially entails the modal claim that the goings-on it expresses are possible (because, by hypothesis, actual); but this much modality is obviously reducible to actual matters of fact. What concerns Humeans is irreducible *necessary* modal connection between causally related entities.

The last observations allay this concern: since no necessary modal connections are part of *C*'s content, no irreducible such connections are part of this content.

The last observations moreover develop and confirm Anscombe's (1971) remarks:

[C]ausality consists in the derivativeness of an effect from its causes. This is the core, the common feature, of causality in its various kinds. [But] if *A* comes from *B*, this does not imply that every *A*-like thing comes from some *B*-like thing or set-up or that every *B*-like thing or set up has an *A*-like thing coming from it; or that given *B*, *A* had to come from it, or that given *A*, there had to be *B* for it to come from. Any of these may be true, but if any is, that will be an additional fact, not comprised in *A*'s coming from *B*. If we take 'coming from' in the sense of travel, this is perfectly evident. (92)

As Anscombe notes, Humeans typically resist this line of thought on grounds that travel, unlike causation, is observable in the single case:

'But that's because we can observe travel!' The influential Humean argument at this point is that we can't similarly observe causality in the individual case. So the reason why we must connect what we call the cause and what we call the effect . . . must lie in the fact that the succession of the latter upon the former is of a kind regularly observed. (92)

Indeed, Anscombe is right (as Hume granted is intuitive) that the core of causality consists in effects coming from their causes (equivalently: in causes making their effects happen), and that some senses of 'coming from' carry no implication of necessary (much less irreducible necessary) connection. Still, the analogy to travel (involving changes in spatial relations) does not make clear sense of a distinctively *causal* sense of 'coming from', that is similarly observable and non-modally implicated. Anscombe insists that singular causal relations are observable ("is cutting, is drinking, is purring not 'efficacy'") but without specification of which features of the singular situation reasonably suffice to indicate causal "coming from," the Humean will remain unconvinced. It is precisely here that (spatiotemporally mediated) comings-to-be of resemblances play a key and seemingly crucial role, in providing the desired "Hume-friendly" specification of causal coming-to-be.

To sum up: nothing prevents an empiricist, even of Hume's strict variety, from allowing that *E* justifies *C*. This is a good thing, since as above it would be unreasonable (absent reason to think one's experience cannot

be taken at face value) to judge that *C* was not the case, or remain agnostic on whether *C* was the case, having experienced *E*. But *C* is a singular causal belief, expressing that one event made another event happen.

As I'll expand on shortly, causes that produce resemblances are ubiquitous. For the present, we can note that Hume's paradigm "billiard ball" case of causation, whereby a moving billiard ball strikes a stationary ball, and causes the latter to move, falls under this rubric. Recall Hume's words:

Motion in one body is regarded upon impulse as the cause of motion in another. When we consider these objects with the utmost attention, we find only that the one body approaches the other; and that the motion of it precedes that of the other, but without any sensible interval. 'Tis in vain to rack ourselves with *farther* thought and reflexion upon this subject. We can go no *farther* in considering this particular instance.

On the contrary, we can go *farther* in considering this particular instance, by means of observing the *coming-to-be* of a resemblance—here, in respect of motion (or some aspect of motion), between (constituent objects of) the cause and effect events in question.

Of course, to establish that some causal beliefs are justified by singular experiences is not to establish that all causal beliefs are so justified. Indeed, it seems likely that many causal beliefs, singular or otherwise, are not grounded in comings-to-be of resemblances (as when, e.g., the flipping of a switch causes a light to go out). But for purposes of showing that Hume's discussion fails to establish (more precisely, fails to suggest, upon kicking away the experiential ladder) that *Causal reductionism* requires *Causal generalism*, it is not necessary to establish the broader claim. Relatedly, that singular experiences of comings-to-be of resemblances provide a specific basis for resisting Hume's general argument for generalism is enough to motivate attention to resemblance as a useful resource for reductive singularists.

A different sort of difficulty might be thought to stem from the fact that experiences of spatiotemporally mediated comings-to-be of resemblances do not infallibly guarantee the holding of the indicated singular causal relation. The concern here is not infallibility *per se*: as previously observed (note 14), an empiricist cannot maintain that justification requires infallibility without giving up justified belief in ordinary objects and events. It is rather that, if infallibility is not required for justification, then why move to either regularities or resemblances as indicative of causation? Why

not just take singular experience of temporal priority and spatial proximity to justify, albeit fallibly, belief in singular causal relations?

But unlike singular experience of comings-to-be of resemblance, singular experience of spatiotemporal priority and proximity is not plausibly seen as justifying (even fallibly) belief that the prior entity *made* the posterior entity happen. Singular spatiotemporal relations are simply too “loose and separate” to justify (or for that matter, inspire) causal beliefs. It is evident that objects and events end up next to each other for all kinds of non-causal reasons (night follows and is contiguous with day, and so on); and even if some causation is often in the vicinity of such relations (as when a new stapler ends up on my desk) it is typically not the case that the prior proximate entity has caused the other. In other words: even taking our experience at face value we have no reason to think that singular spatiotemporal relations are typically (if fallibly) indicative of a causal relation.

Not so with comings-to-be of resemblances. The order and manner of such singular experiences is strongly suggestive of a non-accidental, productive connection—precisely the sort characteristic of (what Hume admitted was) our intuitive understanding of causation. And indeed, comings-to-be of resemblances are typically correctly indicative of causal relations holding between the entities involved: I walk on the beach and leave a trail of footprints in the sand, the movements of my pen leave resembling marks on the page, and so on. What would be unusual would be a spatiotemporally mediated coming-to-be of a resemblance not involving causal relations between the entities that come to resemble. Hence it is that singular experiences of comings-to-be of resemblances can do what singular experiences of priority and proximity cannot do: plausibly and naturally give rise to and, more importantly, justify the associated causal beliefs.

2. *Resemblance-based Causation*

I have argued that even a strict empiricist like Hume could accept that some causal beliefs may be justified by singular experience—in particular, of spatiotemporally mediated comings-to-be of resemblances. I now want to cut to the contemporary chase and consider what bearing this epistemological and experiential result has on the viability of a metaphysical singularist account of causation compatible with *Causal reductionism*.

Let’s start by kicking away the epistemological and experiential ladders, just as regularity theorists taking Hume as inspiration do. This task is

straightforward, since the holding of resemblance and spatiotemporal relations are, after all, objective matters. We can correspondingly consider the degree to which comings-to-be of resemblances might enter into a metaphysical account of causation. To fix ideas, let's focus on the following thesis, expressing more precisely the conditions holding in cases of resemblance-producing causation:

Resemblance-based causation: Event c causes event e if and only if (i) c is temporally prior and spatially contiguous to e ; (ii) some constituent e_1 of c has feature F ; (iii) c involves e_1 's coming into spatial contact with some constituent entity e_2 of e ; (iv) prior to spatial contact, e_2 fails to resemble e_1 in respect of F (either by not existing or by failing to be F); and (v) after spatial contact, e_2 resembles e_1 (as it was before contact) in respect of F .

Some preliminary points of clarification:

- *Resemblance-based causation* presupposes that entities resemble (or not) in virtue of sharing (not sharing) properties. As such, the presupposed relata of the resemblance relation may be any property-bearing entities (though in the usual case these will be objects or substances—billiard balls, windows, waves, or the like). So far as what sorts of properties/resemblances are presupposed: as per usual in contexts pertaining to natural phenomena these must be non-gerrymandered and more generally such as to cut nature at its (fundamental or non-fundamental) joints; it may also be, though I will not pursue this avenue here, that (at least typically) the comings-to-be of resemblances are in respect of not just natural, but moreover intrinsic, features. Also as per usual, nominalists are invited to translate property talk into their preferred idiom.¹⁷
- Reference to the holding or failing to hold of the given resemblance could be written in terms involving just the havings or not havings of F ; but this would serve no metaphysical advantage (the having of properties and the standing in resemblances going hand-in-hand), and would be less illuminating, in failing to make explicit what is common among the cases at issue—namely, the coming to be of a resemblance.

- Note that the qualifier ‘as it was before contact’ in condition (v) makes room for cases where, after contact, the constituent entity e_1 stops being F , as when a moving billiard ball hits a stationary billiard ball and then stops: here there is still a coming-to-be of a resemblance between e_1 as it was before contact (namely, moving) and e_2 as it is after contact (namely, moving).

Resemblance-based causation is a strong thesis—too strong, for as I’ll shortly argue the stated conditions (even clarified and qualified) are neither necessary nor sufficient for causation. Still, causes that produce resemblances as per *Resemblance-based causation* are ubiquitous. I’ve mentioned some cases previously: after contact, the stationary billiard ball comes to resemble the ball that strikes it in respect of motion; I walk on the beach, and leave a trail of footprints in the sand; a pen writing on paper leaves behind marks shaped like the preceding movements of the nib. Examples can be indefinitely multiplied: the bullet hits the target, and leaves behind a hole resembling the bullet’s cross-section in both shape and dimension; the bread comes to resemble the interior of the oven in respect of temperature; after contact, one subatomic particle comes to resemble another in respect of possession of a certain quantity of energy or momentum;¹⁸ and so on. Some such complex events might be best understood as involving chains of simpler events which pairwise satisfy the conditions in *Resemblance-based causation*; I won’t pursue such refinements here.

Another wide class of cases where resemblance-producing causes are clearly at issue involves intentional mental causation. Suppose I form the intention to cook some pasta. When later I find myself cooking some pasta, this is reasonably supposed to be (and is unreasonably supposed not to be) the product, on that occasion, of my previous intention. Here again there is a coming-to-be of a resemblance: at first the idea of my cooking some pasta did not resemble my situation in the world; later, after spatiotemporally locating myself in an appropriate situation, idea and actuality came to resemble. Unlike in the previous cases, this coming-to-be of a resemblance is not obviously spatially mediated (our intentions do not obviously “touch” the world). This suggests, perhaps, that the coming-to-be of a resemblance (at least in some reasonable vicinity of the locus of the cause event) may *itself* suffice for resemblance-based causation (in

which case we might follow Hume in ultimately dispensing with spatial contiguity as a necessary component of causal relations). Alternatively, one might try to make out that spatial contiguity is in place, after all.

Though resemblance-producing causes are ubiquitous, I have said that it is unlikely that all experience of causation involves the coming-to-be of resemblances, and the same is true for any objective correlate of such experience. To be sure, it might be that some causal relations that initially seem not to involve comings-to-be of resemblances really do so. So, for example, though the application of heat might seem not to resemble the melting of the ice, a deeper understanding of the processes of heating and melting (e.g., in terms of mean molecular kinetic energy) may reveal the coming-to-be of a resemblance (cf. Rieber 2001, 59) or, more generally (and to anticipate the discussion of transference accounts in §3.3), perhaps most or all causal relations involve the comings-to-be of resemblances in respect of (transferred amounts of) conserved quantities. But for reasons I'll expand on in §4, the success of the present project does not depend on all causation's being resemblance-based; so here I take for granted that the conditions in *Resemblance-based causation* are not necessary for causation.

Might comings-to-be of resemblances be sufficient for causation? There are three reasons to think not, in order of increasing concern. The first is that resemblance is too easy to come by, since "it is a philosophical truism that everything resembles everything else in some way or another."¹⁹ The flexibility of resemblance does not in itself, however, pose any threat to the sufficiency of *Resemblance-based causation*. What this hypothesis supposes is sufficient for singular causation is the *coming-to-be*, not the mere holding, of a resemblance. These comings-to-be involve changes in (the having of) certain features, which constrain the respects of resemblance at issue: what is required is that initially certain entities, constituent of cause and effect events, do not resemble; and that later (typically, after spatiotemporal contact) they do. As such the mere presence of standing resemblances between (constituent entities of) cause and effect events, no matter how numerous, does not itself undermine the sufficiency claim in *Resemblance-based causation*.

Somewhat more specifically, the respects of resemblance at issue in a given case of resemblance-based causation are constrained by facts

about what features of the constituent object(s) of the effect event underwent change: it is the *shape* of the dough which changes upon contact with the cutter; it is the *size* of the balloon which changes upon being inflated; it is the *charge* of the sphere which changes upon contact with the wire, and so on. Again, standing resemblances are irrelevant. The relevant respects of resemblance in a given case are moreover constrained by which such changes are characteristic of the effect at issue; as we'll see, changes occurring in the same spatiotemporal region might be associated with different effects.

A second, more pressing concern about sufficiency also appeals to the flexibility of resemblance.²⁰ Consider the case of the singer whose high-pitched singing of the word "shatter" results in the breaking of the glass. Here one wants to rule out the (event citing) semantic properties of (constituents of) the singing as causing the breaking; but we might suppose, for hypothesis, that these properties resemble some of the properties of (constituents of) the breaking (perhaps meanings are complex structures in semantic space that abstractly resemble the relevant goings-on in physical state space). The general concern here is that events and their constituents can come to share properties at many levels of grain, so that the conditions specified in *Resemblance-based causation* will again make room for too many causes.

The response here starts by again noting that the resemblances relevant to identifying resemblance-producing effects will be constrained by facts about what features of the constituent object(s) of the effect event underwent change, then moreover notes that these features will themselves occupy a specific "level of grain," such that resemblances reflecting different levels of grain will not be relevant to identifying the causes at issue.²¹ For example, in the case of the singer, the physical structures at issue in breakings are quite specific, citing quantities like mass-energy, momentum, and so on. Even supposing, then, that there is a level of grain at which the semantic and physical structures resemble, the constituent entities of the associated events will not resemble in the distinctive respect(s) F (F_n) characteristic of the breaking; so *Resemblance-based causation* will not identify the event citing the meaning of the sung word as a cause of the shattering. (That said, there is no in-principle problem with events citing semantic properties' being efficacious vis-à-vis breaking events, and the like: that's just how spells would work.)

There remains, however, a compelling reason to deny the sufficiency claim. Consider Castañeda's (1984, 20) variation on Hume's billiard ball case, as summarized by Ehring (1997):

Billiard ball *A* is moving toward a stationary billiard ball, *B*. At the moment of contact a mechanism under the table stops *A* and prevents *B* from moving. At that same time another mechanism releases *B* and causes *B* to move in just the way it would have had the collision taken place. (164, fn. 10)

As Ehring notes, Castañeda offers this case as (when reproduced) a counterexample to a Humean conception of causation, but it is also a counterexample to a conception taking (even spatiotemporally mediated) comings-to-be of resemblances as sufficient for singular causal relations: after all, in Castañeda's case, there is a spatiotemporally mediated coming-to-be of a resemblance, but by hypothesis no causation between the associated events. For another example, a pen writing through carbon paper; here the lower sheet comes to resemble the intermediate sheet in respect of being inscribed by a certain shape, but the intermediate sheet's having an inscription of a certain shape doesn't cause the lower sheet to do so.²² Appeals to constraints on the relevant resemblances won't help here, since the events competing for producing the resemblance each appear to have the feature *F* whose coming-to-be is characteristic of the effect. So I also propose to grant that comings-to-be of resemblances do not (at least not by themselves; see §3.2 and §3.4) serve as a sufficient reductive basis for singular causal relations; again, this won't matter for present purposes.

To sum up so far: while the conditions at issue in *Resemblance-based causation* are ubiquitously satisfied, these conditions do not appear (at least, not obviously) to be either necessary or sufficient for causation.²³

3. *Resemblance-based Resources for Reductive Singularists*

Nonetheless, as I'll now argue, comings-to-be of resemblances can play an important, and perhaps crucial, role in vindicating reductive singularism. The main objections to existing singularist accounts are intended to show that these accounts also fail to provide a sufficient reductive basis for causation. However, as we'll see, in combination with comings-to-be of resemblances, both change-based and transference accounts can avoid these objections, thus gaining sufficiency for a wide swath of causal relations.

3.1 Change-based accounts

Ducasse (1924 and 1926) was concerned, as I am here, to establish the viability of (what we might call) Humean singularism, by showing that singular causal relations might be constituted by elements acceptable even to a strict empiricist. In addition to priority and proximity, Ducasse appealed to our abilities to observe changes—that things are first one way, and then another—which experiences are both appropriately reductive and (relevant to the properly metaphysical project) amenable to being objectified. Roughly, on Ducasse’s account, a cause is the change event immediately prior and spatially contiguous to an effect event. More specifically (along lines of his 1926, 59):

Event *c* causes event *e* if (1) change *c* occurred during a time and through a space terminating at the instant *i* at the surface; (2) change *e* occurred during a time and through a space beginning at the instant *i* at the surface; (3) no change other than *c* occurred during the time and through the space of *c*, and no change other than *e* during the time and through the space of *e*.

Perhaps the primary objection to Ducasse’s account is that it cannot individuate causes in an appropriately fine-grained way (see Tooley 1977, 287 and Ehring 1997, 8).²⁴ One concern here is that there is no evident means of individuating *c* qua “change event” so as to avoid identifying it with an inappropriately large temporal segment (tracing back from instant *i*). But even supposing *c* can be appropriately temporally restricted, a more pressing concern remains; namely, that causes are more finely individuated than events, understood as spatiotemporal regions containing a change. As Tooley (1977) notes:

Causation is not just a relation between the totality of states of affairs existing during some interval, and terminating at some surface at some instant, and the totality of states of affairs beginning at that surface and at that instant, and existing throughout some interval. Causation is a relation that holds between different parts of two such totalities. Thus . . . if a brick strikes a window at the same time that sound waves emanating from a canary do, one wants to be able to say that it is the brick’s striking the window that causes it to shatter. But this is precluded by Ducasse’s analysis. (287)

In Ehring’s (1997) terms, “Ducasse’s definition does not distinguish between causally relevant and irrelevant changes in the situation preceding [the effect]”

(8). A related difficulty, not usually highlighted, is that effects are also typically more fine-grained than Ducasse's account allows: not every aspect of a given posterior change event may be relevant to its being an effect.

Ducasse raises the objection concerning fine-grained causes against himself,²⁵ and responds by distinguishing two senses of 'cause': one applicable to causal attributions of events understood as tokens, and another, applicable to causal attributions of events understood as types:

[T]he expression 'the cause of the breaking of this window' has two senses, one strict, and the other elliptical. In the strict sense, it means 'the fully concrete individual event which caused all the concrete detail of this breaking of this window'. In the elliptical (and indeed more practically interesting) sense, it means 'that which the cause of this breaking of this window has in common with the individual causes of certain other individual events of the same sort'. (135)

This distinction provides the means, Ducasse claims, to more finely individuate causes:

Thus, if we say that the impact of a brick was the cause of the breaking of the window, and that the song of the canary had no part in it, [this] is not to say that it was not part of what did then and there suffice; it *is* to say only that in *another* case, otherwise similar, where the song did not occur, an effect of the *same sort*, viz. breaking, nevertheless did occur. (134)

Ducasse's response is not satisfying, however, either in general or for purposes of vindicating singularism.

First, Ducasse's response is generally unsatisfying, for nothing in the objection hinges on the type/token distinction as applied to causes or effects. Related to Fair's observation that we can recognize a sequence as causal without knowing or presupposing the holding of a law, we can identify some part *c* of a change event as being the cause of a given effect without knowing or presupposing anything about whether events of the same type as *c* would cause a similar effect.²⁶

Second, the specific means by which Ducasse proposes to accommodate fine-grained causes will not satisfy a singularist. To narrow down the coarse-grained options, Ducasse appeals to variations on the theme of Mill's methods, whereby situations similar to the initial situation in certain respects but different in other respects are produced, in order to identify what aspects of change events of type *c* are necessary to producing effects of type *e*. Ducasse also appeals to such experimental strategies in order to overcome the secondary difficulty that, by lights of a change-based account,

we may easily go wrong in our causal attributions, since we are typically not in position to know (by observation or any other singular route) whether *c* and *e* were the *only* changes to occur in their respective regions.

There are different ways of interpreting Ducasse's appeals to experimental method, but neither makes sense so far as establishing singularism is concerned. The appeal to variability in order to identify which features of the original situation are *necessary* to the effect suggests that ordinary causal attributions involve a counterfactual aspect. Reflecting on his earlier (1984) implementation of a similar strategy against a similar objection, Salmon (1994) says:

For example, a solidly hit baseball and an atmospheric molecule, say nitrogen, strike a glass window almost simultaneously. It may be tempting to say that the baseball caused the window to shatter, not the nitrogen molecule, because the window would not have shattered if it had not been struck by the baseball. But this analysis is unacceptable if we want to avoid counterfactuals. (303)

Indeed, the singularist has good reason to avoid counterfactuals as needed to make sense of causal attributions; for it is uncontroversial that the truth-conditions of counterfactuals (at least, those pertaining to natural phenomena) require appeal to causal laws.

Alternatively, Ducasse's appeal to experimental method might be directed at identifying what features of the original situation are regularly or modally sufficient to producing the effect. But that regularities, even experimentally controlled ones, are required to make sense of standardly fine-grained causal attributions on Ducasse's account undermines this account's singularist credentials; as Sosa and Tooley (1993) note, "The problem now, however, is that this account seems to differ only terminologically from a Humean account of causation" (18). Relatedly, such a concession to regularity theories threatens to reintroduce what is arguably the primary objection to regularity accounts—namely, that we are typically not in position to establish that the requisite regularities are in place, even given world enough and time.

To sum up: that Ducasse's account does not accommodate standardly fine-grained causes indicates that changes alone (even spatiotemporally mediated ones) do not serve as a sufficient reductive basis for singularist causation. Moreover, Ducasse's attempt to achieve the desired fine-grained

individuation ultimately relies on either counterfactuals or regularities, undermining his singularism.

3.2 Resemblance-based Resources for Change-based Singularism

The above difficulties are not insuperable, however. Comings-to-be of resemblances provide resources enabling Ducasse and any other change-based theorists there might be to accommodate more fine-grained individuation (and confirmation) of causes. There is no barrier, of course, to Ducasse's accepting that causation may sometimes involve comings-to-be of resemblance, for such comings-to-be are themselves changes, whose spatiotemporal mediation (assuming it is needed) satisfies his conditions. As I'll now argue, with resemblance on the scene, Ducasse has a clear means of distinguishing between the relevant and the non-relevant "parts" of the change events associated with causal relations, without appeal to either counterfactuals or regularities.

Let's start with the coarse-grained change event that, on Ducasse's account, is identified with the effect. Such a change event will be constituted by one or more entities having undergone one or more specific changes, in respect of one or more features F (F_n). Such specific respects of change provide a basis for fine-grained individuation of effects; hence even prior to attention to resemblance Ducasse arguably had resources to individuate effects more finely than in terms of "entire change events."

Where resemblance seems crucially useful is in providing resources for more finely individuating the cause(s) of a given effect. Suppose for simplicity that the effect event is characterized as involving a single change, whereby an entity e_2 comes to have feature F . What caused the effect? In cases (which are, as noted, ubiquitous) where the conditions in *Resemblance-based causation* are met, a change-based singularist can answer: the cause was the prior and proximate change event having a constituent e_1 that was (prior to contact with e_2) F . Such a cause will be the relevant part of the entire change event prior and proximate to the effect.

So, for example, consider the brick/canary song case. In fact, in this as in most cases of causation there are many features (salient experientially and/or theoretically) characterizing the event standardly (finely) individuated as the effect. Among the characteristic features of the shat-

tering are: that it starts in a region co-located with the spatial profile of the brick upon impact; that portions of the shattered glass are “carried along” by the brick as it moves through the window; that the momentum gained by the glass after impact is very different from its previous momentum, and is approximately²⁷ the same as that which the brick loses after hitting the glass; and so on. Each of these features involves the window (the constituent entity of the shattering) coming to resemble the brick (the constituent entity of the antecedent change event) in one or other feature: shape or initial region of occurrence, motion, amount of momentum, and so on.

Not so for the sound wave associated with the canary’s song. The initial region of the shattering is not co-located with the spatial profile of the sound wave upon impact; the trajectory of the shattered glass does not resemble the trajectory of the sound wave; the change in the window’s momentum after shattering is not approximately the same after impact as that which the sound wave loses after impacting the glass, and so on.

Of course, this is not to say that, when the sound wave hits the glass, no causation occurs. On the contrary: upon such impact, the window changes in certain respects, and these changes might well be appropriately attributed to the sound waves—in particular, if the changes involve comings-to-be of resemblances. For example, consider the effect of the window’s coming to have a part with a certain vibration. Again, this change event is associated with certain features, that can serve as a basis for finely individuating the sound wave as the cause: the change in vibration of the window’s part was spatially collocated with the sound wave’s impact (not with the brick’s impact); the induced frequency of vibration of the window’s part was approximately the same as the sound wave’s frequency on impact (not with the brick’s frequency on impact), and so on.

Incorporation of comings-to-be of resemblances into a change-based account thus enables fine-grained individuation of causes, even when multiple causal relations occur within a single spatiotemporal region. Moreover, since comings-to-be of resemblances are (like changes and spatiotemporal relations) metaphysically available in the single instance, this accommodation of fine-grained causes and effects is achieved without appeal to either counterfactuals or regularities—thus preserving the singularist credentials of a change-based account.

In combining Ducasse’s change-based conditions with those at issue in *Resemblance-based causation*, have we arrived at a sufficient reductive

basis for singular causation? Not quite yet. As previously noted, Castañeda's billiard ball case shows that even spatiotemporally mediated comings-to-be of resemblances are not generally metaphysically sufficient for causation, and the incorporation of Ducasse's conditions do not seem to overcome this difficulty. Here, though, an aspect of Ducasse's original account comes in handy. Recall that the conditions that Ducasse proposed as sufficient for causation specified that the cause be the *only* change event prior and proximate to the effect.²⁸ Though this specification is too strong (as we've seen, it prevents finegrained individuation of causes that are parts of larger change events), a weaker variation provides a plausible response to the insufficiency concern. In particular, as part of the change-plus-resemblance-based conditions on causation, we can require, not just that some prior and proximate constituent of the antecedent change event be *F*, but moreover that the constituent in question be the *only* such prior and proximate resembling entity.²⁹ This condition does not appear to be satisfied in the Castañeda case (both the initially moving billiard ball and the underlying mechanism are prior and proximate moving entities),³⁰ whereas it does appear to be satisfied in the brick/canary and baseball/nitrogen molecule cases. At least for all previous objections show, then, changes in combination with unique comings-to-be of resemblances provide a sufficient reductive metaphysical base for singular causation.

I want to close this discussion by noting two epistemological benefits of incorporating comings-to-be of resemblances into Ducasse's conditions on singular causation. First, attention to resemblances allows the change-based singularist to confirm causal attributions without appeal to either counterfactuals or regularities. As the brick/canary song case indicates, causes can (and perhaps often do) produce *multiple* resemblances in a given effect event. Such comings-to-be of multiple resemblances associated with the effect event zero in on a specific cause; hence serve as a confirmation base for a given causal attribution, available in the single instance.

Second (and most importantly), the combined conditions avoid the serious epistemological problems with regularity accounts. As noted, such accounts fail to accommodate our seeming abilities to identify causes in the absence of knowledge of laws or general facts. And worse, from the perspective of the reductionist's concern with inaccessible posits (which concern is in large part of their rejection of irreducible modality), we are arguably not in position to know whether the requisite regularities obtain.

By way of contrast, changes involving comings-to-be of resemblances are metaphysically present and hence in-principle epistemologically accessible in the single instance; indeed, as per the ubiquitous cases of resemblance-producing causation, experiences involving these features form a readily accessible basis for a wide variety of causal attributions. To be sure, judgments of changes involving comings-to-be of resemblances are fallible, and some such goings-on may remain epistemologically inaccessible, for whatever reason. Still, there is no “global” difficulty for gaining access to resemblance-based changes, of the sort that threatens to undermine even the simplest causal judgments on a regularity theory.

3.3 Singularist Transference Accounts

Transference theorists typically understand singular efficacy in terms of one or other fundamental physical process, as on Fair’s (1979) account of causation as identical with the transfer of energy, Salmon’s (1994) “mark-transmission” account, and Dowe’s (1992) account on which the transfer of any conserved quantity will suffice. In appealing to quantities that are largely theoretical, such accounts are not obviously placeable in a Humean framework, but no matter. For example: if causation is transfer of energy; if such transfers may be understood without appeal to irreducible modal facts (as is plausible); if what energy is transferred between events is a relatively local matter of fact (as is also plausible); then here we have one way to be a neo-Humean singularist.

Still, transference accounts face difficulties. First, like changes, transfers (even when spatiotemporally mediated) do not individuate causes in sufficiently fine-grained fashion: the waves from the canary’s song transfer energy, momentum and other physical quantities to the window as well as the brick. Again, appropriate individuation may be achieved (in particular) by appeal to counterfactuals; but such an appeal is in clear tension with the core singularist project. Hence it was that Salmon (1994) came to reject his earlier (1984) attempt to accommodate fine-grained individuation of causes in counterfactual fashion.

Neither Salmon nor any other physical-quantity transference theorist has, however, provided an adequate alternative path to appropriately fine-grained causes.³¹ Salmon (1994) suggested (expanding on Dowe 1992) that fine-grained individuation of causes could be accommodated by appeal to transfers of conserved quantities:

In discussing interactions it is essential to keep in mind the fact that we are dealing with conserved quantities. In an interaction involving an exchange of momentum, for example, the total momentum of the outgoing processes must be equal to that of the incoming processes. This point is important in dealing with certain kinds of interactions in which three or more processes intersect in virtually the same space-time region. [Rather than appeal to counterfactuals] [w]e should say instead that, in the interaction constituted by the nitrogen molecule and the shattering window, momentum is not conserved. Take the window to be at rest; its linear momentum is zero. The linear momentum of the nitrogen molecule when it strikes the window is not zero, but fairly small. The total linear momentum of the pieces of the shattered window after the collision is enormously greater than that of the incoming molecule. In contrast, the total linear momentum of the baseball as it strikes the window is about equal to the momentum of the pieces of glass and the baseball after the collision. So . . . we are justified in saying that the window was broken by the collision with the baseball, not by the collision with the nitrogen molecule. (303f.)

Salmon's response is unsatisfactory, however. The appeal to conserved quantities is supposed to assist in ruling out the nitrogen molecule as a cause of the shattering, since "in the interaction constituted by the nitrogen molecule and the shattering window, momentum is not conserved." But conservation laws require that the total momentum of the outgoing processes be *exactly* equal to that of the incoming processes, not "about equal." If the nitrogen molecule hits the window simultaneously with the baseball, the total momentum of the "outgoing process" involving the shattering will reflect contributions from both the baseball and the molecule. Hence, in the interaction constituted by the baseball and the shattering window, momentum is not conserved, either. If anything, appeal to conservation laws, in combination with features like "total momentum," supports taking the cause of the shattering to be the combination of the (impacts of the) baseball and the molecule. But then the transference singularist is back in the coarse-grained soup, with no clear way to identify the baseball as the cause of the shattering.

A second difficulty faced by transference accounts lies in explaining how causation, understood as involving theoretical relations or processes of fundamental physics, links up with ordinary causal attributions involving relatively "macro" goings-on. One concern here is that ordinary causal attributions do not cite and seem not to presuppose the holding of transfers of the relevant quantities. As Dieks (1981) notes:

Consider, e.g., history. A statement like ‘antiwar demonstrations in the U.S.A. were a cause of the end of the Vietnam war’ has a clear meaning quite apart from any physical considerations A sudden upheaval in physical theory which would obviate the concept of energy would not change our understanding of the statement. (107)

More generally, as Dieks says (105), transference accounts involve “divergencies from the everyday language use of the concept ‘cause’.”

Another concern has to do more specifically with confirmation. As Tooley (2004) says,

A crucial question for any account of causation . . . is whether it is compatible with our everyday views concerning the possibility of causal knowledge, and concerning the sorts of evidence that serve to confirm causal claims. (320)

Any evidence that we normally take to be relevant to causal claims should, it seems, turn out to be relevant on our preferred account of causation. But it is unclear how our ordinary evidence for ordinary causal attributions might be relevant to the holdings of certain theoretical relations of fundamental physics. For on the face of it, we do not observe or otherwise experience transfers of energy or other physical quantities—at least, not as such.

To be sure, the holding of reductive relations between macro-phenomena and micro-physical phenomena would provide a bridge between causal attributions at the different levels; along these lines Fair takes as a presupposition of his account that ordinary causal relata are reducible to micro-physical goings-on. Dowe (1995) summarizes the strategy:

Fair’s program begins with the reduction of the causal relata found in ordinary language. Events, objects, facts, properties, etc. need to be re-described in terms of the objects of physics. . . . The physical quantities, energy and momentum, underlie the properties that are identified as causes or effects in everyday causal talk. (364)

Fair’s strategy is unsatisfactory, however. One problem, though not the deepest, involves the operative assumption that all ordinary causal relata can be re-described in physical terms. If “re-description” requires explicit ontological reduction (involving, presumably, intertheoretic identities), then the assumption is widely rejected, since non-reductive physicalists (the majority, these days) and traditional physicalist rivals (emergentists, substance dualists, etc.) agree that such reductions are not

even in-principle available for much mental and perhaps other (e.g., chaotic or biological) phenomena.³² But perhaps it will do, for transference-theorist purposes, to understand the needed redescription as requiring something weaker: that, as a matter of fact, certain relevant features of higher-level goings-on (e.g., energy or momentum) be identical to or otherwise “underlain” by the associated features of physical goings-on. Such a partial reduction is compatible with either reductive or non-reductive physicalism; and while it still controversially presupposes the falsity of emergentism (since, as per McLaughlin 1992 and Wilson 2005, on the best formulations of this view emergent phenomena involve new energies or forces associated with new fundamental interactions), transference theorists may be happy to bite the physicalist bullet.

The deeper problem with Fair’s strategy is that it fails to make sense of ordinary belief in and evidence for macro-causal attributions. The first concern with transference theories is that ordinary causal attributions do not cite and seem not to presuppose that transfers of any physical quantities are at issue. It is no response to this concern to require that (at least some aspects of) these ordinary phenomena be reducible to the requisite physical quantities, since it is even more evident that ordinary causal attributions do not cite or seem to presuppose the availability of such reductions.³³ As such, the second concern (about confirmation) also remains unaddressed, since it then remains unclear whether and how our everyday views about the evidence for causal claims dovetail with evidence for associated claims about physical quantity transfers.

3.4 Resemblance-based resources for transference singularism

Here again, the conditions cited in *Resemblance-based causation* provide useful resources for the reductive singularist. Again we can start by observing that there is no incompatibility between resemblance-based and transference accounts, for transfers of the relevant quantities may well involve comings-to-be of resemblances. This is so regardless of whether transfers are of some numerically identical entities (as per Aronson and Fair) or rather just of certain qualitative or quantitative aspects of some entities (as per Dowe and Salmon). As I’ll now argue, with resemblance on the scene, transference theorists can achieve both fine-grained individuation (again, without appeal to counterfactuals or regularities) and accommodation of ordinary causal attributions.

First, attention to comings-to-be of resemblances allows for an improved version of Salmon's suggestion that attention to conserved quantities allows for fine-grained individuation of causes. Here the key idea is to understand the suggestion as flagging that transfers of such quantities may involve comings-to-be of resemblances.

For example, in Salmon's baseball/nitrogen molecule case (and focusing on the change-features that transference theorists think are most relevant to causation), among the distinctive features of the shattering is that the momentum gained by the glass after impact is very different from its previous momentum, and that this difference in quantity of momentum is approximately the same as that which the brick loses after impacting the glass; similarly for energy gained by the window, and lost by the brick. Assuming, as per the conditions imposed by *Resemblance-based causation*, that the effect at issue involves one or more comings-to-be of a resemblance, there is a clear (and again, clearly singularist) path here to identifying the baseball, rather than the nitrogen molecule, as the cause of the shattering: the increases in the physical quantities associated with the shattering resemble those possessed (and then lost) by the baseball—not those possessed (and lost) by the molecule.

This sort of case indicates another way in which comings-to-be of resemblances are useful for purposes of fine-grained individuation of causes; for the resemblances at issue need not be exact.³⁴ It is not required, to identify the (impact of) the baseball as the cause of the shattering, that the baseball have (more specifically, have and then lose) *exactly* the amount of energy or momentum associated with the shattering. Supposing that a given effect involves some constituent entity e_2 coming to be F , it is enough, for an event to be identified as the cause (or most relevant cause) of the effect, that it have a constituent entity e_1 that clearly and closely resembles e_2 in respect of F . To be sure, not all cases will be so easily legislated, on this score, as the brick/canary song or baseball/nitrogen molecule cases. But no matter; what is to the present point is that in many cases—in particular, the cases that were supposed to cause trouble for transference theorists—there is a clear route, via comings-to-be of resemblances, to conditions tracking the finely individuated causes of the effects at issue—conditions satisfying both *Causal reductionism* and *Causal singularism*.

Second, that ordinary causal attributions don't cite or seem to presuppose the occurrence of certain theoretical processes isn't a barrier to a transference account, so long as ordinary attributions are compatible with such processes and—most important for making sense of ordinary practice—evidence for ordinary attributions is plausibly seen as evidence for the requisite transfers. Both conditions are plausibly met, when the conditions in *Resemblance-based causation* are satisfied. In Salmon's case, the observable (more generally, "macro") comings-to-be of resemblances (e.g., involving the window's having a part initially resembling the baseball in respect of shape, and the shattered parts' coming to resemble the baseball in various respects of motion) are clearly compatible with micro-processes involving the transfer of various physical quantities. This much Fair allows, of course; the advantage of attention to comings-to-be of resemblances is that these provide an evidential basis for ordinary causal goings-on that is at the same time an evidential basis for the underlying physical processes.³⁵ Indeed, scientists have historically worked top down, from experienced changes—including and especially involving comings-to-be of resemblances in respect of shape, motion, and even force—to increasingly theoretical processes. Observable and more generally experiential comings-to-be of resemblances thus plausibly serve as a (fallible) basis for ordinary causal attributions, even if transference theorists are correct that the ultimate ground for such experiences and associated attributions is one to which we have mainly theoretical access.

Again, we should ask whether, in combining conditions associated with transference theories with those at issue in *Resemblance-based causation*, we have arrived at a sufficient reductive basis for singular causation. Here I think we may assume so, without further revision. Castañeda's billiard ball case was originally offered in support of a transference view (involving transfers of the general quantity 'causity', of which energy was supposed to be a paradigm case); hence transference theories are generally not subject to objection from this (or the carbon copy) case. At least as far as all previous objections show, transfers in combination with unique comings-to-be of resemblances provide a sufficient reductive base for singular causation.

Finally, incorporation of comings-to-be of resemblances into the specified conditions on causation reaps epistemological benefits for transference theories parallel to those reaped by change-based theories. Again,

the presence of *multiple* comings-to-be of resemblances may frequently serve to zero in on a specific cause, even in the single instance. Again, transfers involving comings-to-be of resemblances are metaphysically present and hence in-principle epistemologically accessible in the single instance; indeed, given that ordinary experiences of such comings-to-be may serve as evidence for the transfers at issue, such in-principle access is readily available. And again, while either experiential or theoretical judgments of transfers involving comings-to-be of resemblances may be fallible, in any case there is no global difficulty, of the sort facing regularity accounts, with our gaining epistemological access to the causal facts.

4. *Bootstrapping General Warrant for Reductive Singularism*

Existing singularist accounts do not provide sufficient reductive conditions for causation; however in combination with conditions specifying the appropriate comings-to-be of resemblances, they arguably do so. More generally, resemblance-based resources enable both change-based and transference singularists to appropriately respond to the cases, and associated objections, that have been raised against them.

Even granting that changes-plus-resemblance or transfers-plus-resemblance suffice for singular causation, this does not establish that all causation satisfies either combination of conditions. On the contrary, I have previously granted that comings-to-be of resemblances are not necessary for causation; and it is not clear why adding either changes or transfers to the mix should change this assessment.

This seeming failure to provide necessary conditions on causation ultimately doesn't matter, however, for purposes of vindicating reductive singularism as against reductive generalism. For the fact that the conditions in *Resemblance-based causation* (in combination with either changes or transfers) model reductive singularism for a core class of cases can be used to make a *prima facie* case for reductive singularism in general.

To see how, note that for a given metaphysically reductive account to be generally warranted, it is not required that an explicit reductive basis be identified for all cases, much less that a single such basis (involving changes vs. transfers, or whatever) be identified. It suffices to identify some suitably large and typical class of cases of the phenomenon at issue, which can be given one or other successful reductive treatment. Having

established that reductions are available for some core class of cases, then (absent some reason to think that some cases not in the class are in-principle not amenable to reduction) it is simplest and most systematic to assume that all cases of the phenomenon at issue are similarly reducible (again, even in the absence of explicit reductions for all cases).

Compare the reductive physicalist who, with a class of core cases of reduction to the physical in hand, assumes that all goings-on are reducible to the physical, even if the details of reduction may differ in cases outside the class. Of course, in the physicalism debates there is dispute over whether cases not in the class—in particular, involving qualitative and intentional mental features—are in-principle irreducible or not; but even so, the reductionist position is not considered without merit. Singularists in the causation debates occupy a distinctly stronger position, for there is not, to my knowledge, any argument besides Hume's to the effect that reductive singularism is in-principle untenable (either in general or in any particular cases); and consideration of comings-to-be of resemblances—distinctly reductive singularist resources—discredits Hume's argument.

5. Conclusion

Recall Hume's somber words:

All events seem entirely loose and separate. One event follows another; but we never can observe any tie between them. They seem *conjoined*, but never *connected*. (*Enquiry*, Part II, §IV)

Here Hume reports that he cannot see how to accommodate the intuitive understanding of efficacy, according to which singular causes *produce* their effects or *make* their effects happen.

Hume was wrong, however, and so have been those who thought the only route to *Causal reductionism* was through *Causal generalism*. Comings-to-be of resemblances can justify singular causal beliefs and, more to the point of the metaphysical project, can arguably serve, in combination with either changes or transfers of appropriate physical quantities, as a sufficient reductive basis for singular causal relations, applicable to a core class of cases. Moreover, having established that a wide swath of causal relations can be metaphysically grounded in reductive singularist resources, the singularist faces no barrier to assuming that all

causal relations are so grounded, whether or not explicit reductions of all cases are on the table.

These results are to the good of providing an account of causation, for both metaphysical and epistemological reasons. The general viability of a singularist account makes sense of the intuitive metaphysical understanding of causal relations as being singular, productive goings-on—an understanding whose denial, in regularity theories, threatens to rob us of all our causal knowledge. And the general viability of a *reductive* singularist account shows that the intuitive metaphysical understanding may be accommodated without appeal to irreducible modality.

It is attention to the role resemblance plays in causal relations that has achieved these goods. Here I hope to have shown that such attention reveals previously unappreciated resources—in the first instance, for singularists; but more generally for causal reductionists, like Hume, who may not have fully appreciated their options.

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NOTES

1. Thanks for comments on previous versions to Helen Beebe, Benj Hellie, Ian Proops, audience members at NC State, two anonymous referees, and especially Louis Loeb.

2. Or other causal relata (e.g., objects); here I'll focus on events.

3. Notwithstanding Hume's claim that "we may define a cause to be an object, followed by another, and where all the objects similar to the first are followed by objects similar to the second" (*Enquiry*, §VI, Part II), it is unclear whether Hume took regularities (or the associated psychological "imprinting") to be metaphysically constitutive of causation, or rather to suggest (see Strawson 1992) that regularities are all we can know of causation. What follows does not turn on this properly historical dispute.

4. Some obvious descendants are found in Pearson (1911), Hempel and Oppenheim (1948), and Suppes (1970); also in the Humean vein are counterfactual accounts of causation on which patterns of events determine laws entering into the truth of counterfactuals (as in Lewis 1973). See the introduction to Sosa and Tooley (1993) and Wilson (2006) for further references and discussion.

5. *Causal singularism* is stated in vague terms ("relatively local," "goings-on"); different singularist accounts precisify these terms differently. I take it that the general intended contrast with *Causal generalism* is clear.

6. As Anscombe (1971, 91) says, "[W]e often know a cause without knowing whether there is an exceptionless generalization of the kind envisaged"; as Castañeda (1984, 17)

says, “We are often more certain that an item *c* has caused an item *e* than of any causal law under which *c* and *e* fall.”

7. A non-standard variation on the transference theme is found in Ehring’s (1997) suggestion that causation involves the transfer not of physical quantities *per se*, but of numerically identical tropes. The appeal to transferred properties in Ehring’s account bears a certain resemblance to the resemblance-based approach that I will suggest is key to making sense of singularist causation; however, a full engagement with the details of Ehring’s view is beyond the scope of this paper (though see note 31 for some concerns).

8. As we’ll see, there are available variations on this theme: the comings-to-be of resemblances may or may not be spatiotemporally mediated, may or may not be associated with transfers of conserved quantities, etc.

9. As Tooley (2004, 284) says: “[I]t seems to me that the reason that one rarely encounters any arguments bearing upon this thesis [of *Causal generalism*] is that most philosophers have generally been convinced by Hume’s argumentation on this matter.”

10. In the first instance, Hume’s argument is directed against singular experience’s being sufficient for giving *content* to causal beliefs. Hume’s deeper target, however, is against such experience’s being sufficient to *justify* causal beliefs (for Hume, justification is attendant on appropriately gained content), and so in what follows I will discuss Hume’s argument in terms of the justification, not the meaningfulness, of singular causal beliefs.

11. In a questionable move, Hume characterizes the missing link as one involving “necessary connection” (“there is a **necessary connexion** to be taken into consideration”). Talk of necessity invokes correlational or modal connotations not obviously present in talk of singular causes’ producing their effects or making their effects happen. This leap may be partly diagnostic of why Hume neglects the alternative case I will identify.

12. Strictly speaking, as Doug Jesseph pointed out, the failure of resemblance is in respect of having a spatiotemporally distinguished star-shaped part, to get around the worry that we can observe star-shaped parts in the dough prior to their being spatiotemporally distinguished; assume this in what follows.

13. Hume would presumably also maintain that the experience gives rise to the belief/content in question, but here again my focus is on the justification rather than the origin of the content in question.

14. *Reasonable judgment* also does better than some other attempts to identify what characteristics an experience must have in order to justify corresponding beliefs. So, for example, it will not do to saddle the empiricist with the view that experience can only justify beliefs that are immune to skeptical or other error, for then justified belief in ordinary objects and events will almost certainly go out the window. See, e.g., Anscombe (1971), p. 93: “[H]ume confidently challenges us to ‘produce some instance, wherein the efficacy is plainly discoverable to the mind, and its operations obvious to our consciousness of sensation’. Nothing easier: is cutting, is drinking, is purring not “efficacy”? But it is true that the apparent perception of such things may be only apparent: we may be deceived by false appearance. Hume presumably wants us to “produce an instance” in which *efficacy* is related to sensation as *red* is. It is true that we can’t do that; it is not *so* related to sensation.”

15. To be sure (as a referee pointed out) the reasonableness of such a singular judgment (that a given spatiotemporally mediated coming-to-be of resemblance *R* indicates a causal relation) goes hand in hand with a corresponding general judgment *G* (that any similar spatiotemporally mediated coming-to-be of resemblance *R* will indicate a causal relation). This doesn’t bear on the singularism/generalism debate, however, for *G* is not a general content of the sort at issue in *Causal generalism*. In Humean terms, the sort of general

content *Causal generalism* supposes is constitutive of causation can be appropriately asserted (if not justified) only subsequent to experience of the requisite regularities; *G*, by way of contrast, can be appropriately (indeed, justifiably) asserted upon a single such experience, and more generally does not reflect the holding of a causal law. Compare: if it is reasonable to judge that two red entities resemble, it is reasonable to judge that other similarly red entities will resemble; the latter general judgment can be made after a single experience, and does not indicate that resemblance is partially constituted by laws or general facts. *G* is like the latter general claim, in simply registering what it is generally reasonable to believe upon having certain experiences.

16. As it happens, we live in a causally fairly well-behaved world; so such experiences and associated connections as these tend to be modally stable—at least if the relevant features are reproduced, actually or counterfactually. But for all the content of *C* entails, it might well be that the next time I or someone else presses the cutter into the dough something entirely different (perhaps nothing at all) occurs.

17. See, e.g., Rodriguez-Pereyra (2002) for nominalist strategies for accommodating respects of resemblance.

18. Note that contemporary proponents of *Causal reductionism* may happily admit the existence of and resemblances involving theoretical quantities like energy and momentum.

19. As a referee observed.

20. Remarked by the same referee.

21. The thought here is not so different from Yablo's (1992) appeal to considerations of "proportionality" as a means of identifying which causes are relevant to producing an effect.

22. Thanks to Chris Lui for this case, and to Mark Lee for a related case.

23. Note that the main result of §1 (that comings-to-be of resemblances can justify some singular causal beliefs) and of §2 (that while comings-to-be of resemblances characterize many cases of causation, these are neither necessary nor sufficient for singular causation) are compatible: unsurprisingly, sufficient bases for justification are easier to come by than sufficient bases for metaphysical reduction.

24. Another objection to Ducasse's account is that it cannot handle causal action-at-a-distance (see Tooley 1977, 287–88); however, since such cases lie outside the commonly accepted realm, their coverage (or not) is (as Lewis puts it) spoils for the victor. Similar remarks go for transference and resemblance-based accounts, supposing that transfers or comings-to-be of resemblances must be spatially mediated. However (though I won't pursue this here), as suggested above it may be that comings-to-be of resemblances, either alone or in combination with either changes or transfers, can accommodate spatially and perhaps even temporally gappy causation.

25. "Thus, at the instant a brick strikes a window pane, the pane is struck, perhaps, by the air waves due to the song of a canary near by. Yet we usually would say that the cause of the breakage was the impact of the brick, and that the impact of the air waves, although it was part of the prior total change in the contiguous space-time, was no part of the cause" (Ducasse 1926, 133).

26. One might also complain about Ducasse's methodology here. As per usual, a metaphysical account of some phenomenon *X* needs to conform to standard cases, at least, of *X*. It does not do, in response to complaints that the account fails to accommodate standard cases of *X*, to relegate these to an "elliptical" though admittedly "more practically interesting" aspect of what would thereby seem to be some different phenomenon, *Y*.

27. I say 'approximately' since the sound wave also transfers some momentum to the glass; more on this shortly.

28. "When any philosophically pure-minded person sees a brick strike a window and the window break, he judges that the impact of the brick was the cause of the breaking, *because* he believes that impact to have been the only change which took place then in the immediate environment of the window. He may, indeed, have been mistaken, and acknowledge that he was mistaken, in believing that impact to have been the only change in the environment. But if so he will nevertheless maintain that *if* it had been the only change, it would have been the cause" (Ducasse 1926, 131).

29. Note that such a condition does not rule out chains of multiple resemblance-producing causes.

30. Nor in Lui's carbon paper case (both the middle sheet and the tracing pen are prior and proximate entities resembling the loner sheet in respect of inscribed shape).

31. Ehring's (1997) "trope-persistence" account of transfers does better here than standard transference accounts, since causes can potentially be as fine-grained as tropes. As previously (see note 7) full engagement with Ehring's view is beyond the scope of this paper; very briefly, however, I note that this advantage of Ehring's view is undermined by its being implausible that transfers of numerically identical tropes are at issue in a sufficiently wide swath of cases, and relatedly, by its being unclear that such transfers are present in the sort of brick/canary song and baseball/nitrogen molecule case supposed to cause trouble for the transference theorist. An appeal to comings-to-be of resemblances achieves fine-grained causes in many core cases of causation, and moreover does so without commitment to tropes (which are at least somewhat controversial).

32. See Wilson (1999) and Wilson (forthcoming) for further discussion of these views and associated controversies.

33. Relatedly, as Dieks (1981, 107) notes, in discussing historical causal statements, "Even if it were found true that such causal statements are, as a matter of fact, always co-extensive with transfers of energy-momentum, this result could hardly be expected to be helpful in stating truth conditions for them; it would merely complicate matters enormously if we would have to judge historical statements via redescrptions in the language of physics."

34. This is not to say that anything goes, of course; the constraints discussed in §2, concerning constraints on relevant resemblances, remain in place. What I'm noting is useful here is the availability (for a resemblance-based account) of inexact resemblance in respect of specific features (e.g., quantity of momentum gained), not of exact resemblance in respect of unspecific features (e.g., having some or other structure).

35. See Wilson (2007) for arguments to this effect for the case of forces and, relatedly, energies.

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